

CHAPTER 1: INTRODUCTION

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There are two major considerations in financing public education; first, the determination of the total costs to provide a prescribed level of educational services, and second, the apportionment of local and state responsibilities to fund these costs. Once the educational costs have been determined, many of the nation's more than 15,000 school districts are funded through a combination of local revenue and a state basic aid allocation.

The amount of state basic aid that a school district receives is often based in part on a its ability to pay, or its fiscal capacity. Common knowledge suggests that communities vary widely in their ability to support educational services through own-source revenue. Further, education expenditures are already a major part of most state budgets. Thus, the methodology by which public school district fiscal capacity is determined has become critical in determining the most equitable distribution of state funds. Relying on fiscal capacity measurement, equalization programs (often foundation programs) have been used extensively by approximately three-quarters of the fifty state governments to establish a State guarantee for a minimum level of aid, usually on a per pupil basis.

In Virginia, State Basic Aid is the single largest component of the state budget, accounting for approximately 62.7 percent of direct aid to local governments.¹ It is provided under a variety of programs authorized on a biennial basis through the Appropriations Act of the Virginia General Assembly.² Virginia distributes State Basic Aid to its 130 public school divisions largely through a foundation-type equalization plan whose overall structure has been in place since the 1974-76

¹ In the Commonwealth of Virginia, cities are sovereign and fiscally independent of their surrounding counties. Towns are considered within the jurisdiction of the county, but may levy their own taxes to provide services for their residents. The term "school division" is used to denote a political subdivision dependent upon the city, county, or town governing body through which local public education is organized. A Virginia public school *division* is comparable to a public school *district* in many other states, except without the taxing authority as Virginia school divisions are fiscally dependent upon their local governing body. Thus, the fiscal capacity indicators for a public school division are effectively the identical indicators for a "locality" in Virginia. This study is expected to contribute to the understanding of a complex problem for citizens and members of the Virginia General Assembly, hence, the use of terminology unique to the state.

For the 1996-98 Biennium there were 89 county only school divisions, 37 city only school divisions, three school divisions jointly administered between cities and counties (Fairfax City and Fairfax County, Bedford City and Bedford County, Williamsburg City and James City County, and one school division jointly administered between a town and a county (South Boston and Halifax County), and two town school divisions (West Point and Colonial Beach). Approximately 1.1 million pupils were in membership in public school divisions in the Commonwealth of Virginia.

² For the 1996-98 Biennium approximately \$3.25 billion was distributed as State Basic Aid and approximately \$2.80 billion as categorical aid determined by a school division's Local Composite Index.

Biennium.³ This plan utilizes a unique fiscal capacity formula, entitled The Local Composite Index, to distribute State Basic Aid for public schools in the Commonwealth of Virginia. Recently, some members of the legislature prompted by many school boards and their superintendents have expressed concern regarding the apparent volatility of this measure. This study analyzes the methodology by which Virginia's measure of public school division fiscal capacity, the Local Composite Index (LCI), functions as an appropriate measure in the determination of public school division eligibility for State Basic Aid

I. The Local Composite Index: The Virginia Measure of Fiscal Capacity

A distinctive feature, nearly unique among the fifty states, is the method by which Virginia's public school division fiscal capacities are determined. The fiscal capacity formula structure is composed of eighteen ratios. In fact, twelve of these ratios are nested within six compound ratios as noted in Figure 1.0. The numerator of each compound ratio is composed of a *local* value of either a wealth measure or an economic indicator divided by a standardization unit (local average daily membership or local population).⁴ Similarly, the denominator of each compound ratio is composed of an aggregate statewide value of either a wealth measure or an economic indicator divided by a statewide standardization unit (statewide aggregate average daily membership or statewide aggregate population).⁵ When the numerator (Standardized Local Indicator) is evaluated with the denominator (Standardized State Indicator), the resultant unit of analysis is referred to as *the Local to State Ratio* for a specified standardized indicator.

³ Prior to the implementation of its present Foundation Program, Virginia used a foundation-type program, but it was substantially different in structure.

⁴ This local ratio will be referred to as the Standardized Local Indicator.

