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ABSTRACT

A deviant case analysis pilot study analyzed California local education agency data to determine the usefulness of regression analysis in predicting change in achievement from 1984 to 1989 and identified outliers or districts that show greater achievement changes than would be expected given changed demographic conditions. This report on the Successful Indicators Study discusses some previously identified statistical and methodological problems associated with the use of regression, presents the findings of the pilot study, and recommends alternative methods for selecting case study sites. Focus is on developing indicators of conditions and programs within a metropolitan school district that predict success. Data from the 1980 Census, the 1989-90 California Basic Education Data System, and the California Assessment Program tests for the school years 1984-85 through 1989-90 are used. Reading and mathematics scores for grades 3, 6, and 8 from 1984-85 to 1989-90 were used. The findings indicate that the regression procedure has not helped identify local education agencies that are doing well and that have experienced large changes in the demographic conditions under which they operate. Use of a combination of qualitative and quantitative methods is recommended to identify successful local education agencies. Included are six tables and two graphs. (RLC)

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INTRODUCTION

The original goal of the Successful Indicators Study (SIS) was to develop indicators of the conditions within a community and school district that foster a positive climate for improving the achievement of educationally disadvantaged children in the Western region's metropolitan areas. The dependent variables consist of various measures of change in student achievement from 1980 to 1990. The independent variables consist of an array of demographic, fiscal resource, facility and community variables, school system organizational features, and indicators of local political culture. The combination of these variables represents the conditions under which school program responses have proven more or less effective and efficient over the decade. The intervening variables consist of programmatic or related efforts, including staff development, specialized staff recruitment and assignment practices, and service provisions that have been introduced by the communities and the school districts in efforts to improve the life chances, as well as the achievement levels, of educationally disadvantaged students. The SIS project also aimed to develop models and criteria of effective educational treatment of students in metropolitan local education agencies (LEAs) and to assist interested LEAs and community agencies in adapting them to local circumstances.

As originally designed, a regional study was planned to identify fifty districts from the universe of LEAs lying within Metropolitan Statistical Areas (MSAs) in the four state region of the Pacific Southwest. In early 1991, SWRL staff completed a census of metro-area school districts in California, Arizona, Nevada, and Utah. As it became evident that test score and other demographic data would be available for all districts in these states, the original research design to use only a small sample of districts to identify outliers was expanded to the universe of relevant LEAs.

Although we had originally planned to identify districts in all four state using regression analysis, California LEAs accounted for 80% of the LEAs in the region. Thus, we decided to try out the procedure for identifying "interesting" LEAs on most of the universe instead of only a sample, simply by looking at California LEAs for which computer data were available.

In our original design, we planned to identify districts that showed rapid growth in numbers of educationally disadvantaged students from 1980-1990, using 1980 and 1990 Census district data. However, there was a delay in the release of the school district level 1990 U.S. Census data. Because of the lack of district-level 1990 Census data, we looked at alternative sources of data.

Consequently, in this analysis, we have used the 1980 Census data, the 1989-1990 California Basic Education Data System (CBEDS) data and California Assessment Program (CAP) test data for the school years 1984-85 and 1989-90.

The major purpose of the deviant case analysis pilot study is to determine the usefulness of regression analysis in predicting change in achievement from 1984 to 1989 and to identify outliers or districts that show greater achievement changes than would be expected given changed demographic conditions. Our original intention was to use these outliers as intensive case study sites. In this report, we discuss some previously identified statistical and methodological problems associated with the use of regression and present the findings of the pilot study. We also recommend alternative methods for selecting case study sites.

STATISTICAL AND TESTING ISSUES

Because the goal of the study is to develop indicators of conditions and programs within a school district that predict "success," the major dependent variable consists of a standardized measure of change on district-level achievement in math and reading between 1980 and 1990. High growth over time was defined as the "success" measure for the regression.

