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AUTHOR Sherman, Joel D.
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ABSTRACT

By focusing attention on comparative state performance in educating students, the Wall Chart (State Education Statistics, 1983) forced policymakers to consider state differences in student populations and the consequences of these differences for the outcomes of state systems of education. This paper presents the results of a study that attempted to develop and refine the methodology for constructing a state education service requirements index and to develop alternative indices based on these methodologies. Two methodologies used to develop the indices are presented. The first involved a regression analysis which measured the effects of different student characteristics on student achievement. The second methodology involved the computation of indices based on the excess cost of educating children with special educational needs. Developed indices included: (1) base indices limited to three student characteristics: poverty, handicapping, and non-English-language background; and (2) comprehensive indices that included the three base characteristics and two additional characteristics: single-parent-family status, and mother's low educational attainment. Data were obtained from the 1980 Census and the Office of Special Education and Rehabilitation Services in the Department of Education. Both methodologies produced indices of state education service requirements that were consistent in their state rankings. (Author/PN)

INDICATORS OF EDUCATIONAL NEED

Joel D. Sherman

Pelavin Associates

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EXECUTIVE SUMMARY

Since the Federal Government began funding categorical programs for selected target group children over 20 years ago, there has been considerable interest in an indicator of the states' cumulative education service requirements. The publication in 1983 of "State Education Statistics," more commonly known as the "Wall Chart," sparked further interest in such an indicator. By focusing attention on comparative state performance in educating students, the Wall Chart forced policymakers to consider seriously state differences in student populations and the consequences of these differences for the outcomes of state systems of education.

Following the release of the Wall Chart, the Center for Statistics contracted with Pelavin Associates to conduct a study that would: 1) develop and refine the methodology for constructing a state education service requirements index and 2) develop alternative indices based on these methodologies. This paper presents the results of that study.

Two methodologies were used to develop the indices of state education service requirements. The first involved a regression analysis which measured the effects of different student characteristics on student achievement. Regression coefficients generated from an individual-level regression analysis were used to develop an index of service requirements based on expected state-level achievement scores. The individual-level regression was performed using a sample of about 2,500 first graders in the Sustaining Effects Study, a nationally-representative survey of Title I elementary schools conducted in the late 1970's. The state index was constructed by substituting Census data on

student characteristics for individual-level data in the regression equations.

The second methodology involved the computation of indices based on the excess cost of educating children with special educational needs. State indices were developed by applying pupil weightings established in studies of the excess cost of programs for economically-disadvantaged children, handicapped children, and children with limited proficiency in English to the number (or percent) of children with these characteristics in the states.

Several different indices were developed using each of the two methodologies. These included: 1) base indices that were limited to three student characteristics -- poverty, handicapping, and non-English-language background; and 2) more comprehensive indices that included the three base characteristics and two additional characteristics -- single-parent-family status, and low mother's educational attainment. State-level data on poverty, non-English-language background, single-parent-family status and educational attainment came from the 1980 Census; data on handicapped children came from the Office of Special Education and Rehabilitative Services in the Department of Education.

RESULTS OF THE ANALYSIS

The regression methodology and the excess-cost methodology produced indices of state education service requirements that were quite consistent in their state rankings. In the summary of findings, we therefore focus on the more comprehensive indices, as these were developed

using all five student and family background characteristics. The analyses found that:

- States in the Southeast and Southwest had the highest indices of education service requirements. States in the Mideast, New England, and the Great Lakes followed in their service requirements, while states in the Plains, Far West and Rocky Mountains had the lowest education service requirements. (See Map 1 and Figure 1 for the indices generated by the regression analysis and Map 2 and Figure 1 for the indices generated by the excess-cost analysis.)

- States in the Southeast had the highest index values because of a high concentration of children in poverty, children from single-parent families, and adult females with less than a high-school education. States in the Southwest had high index values because of the concentration of children in poverty and children from non-English-language backgrounds. (See Table 1.)

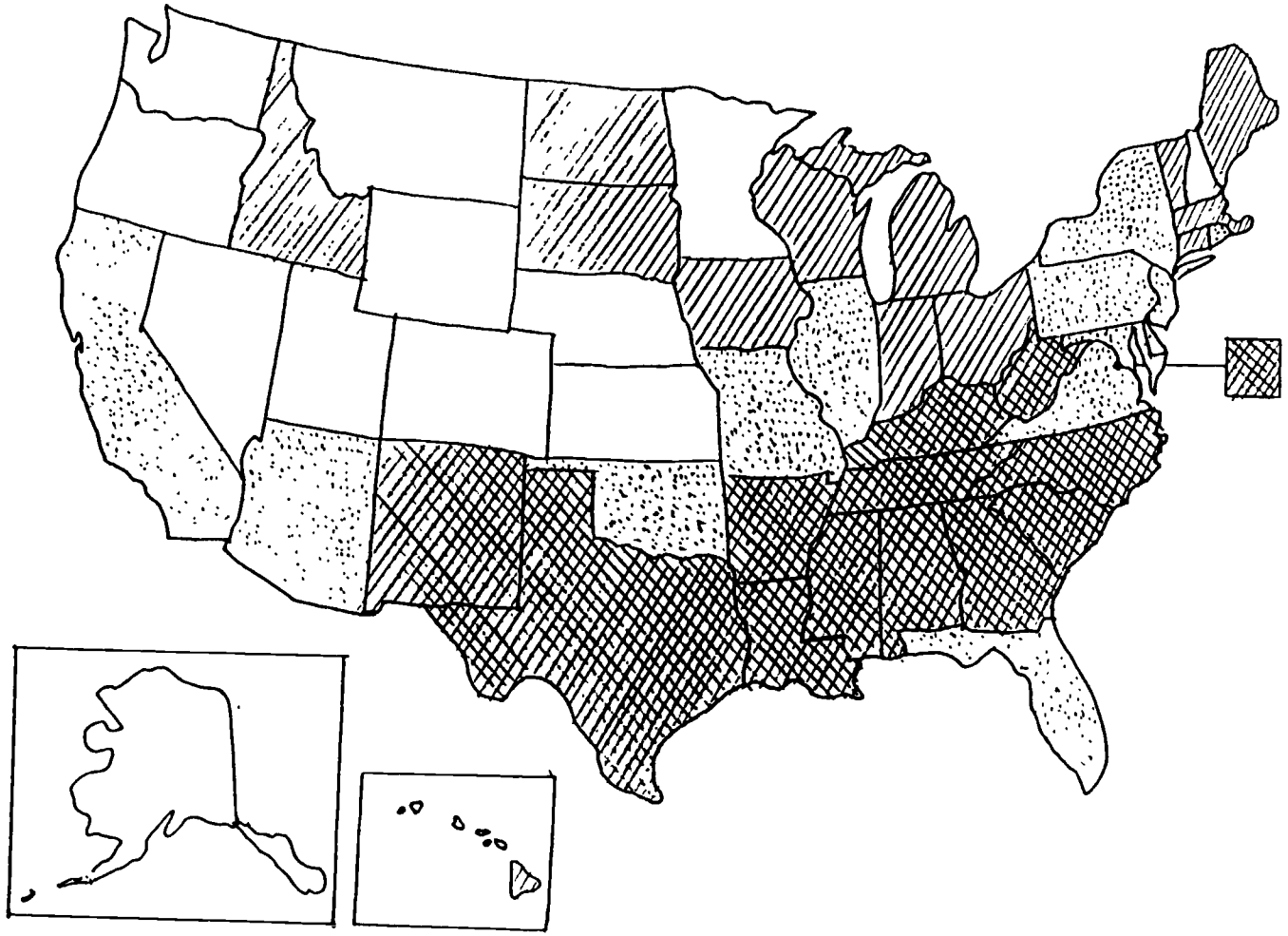
- Other states with high educational service requirements included New York, California, New Jersey and Massachusetts. California ranked high in service requirements because of the high concentration of children from non-English-language backgrounds; New York, because of the concentration of children in poverty and children from non-English-language backgrounds; Massachusetts, because of the high proportion of children served as handicapped; and New Jersey, because of moderate to high concentrations of poverty, handicapped, and non-English-language-background children. (See Table 1.)