⁵ This state ratio will be referred to as the Standardized State Indicator.

$$\begin{array}{l}
 \begin{array}{l}
 \mathbf{0.5} \\
 \frac{\text{Local True Value of Real Property}}{\text{Local Average Daily Membership}} \\
 \frac{\text{Total Local True Values of Real Property Statewide}}{\text{Total Average Daily Membership Statewide}}
 \end{array}
 + \mathbf{0.4} \\
 \begin{array}{l}
 \frac{\text{Local Virginia Adjusted Gross Income}}{\text{Local Average Daily Membership}} \\
 \frac{\text{Total Virginia Adjusted Gross Income Statewide}}{\text{Total Average Daily Membership Statewide}}
 \end{array}
 + \mathbf{0.1} \\
 \begin{array}{l}
 \frac{\text{Local Total Taxable Retail Sales}}{\text{Local Average Daily Membership}} \\
 \frac{\text{Total Taxable Retail Sales Receipts Statewide}}{\text{Total Average Daily Membership Statewide}}
 \end{array}
 = \text{Average Daily Membership Composite Index}
 \end{array}$$

$$\begin{array}{l}
 \mathbf{0.5} \\
 \frac{\text{Local True Value of Real Property}}{\text{Local Population}} \\
 \frac{\text{Total Local True Values of Real Property Statewide}}{\text{Total Statewide Population}}
 \end{array}
 + \mathbf{0.4} \\
 \begin{array}{l}
 \frac{\text{Local Virginia Adjusted Gross Income}}{\text{Local Population}} \\
 \frac{\text{Total Virginia Adjusted Gross Income Statewide}}{\text{Total Statewide Population}}
 \end{array}
 + \mathbf{0.1} \\
 \begin{array}{l}
 \frac{\text{Local Total Taxable Retail Sales}}{\text{Local Population}} \\
 \frac{\text{Total Taxable Retail Sales Receipts Statewide}}{\text{Total Statewide Population}}
 \end{array}
 = \text{Population Composite Index}$$

$$\mathbf{0.45} \left[\mathbf{0.6667} \times \text{Average Daily Membership Composite Index} \right] + \mathbf{0.3333} \times \text{Population Composite Index} = \text{Local Composite Index}$$

Figure 1.0. The calculation of the Local Composite Index.

Source: Virginia Department of Education, *Facing Up*, 1995.

Note: The actual LCI calculation utilizes a 0.45 as the Composite Multiplier for the 1996-98 Biennium as directed by the Virginia General Assembly in its Appropriations Act. However, because the multiplier has varied across different biennia, comparisons across biennia are made excessively complex, if not impossible. Therefore, all LCI values used in this study are standardized by applying 0.50 as the Standardized Composite Multiplier (a multiplier that was applied from 1973-74 through 1984-85 Biennia).

Six Local to State Ratios are employed in Virginia's fiscal capacity formula. Each set of three Local to State Ratios specifies an index, either the Average Daily Membership index or the Population index. These indices are weighted, summed, and multiplied to form a *composite* index number for each public school division. When ranked, these index numbers comprise a relative ranking of school divisions entitled the Local Composite Index (LCI).⁶ The 1996-98 Biennium LCI is shown in Table 1.0

⁶ Refer to Chapter 2 for a description of the LCI computation in greater detail.