In the state of California, the CAP tests have been given since 1980, but prior to 1984, the CAP tests were sufficiently different so as to be non-comparable. Thus, we used achievement in 1984-85 through 1989-1990. Although we had planned to look at achievement in grades 3, 6, 8, and 12, grade 12 scores had to be deleted as a new grade 12 CAP test was first administered in the 1987-88 school year and older tests were non-comparable. No reading or math scores were available at the eighth grade level until 1984. Thus, we used reading and math scores for grades 3, 6, and 8 from 1984-85 to 1989-90.

Some limitations should be placed on interpretations made from the model presented. The data set contains aggregated district-level information and not individual level data. Both the demographic and the achievement data represent district averages calculated from either household (Census data) or school building (CAP and CBEDS) data. By grouping observations and estimating parameters based on grouped means, the variation between individual observations is lost. This may reduce the variation of the grouped data and may also artificially inflate the R^2 result. Basically, what is lost is the information on the variation of observations within groups (e.g. schools within districts). The R^2 of the regression equation may be influenced, as the larger the variability of a given sample on the independent variables, the larger the R^2. Low R^2 values reflect a large amount of variation in the dependent variable unexplained by the model.

Another assumption in regression analysis is that the model is perfectly specified and there are no omitted yet significant predictors. It is likely that this assumption is incorrect. The regression model used did not include school environment or program variables that reflect within-district differences or that represent a particular district's policies and procedures. Variables such as teacher or curriculum quality measures, which may also influence gain in achievement, are not included. The school effectiveness literature has shown evidence that school environment, special programs, teacher quality, and curriculum quality all have an influence on school-level achievement. However, no data on these variables were available. In addition, according to Pedhazur (1982), when relevant variables are omitted from the regression equation, and they are correlated with the variables remaining in the equation, estimation of the regression coefficients for the latter is biased.