- The number (or proportion) of children in poverty in a state and the educational attainment of female adults strongly influenced a state's ranking on the service requirements indices. State values on the service requirements indices had strong correlations with percent poverty and with the proportion of female adults with less than a high-school education. (See Table 2.)

- Other student and family background characteristics had less effect on a state's ranking on service requirements. State values on the service requirements indices had a moderate correlation with a state's proportion of children from single-parent families, a low correlation with the percent of children from non-English-language backgrounds and no correlation with the percent of children served as handicapped. (See Table 2.)

MAP 1

QUARTILE RANKINGS OF STATES ON REGRESSION-BASED INDEX OF EDUCATION SERVICE REQUIREMENTS



QUARTILE 1: Lowest Education Service Requirements

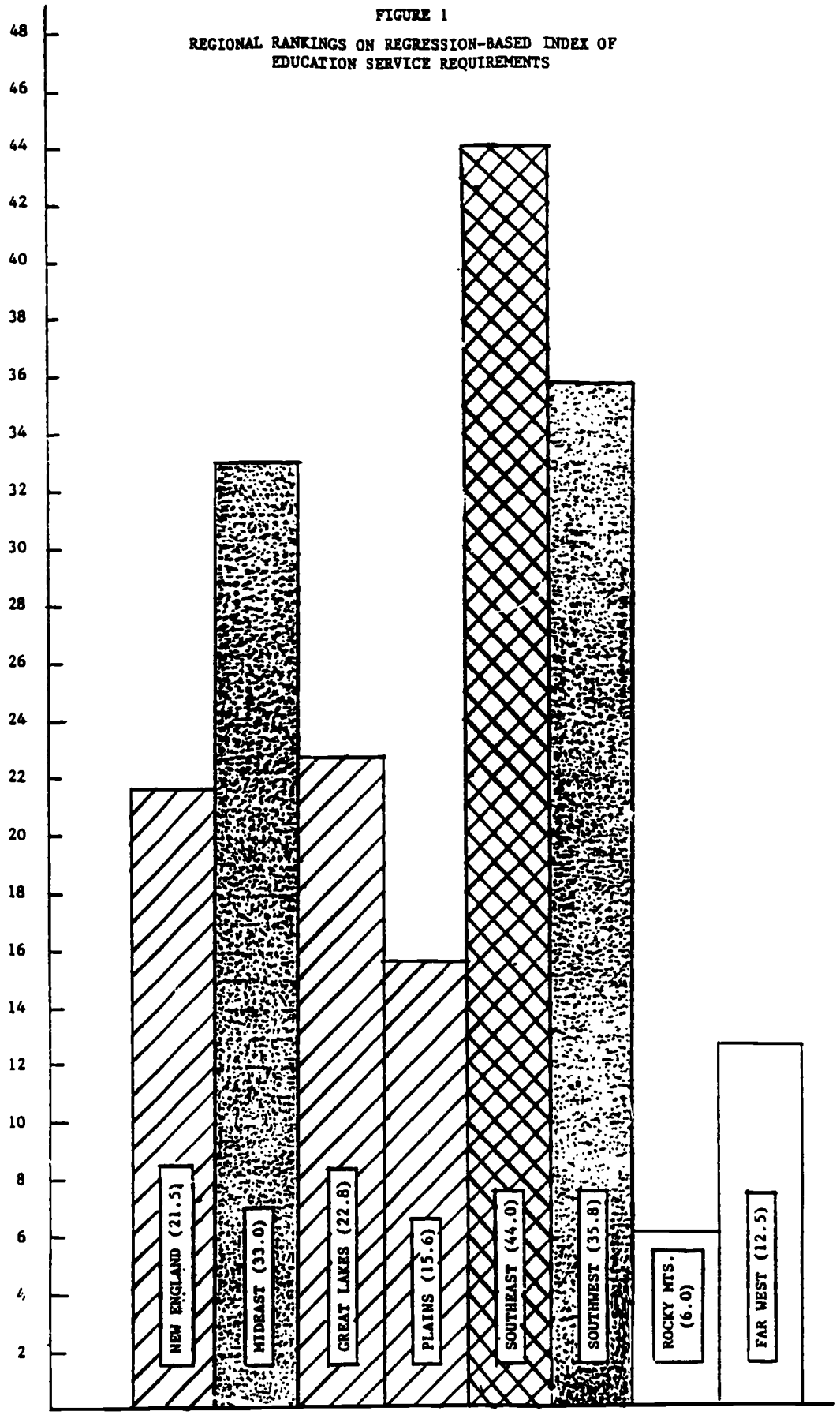
QUARTILE 2: Low-to-Moderate Education Service Requirements