TABLE 1.0. The Local Composite Index, Biennium 1996-98

School Division		School Division		School Division	
Alexandria	0.8000	Powhatan	0.3937	Danville City	0.3129
Arlington	0.8000	Frederick	0.3924	Southampton	0.3108
Bath	0.8000	Staunton	0.3859	Prince Edward	0.3096
Fairfax City	0.8000	Galax City	0.3854	Greene	0.3075
Falls Church	0.8000	York	0.3852	Craig	0.3064
Surry	0.8000	Lynchburg	0.3844	Halifax	0.3060
Williamsburg	0.8000	Spotsylvania	0.3837	South Boston	0.3060
Rappahannock	0.7420	Botetourt	0.3831	Wythe	0.3046
Loudoun	0.7322	Isle of Wight	0.3818	Henry	0.3039
Fairfax	0.7235	Richmond	0.3798	Amherst	0.3029
Goochland	0.7083	Madison	0.3775	Norfolk	0.3018
Louisa	0.6784	Fluvanna	0.3765	Pulaski	0.3012
Fredericksburg	0.6568	Shenandoah	0.3755	Giles	0.3002
Lancaster	0.6467	Kong George	0.3753	Northampton	0.2979
Fauquier	0.6189	Covington	0.3733	Patrick	0.2960
Albemarle	0.6080	Franklin	0.3717	Campbell	0.2952
Northumberland	0.6014	Martinsville	0.3716	Hampton	0.2947
Winchester	0.5940	Rockbridge	0.3713	Newport News	0.2941
James City	0.5993	Charles City	0.3666	Franklin City	0.2924
Middlesex	0.5684	Bedford City	0.3664	Dinwiddie	0.2923
Harrisonburg	0.5483	Stafford	0.3663	Alleghany	0.2854
Charlottesville	0.5447	Montgomery	0.3625	Buckingham	0.2839
Clarke	0.5366	Augusta	0.3550	Appomattox	0.2729
Henrico	0.5249	Sussex	0.3527	Carroll	0.2727
Highland	0.5009	Chesapeake	0.3522	Hopewell	0.2695
Manassas	0.4968	King William	0.3513	Brunswick	0.2674
Mathews	0.4883	King and Queen	0.3497	Pittsylvania	0.2630
Nelson	0.4878	Rockingham	0.3480	Prince George	0.2612
Colonial Heights	0.4730	West Point	0.3472	Charlotte	0.2542
Hanover	0.4680	Norton	0.3433	Clifton Forge	0.2543
Richmond City	0.4507	Virginia Beach	0.3425	Smyth	0.2534
STATE	0.4500	Amelia	0.3394	Tazewell	0.2480
Bristol City	0.4449	Radford	0.3376	Grayson	0.2475
Salem	0.4356	Poquoson	0.3343	Nottoway	0.2466
Essex	0.4338	Manassas Park	0.3335	Russell	0.2444
Prince William	0.4315	Caroline	0.3335	Petersburg	0.2437
New Kent	0.4224	Accomack	0.3275	Buena Vista	0.2418
Orange	0.4223	Emporia	0.3231	Portsmouth	0.2396
Lexington	0.4204	Suffolk	0.3228	Buchanan	0.2377
Roanoke	0.4176	Colonial Beach	0.3192	Bland	0.2358
Warren	0.4066	Cumberland	0.3187	Greensville	0.2277
Roanoke City	0.4046	Floyd	0.3174	Lunenburg	0.2238
Westmoreland	0.4014	Gloucester	0.3173	Dickenson	0.2236
Chesterfield	0.3976	Page	0.3166	Scott	0.2211
Waynesboro	0.3979	Washington	0.3132	Wise	0.2155
Culpeper	0.3969	Mecklenburg	0.3131	Lee	0.1730

Source: Virginia Department of Education, 1997.

The LCI as a Relative Measure.

The LCI is a *relative* or normative measure of local fiscal capacity. A normative measure utilizes all the values in a given sample for a specified period as a basis for its own comparison. Normative measures provide information regarding an individual value relative to its peer statistics. Consequently, each school division LCI value⁷ does not relate directly to a fixed (constant) dollar amount of fiscal capacity per pupil, but simply connotes a relative rank among the "normed" LCI values of all school divisions based upon their respective proportion of the State Mean.⁸

The relative nature of the LCI is accomplished computationally through its rationalized formula structure. The denominator or the statewide component for each of its six Local to State Ratios serves as the base by which its numerator or local standardized indicator is evaluated.⁹ A school division exhibiting a fiscal capacity equivalent to the mean statewide fiscal capacity would theoretically have an LCI value indicative of a one to one correspondence between each of the local and state standardized indicators, or 0.4500 in the 1996-98 Biennium.

As stated earlier Local Composite Index values indicate the individual school division relative fiscal capacity among all Virginia public school divisions and are specific to a biennium or funding period. Higher LCI values are indicative of a greater relative fiscal capacity, whereas lower values signify a relatively more modest ability to pay for education. Typically, LCI values range from 0.1730 to over 1.5000. One way to imagine how a school division LCI value would determine its share of Basic Aid costs (based on its LCI value) is to consider the LCI as the local percentage of each dollar designated. Thus, a school division with an LCI value of 0.3577 would pay approximately 35.77% share of its designated Basic Aid costs.