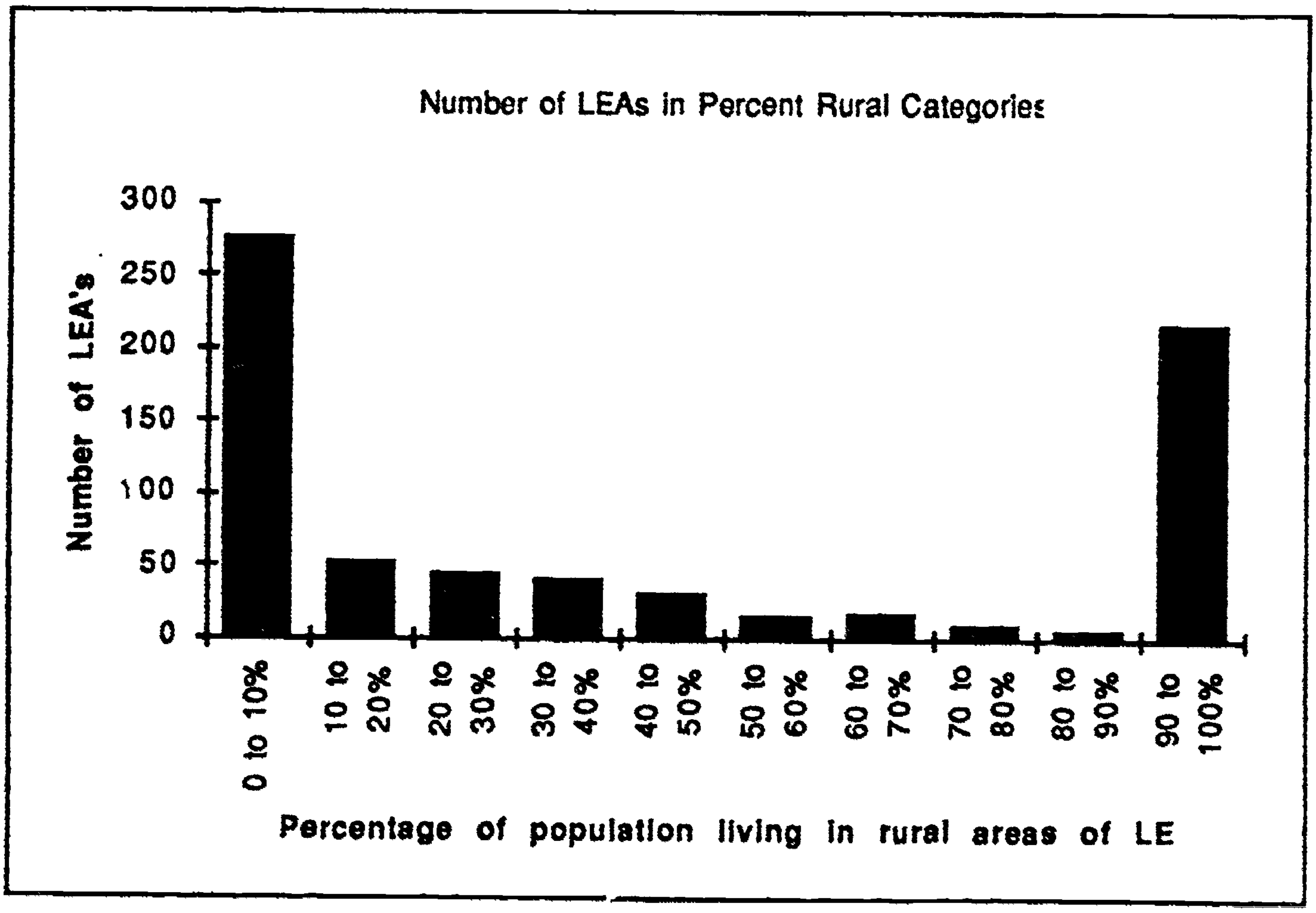
One of the primary assumptions of regression analysis is that the independent variables are measured without error. In this study, because the 1980 Census demographic variables of interest (population size: 5-17 year olds, percent non-white, percent income below poverty level, and percent of 5-17 year olds with poor or no English ability) were not available for 1990, proxies of these were used. The measures were not strictly comparable. For the variable "income below poverty level," in 1980, the Census variable consisted of percent of 5-17 year olds in households with income below poverty level (mean was 12.9%). For 1990, the CAP proxy of the 1980 variable consisted of percent of students in a district who received AFDC (mean was 13%). In another example, for 1980, the Census variable of interest was percent of 5-17 year olds with poor or no English speaking ability (mean was 3.8%), while in 1990 the CAP proxy used was percent of students in grades 3, 6, and 8 who were considered LEP (mean was 8.8%). We do not know the relationship between the 1980 variables of interest and the 1990 proxies. Use of such proxies in calculation of change measures (e.g. variable at time2 - variable at time1 = change) leads to measurement error and results in low reliability of measures. Errors of measurement in the independent variables in a regression analysis may lead to either an upward or downward bias in the estimation of the regression coefficients.

DEVIANT CASE STUDY ANALYSIS

The purpose of the deviant case analysis pilot was to identify districts that show greater achievement changes than expected in order to identify metropolitan LEAs where more intensive case studies could be done. We are interested in LEAs that have experienced large demographic changes relative to other LEAs in conditions that provide greater challenge for educators (e.g. increase in numbers of students in poverty). Additionally, we want to look at those LEAs whose change in student achievement has been substantially better than historically produced under such demographic conditions.

Demographic data at the LEA level are available on Census Bureau Summary Tape Files (STF1F and STF3F). Examining the 1980 census data revealed that many of the LEAs located in MSAs had a substantial fraction of their population residing in areas classified as rural. Figure 1 is a histogram showing the number of LEAs by categories of percent rural population. We decided to exclude the 37% of the LEAs that had 50% or more of their population living in rural areas because the METRO Center mission is to study metropolitan problems.

Figure 1
Number of LEAs by percentage of the population living in rural areas.



Examination of the CAP achievement data revealed that, in LEAs where few students were assessed, scores varied markedly from year to year. Staff at the California Assessment Program confirmed that they were aware of this problem. Since CAP scores also bounce around from year to year because of student population changes, the state does not report data for very small LEAs and recommends care in interpreting data from small LEAs for which data were reported. To deal with the problem of instability of test scores and the undue influence of district size on achievement scores and on the creation of outliers, we elected to exclude LEAs when assessment data were available for fewer than 100 students for grades 3, 6, and 8. This is about 20% of the California districts. Table 1 shows that sixty-two percent of the LEAs are retained for analysis when the small or rural LEAs are excluded.