QUARTILE 3: Moderate-to-High Education Service Requirements

QUARTILE 4: Highest Education Service Requirements

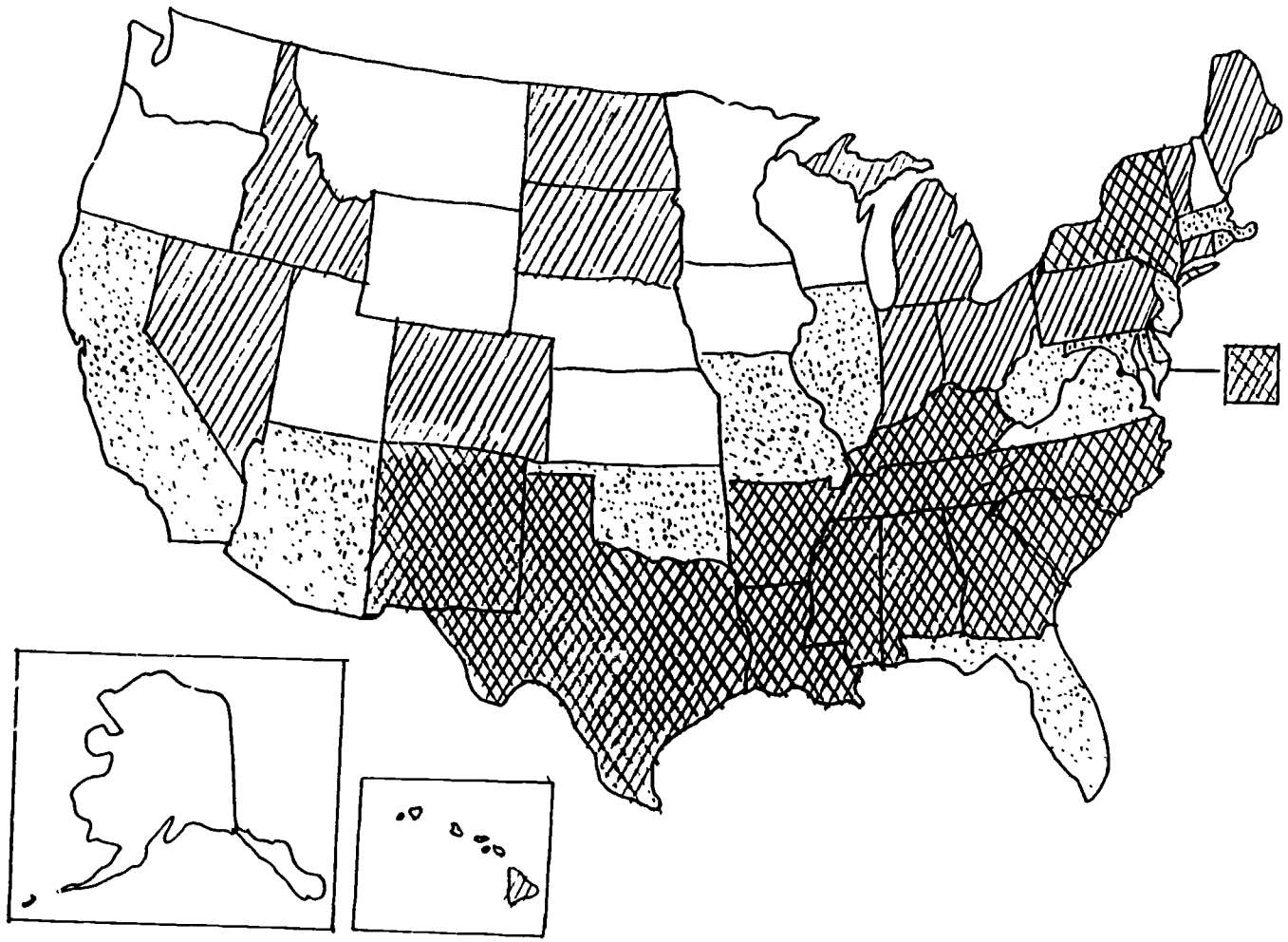
FIGURE 1

REGIONAL RANKINGS ON REGRESSION-BASED INDEX OF EDUCATION SERVICE REQUIREMENTS



MAP 2

QUARTILE RANKINGS OF STATES ON EXCESS-COST-BASED INDEX OF EDUCATION SERVICE REQUIREMENTS



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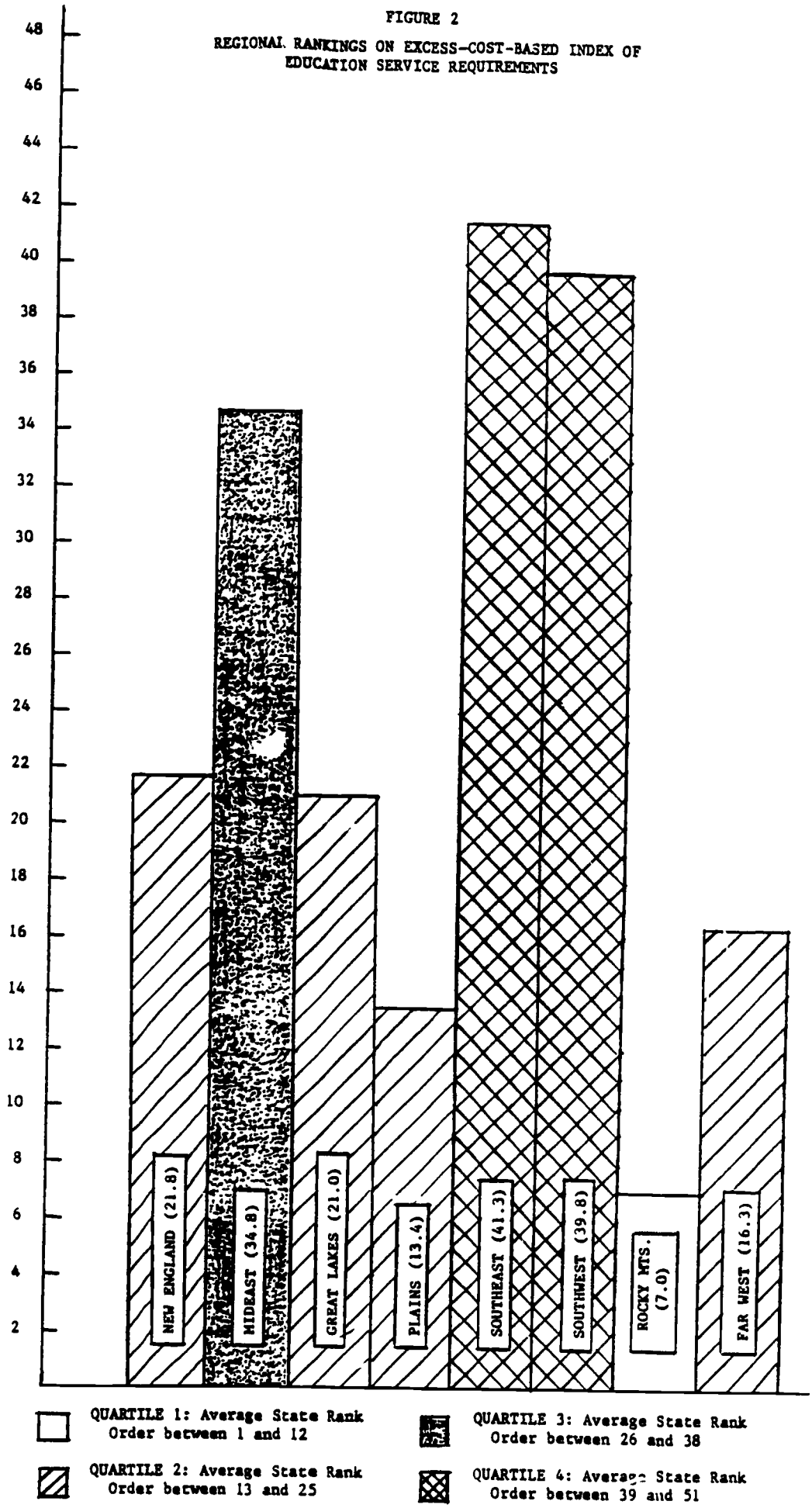

TABLE 1

INCIDENCE OF SELECTED STUDENT AND FAMILY BACKGROUND CHARACTERISTICS ASSOCIATED WITH LOW STUDENT ACHIEVEMENT, 1980

Region/State	Poverty Children as a Percent of 5-17 Population	Handicapped Children Served Under P.L. 94-142 as a Percent of 5-17 Population	Non-English-Language-Background Children as a Percent of 5-17 Population	Children Under 18 Residing with a Single Parent	Females 25 and Over with Less than a High-School Education
NEW ENGLAND					
CONNECTICUT	10.38	8.41	10.99	17.45	30.07
MAINE	15.15	8.67	5.29	14.78	30.53
MASSACHUSETTS	12.33	10.24	9.21	18.13	28.04
NEW HAMPSHIRE	8.90	4.27	4.68	13.55	27.55
RHODE ISLAND	12.62	7.35	9.96	17.84	40.16
VERMONT	13.01	8.37	3.38	14.72	27.46
MIDEAST					
DELAWARE	14.62	8.67	4.43	18.47	31.67
D.C.	26.28	1.56	5.32	41.20	33.28
MARYLAND	11.85	9.08	5.05	19.18	33.31
NEW JERSEY	13.35	8.58	13.40	18.91	33.76
NEW YORK	17.89	4.98	17.21	21.68	34.79
PENNSYLVANIA	13.23	6.75	4.71	15.42	35.97
GREAT LAKES					
ILLINOIS	14.14	8.04	9.72	18.54	34.56
INDIANA	10.99	7.26	3.59	15.06	34.60
MICHIGAN	12.44	6.09	3.88	18.46	31.88
OHIO	12.19	7.70	3.73	15.78	33.48
WISCONSIN	9.61	5.43	3.29	13.45	29.85
PLAINS					
IOWA	10.80	8.40	2.61	11.57	27.27
KANSAS	10.66	7.17	3.66	13.23	26.82
MINNESOTA	9.46	8.27	2.86	11.74	25.76
MISSOURI	14.01	8.54	2.44	15.49	37.40
NEBRASKA	11.56	7.63	2.74	12.09	25.80
NORTH DAKOTA	13.97	6.12	2.83	9.44	31.04
SOUTH DAKOTA	19.40	5.33	4.7	11.93	29.53
SOUTHEAST					
ALABAMA	23.09	7.73	1.66	17.48	44.64
ARKANSAS	22.73	7.49	1.62	16.15	45.18
FLORIDA	17.65	6.75	11.45	19.59	33.80
GEORGIA	20.48	7.49	2.24	18.98	45.56
KENTUCKY	21.15	7.59	1.60	14.28	46.86
LOUISIANA	23.12	7.45	5.07	19.14	43.64
MISSISSIPPI	30.36	6.45	1.71	19.01	45.36
NORTH CAROLINA	17.84	7.99	2.07	16.76	45.42
SOUTH CAROLINA	20.66	8.94	2.24	17.23	47.50
TENNESSEE	20.17	8.19	1.76	16.72	44.24
VIRGINIA	14.39	7.01	3.84	16.28	37.89
WEST VIRGINIA	18.21	7.39	1.57	11.96	44.02
SOUTHWEST					
ARIZONA	15.84	7.57	22.43	15.25	28.34
NEW MEXICO	21.68	6.15	36.59	15.80	32.13
OKLAHOMA	15.08	8.55	3.36	14.71	35.14
TEXAS	18.44	7.12	25.56	14.81	39.03
ROCKY MOUNTAIN					
COLORADO	10.75	6.84	7.97	15.31	22.08
IDAHO	13.38	7.28	4.65	11.77	25.85
MONTANA	12.74	6.45	3.21	12.50	24.06
UTAH	9.78	9.34	5.41	9.64	20.91
WYOMING	7.55	7.54	4.16	10.03	21.82
FAR WEST					
ALASKA	11.40	7.92	10.67	13.97	17.85
CALIFORNIA	14.20	6.87	22.92	18.96	27.62
HAWAII	11.68	5.14	14.37	14.23	27.53
NEVADA	9.40	6.08	7.50	18.47	25.31
OREGON	10.77	6.73	4.44	16.29	23.97
WASHINGTON	10.30	5.65	5.60	16.04	22.73