In strict accordance with the Local Composite Index formula, the time at which a school division achieved a calculated LCI of 1.000 or greater, it would be theoretically responsible for a 100.00% share of its Basic Aid costs. Thus, these school divisions would not be eligible for State Basic Aid. However, the Virginia General Assembly *Appropriations Act* further requires that LCI values greater than 0.8000 be capped or "truncated" at that figure. Thus, this provision guaranteed that all

⁷ The term "Local Composite Index (Indices)" will be used henceforth to refer to the entire ranked index comprised of all public school divisions in the Commonwealth of Virginia. The term "Local Composite Index value(s)" will be used henceforth to designate the index numbers of individual public school divisions in Virginia.

⁸ Note that term "State Mean" refers to the denominator of the Local to State Ratio in which the aggregate statewide value of an indicator divided by the aggregate statewide standardization unit is statistically the mean value of the indicator (per pupil).

school divisions, regardless of their calculated fiscal capacity, an amount of State Basic Aid equivalent to approximately twenty percent of their designated Basic Aid costs.¹⁰

Limitations to the LCI as a Relative Measure.

The major limitations to the LCI as a relative or normative measure include its incomparability across funding periods (in practice), use of the "mean" parameter, and its undifferentiated treatment of variations in local change across the Commonwealth. Both limitations pose problems in the interpretation of Virginia school division fiscal capacity.

Incomparability Across Funding Periods. Unlike most indices in which values from different periods are related to each other through a fixed base (denominator) or criterion value, the Virginia LCIs for different biennia are not reasonably comparable with prior biennia. In essence, the LCIs for each biennium are calculated entirely independent of prior biennium calculations. Thus, they are "untethered" to any historical LCI bases. For example, the LCI value of 0.4267₁₉₉₀₋₉₂ is not directly equivalent to a precise dollar amount per pupil fiscal capacity. Further, it is not equivalent to the LCI value of 0.4267₁₉₈₈₋₉₀, for the biennium immediately preceding it. It is an abstracted and relative ranking that appears to have no precise and constant equivalence to traditional benchmark(s) of fiscal capacity. This incomparability results from the recalculation of the State portion (denominator) of the Local to State Ratio bases anew with each biennium or funding period. (Recall that with respect to ratios, when the base or denominator value changes, a ratio with a constant numerator would be evaluated to a different value.)

A problem that the LCI incomparability across funding periods engenders is the unpredictability and apparent deficit of stability that complicates the budget process in the local school divisions, since State Basic Aid is determined by this measure. Since there is no more important criterion for effective budgeting and program planning than a stable funding source, this limitation is critical to the financial health of public school divisions in Virginia.

Use of the Mean Parameter. The State portion or base of the Local to State Ratio is calculated by dividing the aggregate statewide indicator by its appropriate aggregate statewide standardization unit, as mentioned earlier. This calculation effectively results in the *mean* value of the State Standardized Indicator. It is known that the mean as a measure of central tendency is influenced significantly by

⁹ Refer to Appendix C for Volatility Types of the Local to State Ratio and its Standardized Indicators.

¹⁰ Twenty percent is commonly used by those persons discussing the 0.8000 truncation. However, due to the interactive effect created by the mathematical consideration of the 1% State Retail Sales and Use Tax dedicated to education, the twenty percent guarantee is actually somewhat less. For the purpose of this study, the 0.8000 (eighty percent) truncation will be discussed as a minimum guarantee of twenty percent of State

extreme values. Since indicators and standardization units for some of the school divisions may be considered extreme, when compared with each other, it appears that the use of this algorithm allows outlying school divisions to influence the value of the denominator or base.