Table 1
Number and Percent of Students Assessed in LEA's by Rurality and Size

	Number of students assessed in LEA		
Percent Rural	Less than 100	100 or more	Total
		Number	
50% or more	145	100	245
Less than 50%	7	397	404
Total	152	497	649
		Percent	
50% or more	22	15	37
Less than 50%	1	62	63
Total	23	77	100

We had planned to use U.S. Census data to measure the changing conditions under which the LEAs were operating. However, data from the 1990 U.S. Census are not yet available at the LEA level. Consequently, for this pilot study we have had to use other data sources to locate data somewhat comparable to 1980 Census data. CBEDS provides information on LEA enrollment by ethnicity and grade in the School Information Form (SIF) data base. California Assessment

Program (CAP) data include percentages of Limited English Proficient (LEP) students and percentages of students receiving Aid to Families with Dependent Children (AFDC). Table 2 shows the predictor variables used in the regression, along with means. Change in population size (POP) is the initial measure divided by the final measure. For the three other variables, change is the final measure minus the initial measure.

Table 2.
Predictor Variables and Their Components Used in the Regression Analysis

Variable	Initial Measure	Final Measure
Percentage change in population size (POP)	1980 census: number of 5-17 year olds factored by the proportion of school-age population represented by the grades served by the LEA (n=5944).	1989-90 SIF: total LEA enrollment. (n = 6060)
Change in % minority (MIN)	1980 census: % non-white 5-17 year olds. (x = 21.6%)	1989-90 SIF: % non-white enrollment. (x = 39.9%)
Change in level of poverty (POV)	1980 census: % of 5-17 year olds in households with income below poverty level (x = 12.9%).	1987-88 CAP: % of students receiving AFDC. (x = 13.2%)
Change in % with limited English speaking ability (LEP)	1980 census: % of 5-17 year olds with poor or no English speaking ability (x = 3.8%).	1989-90 CAP: % of students who are LEP. (x = 8.8%)

The initial measure of population size is complicated by the fact that an LEA may not serve all grades, and therefore its total enrollment is not an accurate representation of the population of 5-17 year olds. The U.S. Census data were adjusted to represent the same population as the LEA enrollment. The proportion of students in each grade across all the LEAs in the regression analysis was determined. The number of 5-17 year olds from the census was multiplied by the sum of the proportions of grades served by the LEA. If an LEA served all grades, the sum of the proportion would be one and there would be no adjustment to the census data.

CAP provided LEA level reading and math achievement data for grades 3, 6, and 8 for school years 1984-85 through 1989-90. Both scaled scores and statewide percentile rank were reported. For a given year, the LEA's achievement level was the weighted mean of the scores across grades 3, 6, and 8 and across reading and math. The weighted mean was computed for both the scaled score and the rank. Change in achievement was computed two ways. The first way was simply taking the difference between the 1989-90 mean and the 1984-85 mean. The second way was to compute the slope of the time series regression of the means across all the years from 1984-85 through 1989-90. Thus, four measures of change in achievement were computed. The slope of the time series regression of mean rank (RNK) gave the largest multiple correlation and is reported in Table 3, along with variables included in the regression, multiple R and R^2.

Table 3.
Regression Analysis of Change in Achievement with Change in Selected Demographic Characteristics of Local Educational Agencies

Dependent variable	
RNK	state percentile rank change 1984-89 using slope of time series regression
Independent variables	
POP	percent change in 5-17 year old population 1980 to 1989-90
MIN*	change in 5-17 year olds minority population percentage 1980 to 1989-90
POV	change in 5-17 year olds poverty population percentage 1980 to 1989-90
LEP	change in 5-17 year olds limited English proficient population percentage 1980 to 1989-90

* significant at $p<.05$

$R = .16160$ $R^2 = .0261$ $df = 4,383$ $F = 2.56754$ $p = .0378$

Regression analysis provides a way to predict the value of one variable from other variables theorized to be important predictors. We can identify those LEAs whose actual change in achievement was substantially better than would be predicted by examining the residuals produced by regression analysis. Those LEAs with large positive residuals would be considered for case studies.