TABLE 2

CORRELATIONS BETWEEN REGRESSION-BASED INDEX OF EDUCATION SERVICE REQUIREMENTS, EXCESS-COST-BASED INDEX OF EDUCATION SERVICE REQUIREMENTS AND STUDENT AND FAMILY BACKGROUND CHARACTERISTICS

	Regression-Based Index	Excess-Cost-Based Index
Percent Children in Poverty	-.89	+.86
Percent Children Served as Handicapped	+.01	-.06
Percent Children from Non-English-Language Backgrounds	-.11	+.33
Percent Children from Single-Parent Families	-.49	+.59
Percent Female Adults with Less than a High-School Education	-.92	+.79

I. Introduction

The publication of "State Education Statistics," more commonly known as the "Wall Chart," by the Department of Education in 1983 sparked policymakers' interest in an index that measures each state's cumulative education service requirements. By focusing attention on comparative state performance in educating students, the Wall Chart forced policymakers to consider seriously state differences in student populations and the consequences of these differences for the outcomes of state systems of education.

Despite the interest in a cumulative measure of service requirements, there has been relatively little empirical research on the topic.[1] The Department of Education therefore contracted with Pelavin Associates to conduct a study that would: 1) develop and refine the methodology for creating comprehensive indices of service requirements and 2) produce alternative indices based on these methodologies. This paper presents the results of that study. It includes a general overview of the methodologies used to create the indices, a review of the study's major findings, and recommendations to improve the indices.

II. Methodology

The development of indices of state education service requirements was approached using two alternative methodologies. The first methodology involved regression analysis to determine the effects

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1 The School Finance Project (SFP) developed and published a composite index of educational "needs" as part of school finance studies mandated under the Education Amendments of 1978 (1982). An updated index was subsequently published by the Department of Education in Indicators of Status and Trends (1985). Although an important first step in the assessment of state education service requirements, this index was based more on conventional wisdom about the cost of programs for different types of children than on empirical analysis.

of various student and family background characteristics on student achievement. Regression coefficients generated from an individual-level regression analysis were used to establish an index of service requirements based on expected state-level achievement scores. The second methodology involved the computation of an index based on the excess cost of educating children with special educational needs. Pupil weightings generated from empirical cost studies were applied to the number -- and proportion -- of children in a state with certain characteristics to determine a state's cumulative incidence of children with special service requirements.

Regression Methodology

The regression methodology was based on the premise that a deficit in student achievement could be used as an indicator of a state's education service requirements. Based on this reasoning, a state which had higher concentrations of children with characteristics associated with low student achievement should have lower predicted achievement test scores and, consequently, higher education service requirements than a state with lower concentrations of children with these characteristics. A state's index score would, however, be determined by the mix of children with different characteristics and the relative impact of different student characteristics on achievement.

The creation of a state index based on educational deficiencies or "gaps" involved a two-stage process. First, a regression model was used to estimate the effects of individual student and family background characteristics on student-level achievement. The analysis was performed using a sample of about 2,500 first graders in the Sustaining Effects Study, a nationally-representative survey of Title I elementary schools

conducted in 1976-77. First graders, rather than the entire sample of elementary school children, were used in the analysis to isolate the effects on achievement of student characteristics -- which are beyond the control of school officials -- from the effects of services provided by schools.[2]

Two types of regression analysis were conducted: 1) a baseline analysis in which three student characteristics -- poverty, handicapping, and limited English proficiency (LEP) -- were used as independent variables; and 2) an expanded analysis which included as independent variables the three baseline student characteristics plus children from single-parent families and children whose mothers had completed less than a high-school education. In both analyses, the dependent variable was a combined raw score on achievement tests in reading and mathematics.[3]

The standardized and unstandardized regression coefficients generated by these analyses were then used to create state-level indices of service requirements. This was accomplished by substituting the proportion of children in a state with the student characteristics cited above for individual student data in the regression equation. The

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[2] Sensitivity analyses were also conducted using test scores of fourth- and sixth-graders as the dependent variable to determine whether the student characteristics included in the model affected achievement differently at higher grade levels. The regression coefficients produced in these analyses turned out to be quite similar to the first-grade regression coefficients. The first-grade regressions were therefore used to construct the resource requirements indices.

[3] Sensitivity analyses were also conducted using five other dependent variables in the regression analysis: raw scores in reading; raw scores in mathematics; and percentile scores in reading comprehension, reading vocabulary, and mathematics. The regression coefficients in these analyses were quite similar to those produced using the combined raw score in reading and mathematics as the dependent variable. The regressions based on the combined raw score in reading and mathematics was therefore used to construct the service requirements indices.

process of calculating the baseline state index is illustrated below for a state in which the proportion of children requiring special educational services is: poverty, 15 percent; handicapped, seven percent; and LEP, 12 percent. The expected achievement score for a state without any children requiring special services is 50 and the regression coefficients for each of the student characteristics are: poverty, -.25; handicapping, -.10; and LEP, -.15. The state's service requirements index would thus be:

$$50 + (-.25)(.15) + (-.10)(.07) + (-.15)(.12) = \text{Index Value}$$

$$50 + (-.3075) + (-.0070) + (-.0150) = 49.9405$$

The calculation of the expanded index involved the same procedure, except that single-parent status and mother's educational attainment were included as variables in the equation. For a state in which the proportion of children from single-parent families was 20 percent and the proportion of females over 25 with less than a high-school education was 18 percent and the regression coefficients were -.12 and -.20 respectively, the service requirements index would be:

$$50 + (-.25)(.15) + (-.10)(.07) + (-.15)(.12) + (-.12)(.20) + (-.20)(.18) = \text{Index Value}$$

$$50 + (-.3075) + (-.0070) + (-.0150)\ (-.0240) + (-.0360) = 49.8805$$

Excess Cost Methodology

The second approach to developing a state index of education service requirements was premised on the fact that schools attempt to respond to children's particular aptitudes and needs by providing special educational services, some of which are more costly than services provided the average child. To determine the "excess cost" of services for different types of special-needs students and thus to develop an index based on differences in the cost of services across student groups,

a review of empirical studies of the excess cost of programs for poverty, handicapped, and LEP students was conducted (Kutner, 1985). The results of this review are summarized below.

Compensatory Education - The Sustaining Effects Study (Haggart et al, 1978) found the average excess cost of compensatory programs in reading and mathematics for all elementary grades to be 54 percent higher than the cost of regular elementary programs. The range in excess costs was from 28 percent for first-grade reading programs to 78 percent for sixth-grade reading programs.

Handicapped Programs - Rossmiller (1970) found that special education expenditures per pupil for all programs combined were about twice as high as per pupil expenditures in regular programs. Kakalik (1981) found that, on average, the cost of educating a handicapped child was 2.17 times greater than the cost of educating a non-handicapped child.

Programs for Limited-English-Proficient Children - Garcia's study (1977) of bilingual programs in New Mexico found that, on average, bilingual programs cost 27 percent more than regular education programs. Cardenas' studies (1976) of bilingual programs in Colorado and Texas produced a range in excess costs from a low of 11 percent to a high of 42 percent.

Based on this review, two base excess-cost indices of state service requirements were developed using the following excess cost factors: compensatory programs, 1.54; handicapped programs, 2.17; and LEP programs, 1.27. One index, which was designed to measure the percent of a state's school-age population that had special education service requirements, was developed by multiplying the number of poverty, handicapped, and non-English-language background children (NELBs)[4] by their respective cost weights, summing the cumulative counts of children, and dividing by the total school-age (5-to-17-year-old population). It was calculated as follows:

$$\frac{(1.54 \times \text{Poverty Count}) + (2.17 \times \text{Handicapped Count}) + (1.27 \times \text{NELB Count})}{\text{5-17 Population}}$$

4 Non-English-language-background (NELB) children had to be used to construct the indices because data on LEPs are not currently available on a state-by-state basis.