Undifferentiated Effects of State Base Recalculation. Another serious consequence of the recalculated base among the Local to State Ratios is that the variability over time for a school division LCI value may not be exclusively the result of local or indigenous change; either growth or decline. Rather, some proportion of the variation in a school division's LCI value may be due to the State Standardized Indicator¹¹ base recalculation, which shifts the denominator or base to another value. For example, consider the consecutive LCI values of 0.6656, 0.6756, and 0.6543 and their respective biennial differences of +0.0100 (i.e., $0.6656 - 0.6756 = +0.0100$) and -0.0213 (i.e., $0.6756 - 0.6543 = -0.0213$). These LCI value differences reflect *both* (1) local changes (numerator) and (2) shifts in the state (mean) base (denominator). In other words, variability of the LCI may be due to mathematical characteristics of the LCI formula itself.

One might assume that if the formula produces some undesirable effect, that the formula could be adjusted to correct such an artifact of the calculation. However, there appears to be no compensation for nonindigenous variability in a school division's LCI value. Such variation in the LCI not solely attributable to local changes in fiscal capacity has been termed "volatile" for the conduct of this study. Further, some definitive trends in the LCI Biennial Change Rates among the public school divisions in the Commonwealth can be explained by examining the volatility that is attributable to the shifts in the state base.

Basic Aid for those school divisions with extraordinary fiscal capacity as pursuant to their respective LCI values.

¹¹ Refer to the Appendix A: Glossary for clarification of the "State Standardized Indicator" terminology.

II. Volatility in the Local Composite Index

Volatility is the characteristic of being changeable or unanticipated over time. The term is frequently applied to indices. Volatility of an index can occur due to either external factors or internal factors. External volatility, which is characterized by variability in the inputs to an index, undoubtedly, receives the most visibility. In financial analyses external volatility applies to the individual prices of many stocks, that when summed, would form higher or lower aggregate values. This volatility originates *outside* the index. Conversely, internal volatility is dependent upon the structure of the index formula. Once the input information has been entered into the computation, the change in the output due to the mathematical properties, idiosyncratic and inherent to the formula algorithm, results in internal volatility. Thus, internal volatility originates and results from interactions among inputs *within* the computational process.

The LCI typifies both volatility types. Its external volatility is created by the variation of the input magnitude. These inputs include the following indicators: (1) True Real and Public Service Corporation Property Values, (2) Adjusted Gross Income Values, and (3) Taxable Retail Sales Receipts Values for each public school division. Other inputs that contribute to external volatility by acting as indicator divisors include the standardization units, Average Daily Membership and Population. External volatility appears to be becoming more important to the behavior of the LCI as structural changes emerge in Virginia's economy.¹² Although variation in external inputs certainly can influence the internal volatility of a formula, an index should be designed to minimize this interaction. Future studies addressing the addition or substitution of other indicators in the LCI calculation that may increase validity and lessen volatility may be warranted.

Analysis of the Internal Volatility.

Internal volatility is affected directly by the structural characteristics and algorithms internal to the LCI formula. In the LCI, two characteristics that apparently affect internal volatility include the variability in its Composite Multiplier and its rationalized formula design.

Variability in the Composite Multiplier. The Composite Multiplier in the LCI calculation determines the equivalent index position for the relative state mean fiscal capacity. In other words, a Standardized Composite Multiplier of 0.45 would fix the State Mean LCI value, irrespective of its dollar value per pupil, at 0.4500. The General Assembly has periodically adjusted the Composite Multiplier from 0.49

¹² Stability is being lost by declining dependence upon the military-related industries, the shift from a manufacturing economy to a service-driven economy, a shift away from the ad-valorem tax on vehicles, etc.

to the 0.45 currently employed. This action rendered the LCI incomparable between biennia. Therefore, this adjustment in the Composite Multiplier has enhanced the LCI internal volatility. Since this type of internal volatility was not the primary focus of this study, internal volatility attributable to the variation in the Composite Multiplier was controlled for by standardizing all LCI calculations employing a 0.5 *Standardized* Composite Multiplier value. As stated numerous times throughout this study, the use of the Standardized Composite Multiplier produces LCI values that are not exactly the same as those calculated utilizing the different multipliers.