Although the regression was significant, the R^2 was very low (.026). Thus the independent variables account for very little of the change in achievement. Only one variable, MIN, or change in minority population percentage, was significant.

The ten LEAs with the largest residual (RESID) are reported in Table 4, along with the values of each of the variables in the regression. Table 5 shows the ten LEAs with the largest positive change in achievement (RNK). The same ten LEAs are in both tables with only a slight difference in order. The regression procedure does not improve our ability to locate LEAs with relatively high gain in achievement in the context of change in demographic conditions. We can and do identify the same LEAs simply by looking at achievement.

Table 4
LEA'S With Much Higher than Predicted Change in Achievement

LEA NAME	RESID	POP	MIN	LEP	POV	RNK
NEWMAN-CROWS LANDING UNIFIED	4.28	1.32	32.49	-3.11	-.69	4.15
EDISON ELEMENTARY	3.76	1.35	16.37	2.05	-1.76	3.87
SOUTH BAY UNION ELEMENTARY	3.29	1.23	31.51	17.53	-.09	3.23
SANTA BARBARA ELEMENTARY	2.81	.73	37.99	20.84	-5.12	2.71
BEAUMONT UNIFIED	2.63	1.10	17.45	.90	9.54	2.59
RIVERBANK ELEMENTARY	2.61	1.18	26.16	19.04	-.35	2.62
RAMONA CITY UNIFIED	2.56	1.61	10.93	1.69	-.93	2.73
VENTURA UNIFIED	2.51	.87	11.40	5.74	-1.01	2.66
RIPON UNIFIED	2.25	1.29	12.02	-2.51	3.11	2.34
MANTECA UNIFIED	2.17	1.26	8.28	-.27	-.64	2.35

Table 5.
LEA'S With the Highest Change in Achievement

LEA NAME	RNK
NEWMAN-CROWS LANDING UNIFIED	4.15
EDISON ELEMENTARY	3.87
SOUTH BAY UNION ELEMENTARY	3.23
RAMONA CITY UNIFIED	2.73
SANTA BARBARA ELEMENTARY	2.71
VENTURA UNIFIED	2.66
RIVERBANK ELEMENTARY	2.62
BEAUMONT UNIFIED	2.59
MANTECA UNIFIED	2.35
RIPON UNIFIED	2.34