A second base index, which was designed to reflect a state's total weighted student population relative to its total unweighted student population, was developed by multiplying the number of children in each program category by their pupil weights, adding the number of children without special requirements, summing the count of children,[5] and dividing by the school-age population. The index was calculated as follows:

$$\frac{(1.54 \times \text{Poverty Count}) + (2.17 \times \text{Handicapped Count}) + (1.27 \times \text{NELB Count}) + (1.00 \times \text{Children Without Special Requirements}}{\text{5-17 Population}}$$

The expanded index, which included children from single-parent families and mothers with low educational attainment, was similar in concept to the first base index. However, the proportion of children with each characteristic had to be substituted for the number of children in computing the index, since Census data on these additional characteristics were not based on the school-age population. Also, the poverty weighting of 1.54 was applied to both of these additional characteristics. This was done for two reasons: first, because empirical data on the excess cost of programs for these children were unavailable; and second, because these factors correlated very highly with poverty, both at the individual level and at the state level. The expanded index was calculated as follows:

(1.54 x Percent Poverty) + (2.17 x Percent Handicapped) + (1.27 x Percent NELB) + (1.54 x Percent Single-Parent) + (1.54 x Percent Females with less than a High-School Education)

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[5] Children without special requirements were defined as the difference between a state's 5-to-17 population and the sum of the unweighted number of children in each of the three special requirements categories. It was based on the assumption that each of the three special student population groups in the index represented a discrete population, i.e., there was no overlap in students across the three population groups, since the extent of overlap in these populations could not be determined empirically.

Sensitivity Analysis

With the establishment of baseline indices, several alternative indices were constructed to assess the effects of different poverty, handicapped and LEP weightings on state service requirements. The modifications to the three-factor index were based on the range of excess costs found in the empirical studies. They involved:

- reducing the poverty weighting to 1.28, while holding other weightings constant;
- increasing the poverty weighting to 1.78, while holding other weightings constant;
- reducing the language-proficiency weighting to 1.11, while holding other weightings constant;
- increasing the language-proficiency weighting to 1.42, while holding other weightings constant;
- reducing both the poverty and language-proficiency weightings to 1.28 and 1.11 respectively, while holding the handicapped weighting constant;
- increasing both weightings to 1.78 and 1.42 respectively, while again holding the handicapped weighting constant;

Several expanded indices were also constructed to assess the effects of different weightings for children from single-parent families and mother's educational attainment. These modifications included:

- reducing the single-parent and education weightings to 1.00, since there was no empirical basis for larger program weightings; and
- adjusting the weightings to reflect the relative effects of these factors on student achievement, as found in the SES regression analysis. Based on the standardized regression analysis, these weightings were changed to 1.32 for children from single-parent families and 1.89 for mother's education; based on the unstandardized analysis, the weightings were changed to 1.32 and 1.71 respectively.

Sources of Data

The student and family background characteristics included in the

indices were drawn from two sources: the 1980 Census, and the Office of Special Education and Rehabilitative Services in the Department of Education. The following definitions of data and sources of data were used in constructing the indices:

Poverty - school-age children in poverty (1980 Census);

Handicapping - children age 6-17 served under P.L. 94-142 during the 1979-80 school year, (Office of Special Education and Rehabilitative Services, U.S. Department of Education);

Limited English-Proficiency - school-age children from non-English-language backgrounds (1980 Census);

Single-Parent Status - persons under 18 residing either with a male head of household or a female head of household (1980 Census);

Mother's Educational Attainment - all females over 25 years of age who completed less than four years of high-school education (1980 Census).

III. Results of the Analysis

To provide the appropriate context for assessing state education service requirements, the relative incidence of children with characteristics included in the indices is first presented. This is followed by a discussion of state indices generated from the regression analysis and state indices based on the excess cost of special programs. Included in the latter discussion is a comparison of state rankings on the indices developed using the two methodologies.

Incidence of Children Requiring Special Educational Services

States differ in their student populations in several respects. The first is the relative incidence of children with characteristics associated with low student achievement. Poverty children tend, in general, to be concentrated in states in the Southeast, children from single-parent families in states in the Mideast, and children from non-English-language backgrounds in states in the Southwest. Handicapped

children, however, tend to be distributed fairly evenly across the regions of the country.[6] (See Table 1.)

A second important difference among states is the degree of overlap in different student populations. While there is some congruence in the incidence of children with different characteristics, this congruence is not extensive. States in the Southeast, for example, tend to rank high in the proportion of children from poverty families but low in the proportion of children from non-English-language backgrounds. States in the Southwest similarly rank high in their incidence of poverty children and children from non-English-language backgrounds but relatively low in the proportion of children from single-parent families. At the other end of the spectrum, states in the Rocky Mountain region rank low in their incidence of children in poverty and children from single-parent families but somewhat higher in the proportion of handicapped and non-English-language-background children. (See Table 1 for state data on student and family background characteristics, Table 2 for regional rank orders on these characteristics, and Table 3 for state-level correlations between student and family background characteristics.)

State Indices Based on Deficiencies in Educational Achievement

The first step in developing state service requirements indices based on student achievement was to calculate the regression coefficients that would be used to adjust state-level achievement based on the

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6 It is important to note that interstate variation on these measures differs markedly. The largest interstate variation is in the proportion of NELB children. This is due largely to the high concentration of NELB children in a handful of states Interstate variation in the proportion of handicapped children, on the other hand, is quite small, at least in part because federal regulations place limits on the proportion of children in a state who can be served under P.L. 94-142.

TABLE 1

INCIDENCE OF SELECTED STUDENT AND FAMILY BACKGROUND CHARACTERISTICS ASSOCIATED WITH LOW STUDENT ACHIEVEMENT, 1980

Region/State	Poverty Children as a Percent of 5-17 Population	Handicapped Children Served Under P.L. 94-142 as a Percent of 5-17 Population	Non-English-Language-Background Children as a Percent of 5-17 Population	Children Under 18 Residing with a Single Parent	Females 25 and Over with less than a High-School Education
NEW ENGLAND					
CONNECTICUT	10.38	8.41	10.99	17.45	30.07
MAINE	15.15	8.67	5.29	14.78	30.53
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ILLINOIS	14.14	8.04	9.72	18.54	34.56
INDIANA	10.99	7.26	3.59	15.06	34.60
MICHIGAN	12.44	6.09	3.88	18.46	31.88
OHIO	12.19	7.70	3.73	15.78	33.48
WISCONSIN	9.61	5.43	3.29	13.45	29.85
PLAINS					
IOWA	10.80	8.40	2.61	11.57	27.27
KANSAS	10.66	7.17	3.66	13.23	26.82
MINNESOTA	9.46	8.27	2.86	11.74	25.76
MISSOURI	14.01	8.54	2.44	15.49	37.40
NEBRASKA	11.56	7.63	2.74	12.09	25.80
NORTH DAKOTA	13.97	6.12	2.83	9.44	31.04
SOUTH DAKOTA	19.40	5.33	4.78	11.93	29.53
SOUTHEAST					
ALABAMA	23.09	7.73	1.66	17.48	44.64
ARKANSAS	22.73	7.49	1.62	16.15	45.18
FLORIDA	17.65	6.75	11.45	19.59	33.80
GEORGIA	20.48	7.49	2.24	18.98	45.56
KENTUCKY	21.15	7.59	1.60	14.28	46.86
LOUISIANA	23.12	7.45	5.07	19.14	43.64
MISSISSIPPI	30.36	6.45	1.71	19.01	45.36
NORTH CAROLINA	17.84	7.99	2.07	16.76	45.42
SOUTH CAROLINA	20.66	8.94	2.24	17.23	47.50
TENNESSEE	20.17	8.19	1.76	16.72	44.24
VIRGINIA	14.39	7.01	3.84	16.28	37.89
WEST VIRGINIA	18.21	7.39	1.57	11.96	44.02
SOUTHWEST					
ARIZONA	15.84	7.57	22.43	15.25	28.34
NEW MEXICO	21.68	6.15	36.50	15.80	32.13
OKLAHOMA	15.08	8.55	3.36	14.71	35.14
TEXAS	18.44	7.12	25.56	14.81	39.03
ROCKY MOUNTAIN					
COLORADO	10.75	6.84	7.97	15.31	22.08
IDAHO	13.38	7.29	4.65	11.77	25.85
MONTANA	12.74	6.45	3.21	12.50	24.06
UTAH	9.78	9.34	5.41	9.64	20.91
WYOMING	7.55	7.54	4.16	10.03	21.82
FAR WEST					
ALASKA	11.40	7.92	10.67	13.97	17.85
CALIFORNIA	14.20	6.87	22.92	18.96	27.62
HAWAII	11.68	5.14	14.87	14.23	27.53
NEVADA	9.40	6.08	7.50	18.47	25.31
OREGON	10.77	6.73	4.44	16.29	23.97
WASHINGTON	10.30	5.65	5.60	16.04	22.73