The Rationalized LCI Formula Structure. The LCI ratio structure contributes to internal volatility through the interaction between the numerator and the denominator at two levels: (1) the Local to State Ratio and (2) the Standardized Indicator (Local and State). The internal volatility of the LCI can be illustrated through an analysis of the Biennial Change Rates¹³ of these components. While ratios can be evaluated as a whole unit, the individual changes in their numerator and denominator may produce differential contributions to this evaluation. Ratios increase, when their numerators become proportionately larger *relative* to their denominators. That is, the *rate of change* in the numerator from an initial value to a subsequent value is larger than the *rate of change* in the denominator from its initial value to a subsequent value. Conversely, ratios decrease, when the numerator *rate of change* is proportionately smaller relative to the denominator *rate of change*. To illustrate this point an example effects of ratio component changes follows.

In Figure 1.1, an illustration depicting the change rate in a ratio from an initial value (0.5000) to a subsequent value (0.5385) is shown. Individually, the numerator experienced a change rate of 40.00%, and the denominator grew 50.00%. The subsequent ratio (7/15 or 0.5385) was greater than the initial value (5/10 or 0.5000). Thus, the change rate (for the entire ratio) was positive (7.69% or $0.5385 - 0.5000 = +0.0385$). However, this method of analysis applied to changes in ratio change rates may be limited, because the individual contributions of the numerator and denominator to the ratio change rate of 7.69% have not been determined.

¹³ The term "Biennial Change Rate" is introduced at this point for reference purposes. It will be discussed throughout this study. Its definition: the rate of change from an initial biennium to the succeeding (or final) biennium from the perspective of the initial biennium.

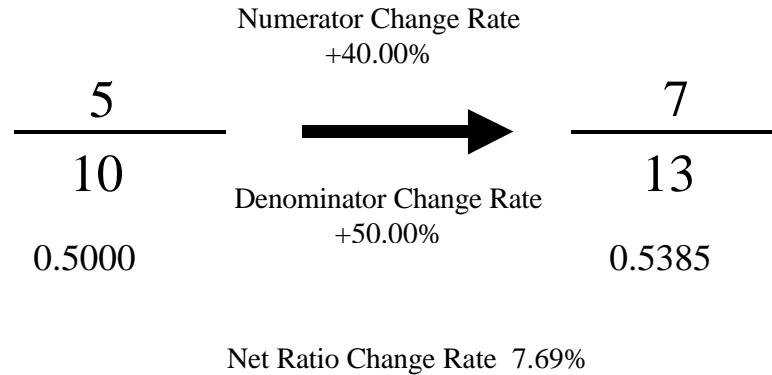


Figure 1.1: Standard Component Evaluation of Ratios.

We can consider an alternate way to assess the contribution of the numerator and the denominator to the change between the ratios as follows: First, the effect on the entire ratio attributable solely to individual rate of change in the numerator can be calculated by isolating it from the changes attributable to the denominator. This can be accomplished by holding the denominator constant and evaluating the differences between the initial ratio and the final ratio. This concept is illustrated by Figure 1.2 in which the denominator is held constant (at 10) from the initial ratio to the final ratio.

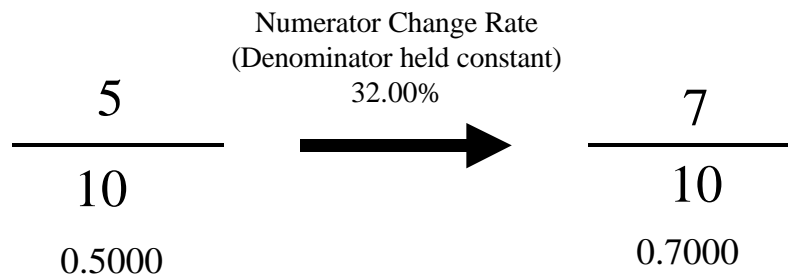


Figure 1.2: Evaluation of the Numerator Change Rate.

The percentage change in the numerator (from five to seven) is calculated to be 32.00%, attributable to the *numerator* alone, and is entitled the Numerator Change Rate. This percentage (32.00%) can be subtracted from the Net Ratio Change Rate (7.69%) as calculated in Figure 1.1 shown above, to obtain a difference (-24.31%). This difference, although negative, can be attributed to

the denominator change rate, whose increase serves to counteract the increase of the numerator for the entire ratio.