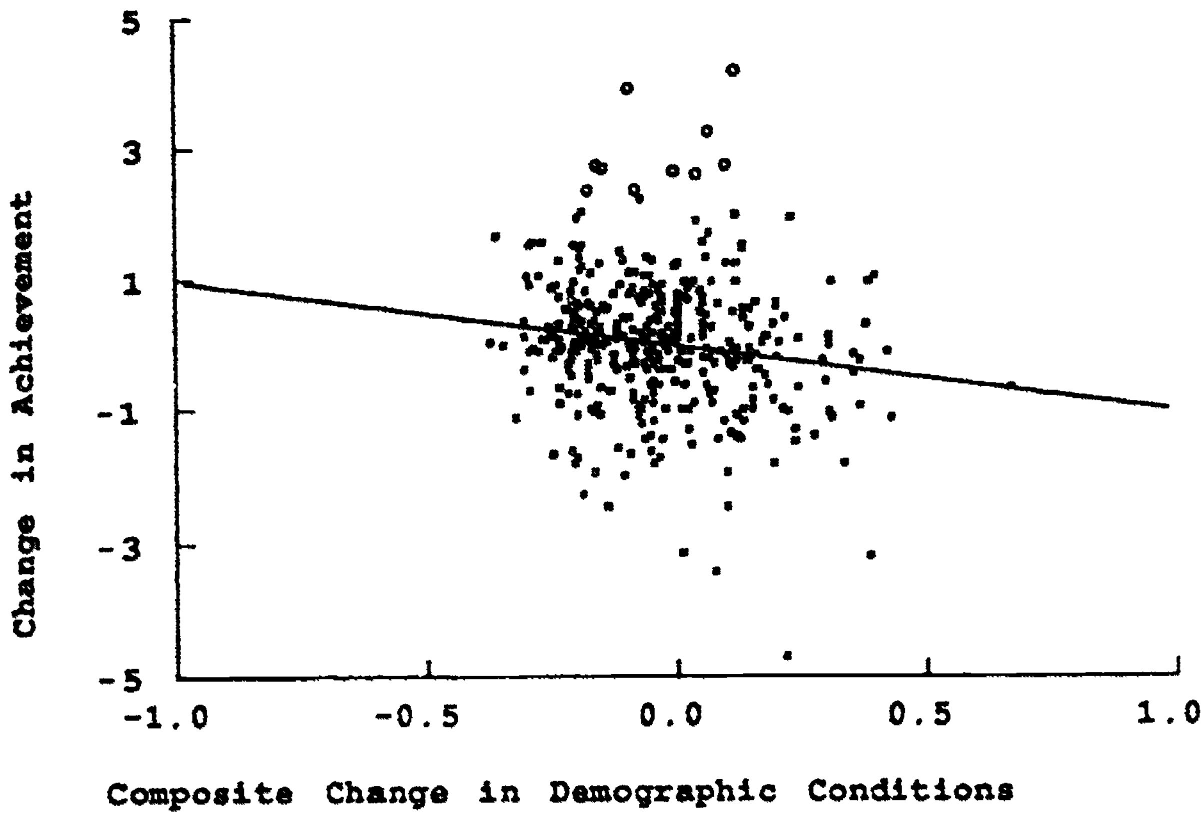
Table 6 presents the same set of LEAs but contains z-scores of the regression variables. This gives a clearer picture of how demographic conditions within the LEA varied from their respective means. In eighty percent of the cases, z score values of the independent variable are less than one standard deviation from the mean. Additionally, there are both positive and negative z scores. Clearly the cases identified by the regression analysis are not at the extremes of the changes in demographic conditions experienced by the LEAs.

Table 6.
LEA'S With the Highest Change in Achievement

LEA NAME	ZPOP	ZMIN	ZLEP	ZPOV	ZRNK	ZPRED
NEWMAN-CROWS LANDING UNIFIED	.28	1.00	-1.22	-.17	4.05	.97
EDISON ELEMENTARY	.33	-.26	-.59	-.30	3.78	-.36
SOUTH BAY UNION ELEMENTARY	.14	.92	1.28	-.10	3.15	.63
SANTA BARBARA ELEMENTARY	-.62	1.42	1.69	-.71	2.64	.84
BEAUMONT UNIFIED	-.05	-.17	-.73	1.07	2.52	.48
RIVERBANK ELEMENTARY	.07	.50	1.47	-.13	2.55	.21
RAMONA CITY UNIFIED	.73	-.68	-.64	-.20	2.66	-.75
VENTURA UNIFIED	-.40	-.64	-.15	-.21	2.58	-.64
RIPON UNIFIED	.23	-.60	-1.15	.29	2.27	-.29
MANTECA UNIFIED	.20	-.89	-.88	-.16	2.28	-.83

The last variable in the Table 6 (ZPRED) is the z-score of the predicted value of the regression. All of the predicted values are less than one standard deviation from the mean. This indicates that the LEAs with the highest gain in achievement are in the middle of the distribution in terms of the changes in demographic conditions under which they operate. The scatter plot in Figure 2 further illustrates this point, showing with open circles the ten high LEAs previously identified. As can be seen, these LEAs are located in the middle of the distribution of composite change in demographic conditions (along horizontal axis). The regression procedure has not helped us identify LEAs that are doing well and that have experienced large change in the demographic conditions under which they operate. The identified LEAs are in the middle of the change-in-demographics continuum.

Figure 2
Change in Achievement as a function of change in population, percentage non-white, percentage poverty, and percentage limited English speaking.



CONCLUSIONS AND RECOMMENDATIONS

The pilot study has analyzed California LEA data to identify outliers or districts that show greater achievement change than would be expected, based on their demographic changes and conditions. The pilot also aimed to ascertain the viability and validity of using regression to identify outliers.