TABLE 2

RANK ORDER OF REGIONS ON SELECTED STUDENT AND FAMILY BACKGROUND CHARACTERISTICS

Region	Percent Children in Poverty	Percent Children Served as Handicapped	Percent Children from Non-English-Language Background	Percent Children from Single-Parent Families	Percent Female Adults with Less than a High-School Education
New England	17.8	34.3	33.7	26.7	22.3
Mideast	31.0	26.7	35.3	42.8	30.8
Great Lakes	17.0	21.2	23.8	28.0	28.8
Plains	19.4	27.1	15.6	8.9	18.0
Southeast	42.7	28.2	11.9	33.8	44.7
Southwest	38.5	26.0	41.5	21.5	30.5
Rocky Mountains	13.0	27.5	27.8	8.8	5.6
Far West	13.5	14.2	39.3	28.8	8.5

TABLE 3

CORRELATION BETWEEN STUDENT AND FAMILY BACKGROUND CHARACTERISTICS ASSOCIATED WITH LOW STUDENT ACHIEVEMENT

	Percent Children in Poverty	Percent Children Served as Handicapped	Percent Children from Non-English-Language Background	Percent Children from Single-Parent Families	Percent Female Adults with Less than a High-School Education
Percent Children in Poverty	--	-.19	+.05	+.47	+.74
Percent Children Served as Handicapped		--	-.14	-.43	+.10
Percent Children from Non-English-Language Backgrounds			--	+.12	-.18
Percent Children from Single-Parent Families				--	+.27

individual characteristics of their students. (Table 4 presents the standardized and unstandardized coefficients for the base indices that include three background variables -- poverty, handicapping, and NELB -- and the expanded indices that include the two additional background variables -- children from single-parent families and mothers with low educational attainment.) In both sets of indices, the combined raw score in reading and mathematics was the dependent variable in the regression.

In the base equations, poverty had the largest negative effect on achievement, depressing scores from one-quarter to one-third of a standard deviation, on the average. The second most-important factor affecting student achievement was handicapping, while NELB had the least depressing effect on student achievement.[7] In the expanded equations, poverty continued to have a relatively large negative effect on achievement, but low educational attainment of the mother replaced poverty as the most significant factor affecting student achievement. These two background characteristics were followed by handicapping, single-parent-family status, and finally, non-English-language background in their influence on educational achievement.

The regression coefficients generated in these analyses were then used to create two base service requirements indices -- one based on the standardized regression coefficients (Index BS), the second based on the unstandardized coefficients (Index BU) -- and two expanded indices -- one again based on the standardized regression coefficients (Index ES), the second based on the unstandardized coefficients (Index EU). Index BS

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[7] It should be remembered that only students in classes classified as grade 1 were included in the sample. This undoubtedly eliminated from the sample the most severely handicapped children and children who could not speak English at all.

TABLE 4

REGRESSION COEFFICIENTS DEMONSTRATING THE EFFECTS OF STUDENT AND FAMILY BACKGROUND CHARACTERISTICS ON EDUCATIONAL ACHIEVEMENT

Student and Family Background Characteristics	Base Indices		Expanded Indices	
	Standardized Index (Index BS)	Unstandardized Index (Index BU)	Standardized Index (Index ES)	Unstandardized Index (Index EU)
Poverty	-0.31	-11.84	-0.18	-6.64
Handicapped	-0.16	-8.13	-0.14	-6.77
Non-English-Language Background	-0.10	-4.69	-0.07	-2.99
Single-Parent Family Status			-0.10	-3.95
Low Mother's Educational Attainment (Less than a High-School Education)			-0.29	-8.68
Intercept		57.32		59.54

represents the difference, in standard deviation units, between the achievement of a state with no poor, handicapped, or NELB children and the state's achievement with actual proportions of children with these characteristics. Index BU represents the predicted average combined raw score in reading and mathematics for each state. Indices ES and EU are similar in concept to Indices BS and BU respectively, except that single-parent status and mother's educational attainment are included as factors in computing the state indices.[8]

The base indices and the expanded indices of state education service requirements were, in general, quite consistent in their state and regional rankings.[9] (See Tables 5 and 6.) States in the Southeast and Southwest consistently ranked highest in their service requirements, with states in the Mideast close behind. States in New England and the Great Lakes, generally ranked in the middle of the distribution, while states in the Plains, Far West and Rocky Mountain regions consistently ranked lowest in their education service requirements. In addition, both the base and expanded indices had similar relationships with student and family background characteristics included in the indices. A low value on the service requirements index, i.e., a lower educational achievement score, was strongly related to a high incidence of poverty children and a high proportion of females with less than a high-school education in a state, moderately related to the proportion of children from single-

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8 The 50 states and the District of Columbia are ranked in ascending order on education service requirements from 1 to 51. A ranking of 1 represents the lowest incidence of service requirements; a ranking of 51 represents the highest incidence of service requirements.

9 The correlation between the base indices and the expanded indices ranged between +.79 and +.84.

TABLE 5

STATE INDEX VALUES ON SERVICE REQUIREMEN.. INDICES BASED ON REGRESSION ANALYSIS

Region/State	Base Indices				Expanded Indices			
	Standardized Index		Unstandardized Index		Standardized Index		Unstandardized Index	
	Index Value	Quartile Ranking	Index Value	Quartile Ranking	Index Value	Quartile Ranking	Index Value	Quartile Ranking
NEW ENGLAND								
CONNECTICUT	-.0586	2	54.8917	2	-.1428	2	55.2512	2
MAINE	-.0675	3	54.5735	3	-.1464	2	55.1531	2
MASSACHUSETTS	-.0658	3	54.5959	3	-.1424	2	55.2003	2
NEW HAMPSHIRE	-.0400	1	55.6996	1	-.1190	1	56.1792	1
RHODE ISLAND	-.0626	3	54.7614	3	-.1743	3	54.3135	3
VERMONT	-.0583	2	54.9409	2	-.1319	2	55.6410	2
MIDEAST								
DELAWARE	-.0649	3	54.6767	3	-.1519	3	54.9688	3
D.C.	-.0900	4	53.8324	4	-.1909	4	53.6116	4
MARYLAND	-.0577	2	54.9416	2	-.1534	3	54.9356	3
NEW JERSEY	-.0707	3	54.4136	3	-.1622	3	54.5924	3
NEW YORK	-.0829	4	53.9897	4	-.1738	3	54.2218	3
PENNSYLVANIA	-.0577	2	54.9845	2	-.1563	3	54.9305	3
GREAT LAKES								
ILLINOIS	-.0682	3	54.5363	3	-.1623	3	54.6318	3
INDIANA	-.0504	1	55.2603	1	-.1478	2	55.2112	2
MICHIGAN	-.0532	2	55.1703	1	-.1445	2	55.2867	2
OHIO	-.0550	2	55.0759	2	-.1482	2	55.1658	2
WISCONSIN	-.0426	1	55.5861	1	-.1272	2	55.9107	2
PLAINS								
IOWA	-.0506	1	55.2356	1	-.1237	2	55.9492	2
KANSAS	-.0493	1	55.3035	1	-.1228	1	55.9843	1
MINNESOTA	-.0465	1	55.3934	1	-.1171	1	56.1641	1
MISSOURI	-.0606	2	54.8525	2	-.1628	3	54.6984	3
NEBRASKA	-.0518	1	55.2029	1	-.1203	1	56.0545	1
NORTH DAKOTA	-.0568	2	55.0361	2	-.1352	2	55.6439	2
SOUTH DAKOTA	-.0745	3	54.3652	3	-.1433	2	55.3105	2
SOUTHEAST								
ALABAMA	-.0865	4	53.8800	4	-.2005	4	53.4660	4
ARKANSAS	-.0850	4	53.9437	4	-.1997	4	53.5132	4
FLORIDA	-.0788	4	54.1440	4	-.1669	3	54.4582	3
GEORGIA	-.0787	3	54.1814	3	-.2000	4	53.4992	4
KENTUCKY	-.0802	4	54.1232	4	-.2000	4	53.5394	4
LOUISIANA	-.0899	4	53.7394	4	-.2013	4	53.4020	4
MISSISSIPPI	-.1070	4	53.1206	4	-.2154	4	52.9454	4
NORTH CAROLINA	-.0712	3	54.4606	3	-.1932	4	53.7449	4
SOUTH CAROLINA	-.0817	4	54.0421	4	-.2062	4	53.2901	4
TENNESSEE	-.0784	3	54.1837	3	-.1940	4	53.6910	4
VIRGINIA	-.0607	2	54.8664	2	-.1646	3	54.6601	3
WEST VIRGINIA	-.0707	3	54.4879	3	-.1838	4	54.0879	4
SOUTHWEST								
ARIZONA	-.0866	4	53.7774	4	-.1522	3	54.8403	3
NEW MEXICO	-.0978	4	52.5416	4	-.1822	4	53.7771	4
OKLAHOMA	-.0650	3	54.6621	3	-.1581	3	54.8262	3
TEXAS	-.0974	4	53.3588	4	-.1891	4	53.6937	4
ROCKY MOUNTAIN								
COLORADO	-.0537	2	55.1171	2	-.1139	1	56.2007	1
IDAHO	-.0590	2	54.9260	2	-.1243	2	55.9081	2
MONTANA	-.0540	2	55.1370	2	-.1165	1	56.1772	1
UTAH	-.0521	1	55.1491	2	-.1047	1	56.4984	1
WYOMING	-.0415	1	55.5857	1	-.1009	1	56.6842	1
FAR WEST								
ALASKA	-.0605	2	54.8262	2	-.1048	1	56.4245	1
CALIFORNIA	-.0809	4	54.0054	4	-.1303	3	54.8979	3
HAWAII	-.0613	3	54.8220	3	-.1327	2	55.6178	2
NEVADA	-.0477	1	55.3613	1	-.1226	1	55.9509	1
OREGON	-.0497	1	55.2856	1	-.1177	1	56.1101	1
WASHINGTON	-.0477	1	55.3785	1	-.1123	1	56.2968	1

TABLE 6

RANK ORDER OF REGIONS ON REGRESSION-BASED INDICES
OF STATE EDUCATION SERVICE REQUIREMENTS

Region	Index BS	Index BU	Index ES	Index EU
New England	21.7	21.8	20.8	21.5
Mideast	31.5	31.7	32.8	33.0
Great Lakes	14.6	14.2	23.8	22.8
Plains	15.6	15.6	16.4	15.6
Southeast	39.7	39.3	44.5	44.0
Southwest	43.8	43.8	34.8	35.8
Rocky Mountains	13.0	13.2	5.6	6.0
Far West	18.2	18.7	11.5	12.5

parent families, weakly related to the proportion of NELB children, and unrelated to the proportion of children served as handicapped under federal law. (See Table 7.)

It is important to note, however, that the state rankings on the service requirements indices were not based on a high degree of variation in index values. On the base standardized index (Index BS), state-level achievement ranged only from four one-hundredths (.04) of a standard deviation below what would be expected if a state had no poor, handicapped, or NELB children to 12 one-hundredths (.12) of a standard deviation below the expected score. On the base unstandardized index (Index BU), state-level achievement measured as combined raw scores in reading and mathematics ranged only from 52.5 to 55.7 -- a difference of only 3.2 test items. On the expanded indices, the range in state-level achievement was slightly greater than on the base indices. Even here, however, the range on the standardized index was only from one-tenth (.10) of a standard deviation to twenty-two one-hundredths (.22) of a standard deviation below the expected score in a state without students with these characteristics; the range on the unstandardized index -- from 52.9 to 56.5 -- was also quite low -- again, a difference of only 3.6 test items.

State Indices Based on Excess Program-Cost

The excess cost studies were used to produce two base indices of education service requirements in the states: one to reflect the proportion of weighted students (poverty, handicapped and NELB) to the state's school-age population (Index C1); the second to reflect a state's total weighted school-age population (including children without special service requirements) relative to its total unweighted school-age

TABLE 7

CORRELATION BETWEEN REGRESSION-BASED INDICES OF EDUCATION SERVICE REQUIREMENTS AND STUDENT AND FAMILY BACKGROUND CHARACTERISTICS

	Index BS	Index BU	Index ES	Index EU
Percent Children in Poverty	-.89	-.87	-.88	-.89
Percent Children Served as Handicapped	+.09	+.06	+.00	+.01
Percent Children from Non-English-Language Backgrounds	-.47	-.51	-.05	-.11
Percent Children from Single-Parent Families	-.42	-.40	-.46	-.49
Percent Female Adults with Less than a High-School Education	-.60	-.58	-.94	-.92

population (Index C2). The base weightings in these indices were 1.54 for poverty, 2.17 for handicapping, and 1.27 for non-English-language background. The excess cost studies were also used to produce one expanded index that included children from single-parent families and females with low educational attainment (Index CE). As stated earlier, the excess cost weightings for the three base student characteristics were the same as in the base index; weightings for the other two factors were set at the poverty weighting, 1.54, since both of these factors correlated most strongly with poverty, both at the individual level and at the state level.

State indices generated using the excess cost methodology were quite similar to those produced using regression analysis.10 (See Tables 8 and 9.) States in the Southeast and Southwest generally had the highest service requirements indices -- the former because of the high concentration of children in poverty and females with low educational attainment, the latter because of the high concentration of poverty and NELB children. States in the Mideast ranked next-to-highest on the indices, largely because they ranked relatively high on almost all student and family background characteristics except handicapping. States in New England, the Far West, the Great Lakes, and Plains regions ranked from the middle to the lower end of the distribution on the indices and states in the Rocky Mountain region consistently had the lowest indices of service requirements, largely because they had a

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10 The correlations between the regression-based indices and the excess-cost based indices were generally quite high. The base regression indices had correlations about +.9 with all of the cost-based indices; the expanded regression indices had correlations between +.6 and +.75 with the base cost indices and correlations of about +.95 with the expanded cost index.