The multiple regression, although significant, had an extremely low R^2 value, and thus has little practical significance. The procedure did identify some outliers based upon regression residuals, but the same outliers would have been identified simply by examining achievement alone. Moreover, LEAs with the highest gains in achievement were found to be located in the middle of the distribution in terms of demographic conditions such as change in minority population or change in poverty. The regression procedure does not help us locate LEAs that exhibit both relatively high gains in achievement and large change in demographic conditions.

Reliance on regression procedures to identify outliers to enable selection of case study sites seems inadvisable. A combination of qualitative and quantitative methods may be more productive. To deal with the problems identified in this pilot study, several options are possible. First, asking district and state level officials for suggestions on possible case study LEAs is one option. Second, selection of LEAs based on level of changes in population and poverty from 1980-90 is another possibility. To identify LEAs with large demographic change that also show change in student achievement higher than expected, the following procedures are suggested:

1. Create a composite change variable (1980-90 using POP, MIN, LEP and POV, and calculate for urban LEAs in sample (could use 1980 Census and 1990 CAP and CBEDS or use 1984-85 and 1989-90 CAP data). Alternatively, we could use MIN alone, as this was the only significant predictor in the regression.

2. Sort LEAs by level of demographic change.

3. Identify LEAs scoring in the top 10% (or other fraction) of demographic change.

4. Within that pool, order LEAs by number of CAP scale score points increased from 1985 - 1990 (NOTE: we may want to just use grade 8. A state of California study on eighth grade achievement found that CAP scale scores increased on average 17 points for grade 8 from 1985-86 to 1989-90. For the CAP, 18 scale points gain equals one-half grade level).

5. Identify districts (in the pool of LEAs that are above average on demographic change) that score above average and use these to choose possible case study sites.

To identify high growth high school LEAs, it may be useful to use CAP data. Once districts with high composite growth have been identified (as per the previously described procedure), the percentage meeting various quality indicator performance levels identified by the state of California can be calculated. Indicators for grade 12 that are used by the state in its California Performance Reports include percent reaching commendable level and above on CAP reading, math, and writing tests; geometry completion, four or more years of English, and dropout rate. An average performance value, which is a weighted average of all of the quality indicator values, can be interpreted as a value that reports the percentage of students who, on the average, across the quality indicators, perform at or above the established standards. Use of these indicators would enable us to explore "high achievement" in a broader way than if we only use CAP scores.

Another option that could be used to identify districts for case studies is to create lists of districts ordered by their rank on demographic variables (e.g. POP, MIN, POV and LEP), along with state percentile rank change from 1984-89 (using the slope of time series regression). The lists, which could be sorted by individual variables, would also include district values on the other variables of interest. The top 10 districts could be identified, or the lists could be examined to find "interesting" LEAs.

To deal with other states in the region, other strategies will be necessary. In the case of Nevada, only two LEAs are of interest: Washoe County and Clark County. Examination of state reports shows that test scores have been declining in Clark County, while the change in the minority population has increased. Test scores are improving slightly in Washoe County, and there has also been an increase in the minority population there.

In Arizona, there are approximately 50 LEAs in the Phoenix and Tucson MSAs. Although the ITBS test has been given there for ten years or more, the test was re-normed after 1986. Thus, the scores are not comparable from 1984-86 to 1987 and later. Thus, it is recommended that achievement from 1987-1990 be calculated for selected districts. Relevant demographic data are available by district (e.g. LEP, free lunch, mobility, percent minority), thus a composite change could also be calculated as for California.

In Utah, the state administered the Stanford Achievement test from 1985-1989 in grades 3, 5, 7, and 11. We have a recent report that contains demographic data for 1990 by districts (e.g. percent tested, percent of students receiving free lunch, AFDC and foster care, and median 1990 test scores) , and data for earlier years are available from the individual districts.

In conclusion, the findings of the pilot study indicate that the regression procedure has not helped us to identify LEAs that are doing well and that have experienced large change in the demographic conditions under which they operate. We recommend using a combination of qualitative and quantitative methods to identify LEAs and have presented several options.