TABLE 8

STATE INDEX VALUES ON SERVICE REQUIREMENTS BASED ON EXCESS-COST ANALYSIS

Region/State	Base Index (C1)		Base Index (C2)		Expanded Index (CE)	
	Index Value	Quartile Ranking	Index Value	Quartile Ranking	Index Value	Quartile Ranking
NEW ENGLAND						
CONNECTICUT	.4799	3	1.1834	3	1.2136	2
MAINE	.4839	3	1.1958	3	1.1863	2
MASSACHUSETTS	.5267	4	1.2104	4	1.2400	3
NEW HAMPSHIRE	.2872	1	1.1099	1	.9267	1
RHODE ISLAND	.4781	3	1.1802	2	1.3735	3
VERMONT	.4211	2	1.1759	2	1.0745	2
MIDEAST						
DELAWARE	.4651	3	1.1908	3	1.2416	3
D.C.	.4945	3	1.1704	2	1.6531	4
MARYLAND	.4400	2	1.1826	3	1.2521	3
NEW JERSEY	.5597	4	1.2078	4	1.3730	3
NEW YORK	.5980	4	1.1998	3	1.4718	4
PENNSYLVANIA	.4065	2	1.1619	2	1.2012	2
GREAT LAKES						
ILLINOIS	.5131	3	1.1957	3	1.3333	3
INDIANA	.3695	1	1.1529	1	1.1371	2
MICHIGAN	.3698	1	1.1478	1	1.1482	2
OHIO	.3993	2	1.1650	2	1.1608	2
WISCONSIN	.3056	1	1.1236	1	.9746	1
PLAINS						
IOWA	.3797	2	1.1629	2	.9800	1
KANSAS	.3633	1	1.1503	1	.9829	1
MINNESOTA	.3595	1	1.1549	1	.9390	1
MISSOURI	.4281	2	1.1807	3	1.2464	3
NEBRASKA	.3758	1	1.1582	2	.9618	1
NORTH DAKOTA	.3817	2	1.1539	1	1.0071	2
SOUTH DAKOTA	.4715	3	1.1787	2	1.1137	2
SOUTHEAST						
ALABAMA	.5397	4	1.2180	4	1.5011	4
ARKANSAS	.5272	4	1.2127	4	1.4776	4
FLORIDA	.5586	4	1.2033	3	1.3860	3
GEORGIA	.5017	3	1.2026	3	1.5003	4
KENTUCKY	.5041	3	1.2050	4	1.4524	4
LOUISIANA	.5759	4	1.2235	4	1.5490	4
MISSISSIPPI	.6234	4	1.2420	4	1.6205	4
NORTH CAROLINA	.4703	3	1.1940	3	1.4321	4
SOUTH CAROLINA	.5355	4	1.2204	4	1.5373	4
TENNESSEE	.5055	3	1.2077	4	1.4494	4
VIRGINIA	.4181	2	1.1686	2	1.2568	3
WEST VIRGINIA	.4562	2	1.1875	3	1.3228	3
SOUTHWEST						
ARIZONA	.6880	4	1.2328	4	1.3643	3
NEW MEXICO	.9236	4	1.2851	4	1.6690	4
OKLAHOMA	.4556	2	1.1888	3	1.2280	3
TEXAS	.7587	4	1.2503	4	1.5923	4
ROCKY MOUNTAIN						
COLORADO	.4121	2	1.1565	2	.9911	2
IDAHO	.4191	2	1.1686	2	1.0025	2
MONTANA	.3729	1	1.1515	1	.9398	1
UTAH	.4183	2	1.1754	2	.8924	1
WYOMING	.3388	1	1.1440	1	.8318	1
FAR WEST						
ALASKA	.4775	3	1.1811	3	.9729	1
CALIFORNIA	.6531	4	1.2169	4	1.3761	3
HAWAII	.4771	3	1.1622	2	1.1233	2
NEVADA	.3665	1	1.1402	1	1.0461	2
OREGON	.3633	1	1.1471	1	.9892	1
WASHINGTON	.3493	1	1.1354	1	.9494	1

TABLE 9

RANK ORDER OF REGIONS ON COST-BASED INDICES
OF EDUCATION SERVICE REQUIREMENTS

Region	Index C1	Index C2	Index CE
New England	26.2	25.8	21.8
Mideast	31.5	28.8	34.8
Great Lakes	14.8	14.2	21.0
Plains	14.4	15.9	13.4
Southeast	36.3	38.8	41.3
Southwest	43.5	45.0	39.8
Rocky Mountains	14.0	14.0	7.0
Far West	20.8	16.7	16.3

relatively low incidence of poverty children, children from single-parent families, and females with less than a high-school education.

The relationships between state rankings on the cost-based indices and student and family background characteristics were also similar, in general, to the relationships found between student and family background characteristics and the regression-based indices. (See Table 10.) On the base indices, a high index of service requirements was strongly associated with poverty, moderately to strongly associated with low female educational attainment and non-English-language background, less strongly associated with single-parent status, and virtually unrelated to the percent of children served as handicapped under federal law. On the expanded indices, a high index was strongly associated with poverty and low female educational attainment, moderately to strongly associated with single-parent status, weakly associated with non-English-language background, and unrelated to the incidence of children served as handicapped.

The excess-cost-based indices differed, however, from the regression-based indices in at least one important respect. The variation in state rankings on the former was considerably greater than the variation on the latter. To a large degree, this was due to a difference in the calculation procedures used to construct the indices. In the regression-based indices, the proportion of children with different characteristics was multiplied by a regression coefficient that was less than one. This had the effect of reducing variation in each component of the index and compressing the variation in index values. The excess-cost-based indices, on the other hand, were constructed by multiplying the number (or proportion) of children with different

TABLE 10

CORRELATION BETWEEN COST-BASED INDICES OF EDUCATION SERVICE REQUIREMENTS AND STUDENT AND FAMILY BACKGROUND CHARACTERISTICS

	Index C1	Index C2	Index CE
Percent Children in Poverty	+.63	+.71	+.86
Percent Children Served as Handicapped	+.04	+.28	-.06
Percent Children from Non-English-Language Backgrounds	+.76	+.53	+.33
Percent Children from Single-Parent Families	+.28	+.22	+.59
Percent Female Adults with Less than a High-School Education	+.37	+.53	+.79

characteristics by a factor greater than one. This had the effect of increasing the variation in each component of the index and thus increasing interstate variation on index values.

Sensitivity Analysis

When alternative base indices were constructed by modifying the weightings of the poverty and NELB factors, there was no effect on state rankings on service requirements. This consistency was due to the fact that the number (and proportion) of poverty children was considerably higher than the number (and proportion) of handicappped and NELB children. Thus, even when the poverty weighting was reduced in the index, the number of poverty children was still so large that the poverty factor continued to dominate the index. An upward adjustment of the handicapped factor from 2.17 to 4.00 did produce a change in the rank order of a few states on one of the two base indices. However, for the vast majority of states, this modification produced virtually no change in state rankings on education service requirements.

Modifications in the expanded indices that involved changes in the weightings for children from single-parent families and females with low educational attainment from a base weighting of 1.54 also produced relatively little change in state index rankings. States in the Southeast and Southwest continued to rank highest in service requirements, states in the Mideast were next-highest, and states in New England and the Great Lakes regions were in the middle of the distribution. States in the Plains and Far West ranked low in their service requirements and Rocky Mountain states consistently had the lowest service requirements indices.

IV. Study Limitations and Recommendations for Improving the Indices

The indices produced in this study are an important step in the development of an assessment of the education service requirements of the 50 states and the District of Columbia. They were derived using the most rigorous empirical methodologies and the best data that are currently available. There are, however, some limitations with these analyses that should be considered before a final assessment of state education service requirements is established. First, the Sustaining Effects Study, which was used to produce the regression-based indices, was not based on a representative sample of the nation's schools, but rather on a sample of Title I schools. Poverty children were therefore overrepresented in the study's sample and children with other characteristics may have been underrepresented. The SES also contained less than optimal measures of handicapping and limited-English-proficiency. A regression-based index of education service requirements could therefore be improved by using a more representative data base. Similarly, the studies used to generate excess-cost-based indices were few in number, and, in the area of language proficiency, were neither representative of the nation as a whole nor representative of the array of programs used to serve LEP children. Again, indices of state service requirements could be improved by using more representative cost studies to generate pupil weightings.

Several limitations in the data used in the analyses also need to be noted at this point. First, the state-level data used to construct the indices (mostly 1980 Census data) are now relatively old and may not adequately reflect the current incidence of children with special service requirements. It would clearly be desirable to have more up-to-date state-level data on all student and family background characteristics

needed for the index. Second, the language-proficiency data in the index are based on children from non-English-language backgrounds, rather than children with limited proficiency in English. The index would much more accurately reflect this special-needs population if LEP data, rather than NELB data, were available for use in the index. Third, the data on children from single-parent families include all children age 0 to 18, rather than school-age children only, since published Census data do not distinguish the preschool population from the school-age population. It may be possible to break out school-age children from the larger group, but this would require special computer runs from the Census. Finally, the data on the educational attainment of females include all females over 25 years of age with less than a high-school education, rather than mothers of school-age children. Again, it might be possible to break out this subpopulation of females from the larger population, but this would require special computer runs by Census. These improvements in the data would, however, appear to be beneficial, as they would produce a more refined assessment of state education service requirements.

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