Another way to conceptualize negative (or opposite from the numerator) denominator change rates may be that as the denominator increases, the value of its ratio grows smaller (numerator held constant). Thus, the change in the denominator (from 10 to 13 as shown in Figure 1.0) can be interpreted as "dampening" the change in the numerator. This dampening is indicated by the use of a sign opposite the positive sign of the numerator. In summary, the Ratio Net Biennial Change Rate (7.69%) can be apportioned into two parts: (1) the Numerator Change Rate (32.00%) and (2) the Denominator Change Rate (-24.51%).

Graphical Analysis of the Net Biennial Change Rate.

Figure 1.3 illustrates graphically how the numerator and denominator change rates can be proportioned to equal a Net Ratio Change Rate. An explanatory statement for the figure reads as follows: The ratio increased from 0.5000 to 0.5385 for a Net Change Rate of 7.69%. The Net Change Rate can be apportioned into the following factors: (1) 32.00% due to a gain in the Numerator, and (2) -24.31% due to a gain in the Denominator. The Change Rate exhibited by the Denominator had the effect of dampening (although incompletely) the magnitude of the Net Change Rate to a value (0.5385) than would have been achieved by the Numerator change alone (0.7000).

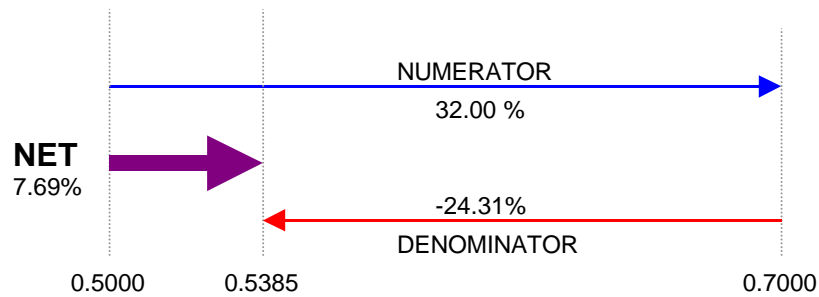


Figure 1.3: Ratio Net Change Rate and the Proportions Attributable to its Numerator and Denominator.

This method of analysis for ratio components can be applied to discern the proportional influence of its structural components on the change in LCI values. As mentioned earlier, internal volatility can be attributed the change in the base or denominator of the Local to State Ratio. Thus, the

effect of the State or denominator component in the Ratio can be analyzed over time and among school divisions of diverse fiscal capacity.

Analysis of Internal Volatility Specific to this Study.

For the conduct of this study the Local to State Ratio in the LCI is the primary unit of analysis. The Local to State Ratio contribution to the LCI internal volatility can be measured using the Net Biennial Change Rates of the Local (numerator) and State (denominator) components.¹⁴ Each Local to State Ratio can be analyzed in two contexts: (1) independently and (2) in its composite interactions with the other Local to State Ratios in its respective LCI calculation.

As shown in Figure 1.4, the Local (numerator) and State (denominator) proportions of the Local to State Ratio Net Biennial Change Rate can be assumed to be summative components:

$$\begin{array}{ccccc} \text{Local} & & \text{State} & & \text{Local to State} \\ \text{Net Biennial} & + & \text{Net Biennial} & = & \text{Ratio} \\ \text{Change Rate} & & \text{Change Rate} & & \text{Net Biennial} \\ & & & & \text{Change Rate} \end{array}$$

Figure 1.4: Summative Components of Local to State Ratio.

If the State (Denominator) value is increasing in value, it can be assumed to be acting in opposition or a "dampening" mode, thus it can be assigned a negative sign. If the State (Denominator) value is decreasing in value, it can be assumed to be acting in an "enhancing" mode, thus, it can be assigned a positive sign.

The internal volatility in the Local Composite Index is designated as the proportion of the Net Biennial Change Rate in the LCI that is not due entirely to local indicators.¹⁵ The measurement of local indicators is assumed the purpose of fiscal capacity measurement. State Indicators are the aggregate or sum of all the Local Indicators statewide.

Although many forecasts may be attempted, the State Indicators cannot be definitively known, until all the Local Indicators are accounted for. Thus, the prospect to anticipate and plan for LCI change beyond the local effects is limited. It is proposed that the State factors contribute significantly to the volatility of the LCI; thus, they are the primary focus of this study.

¹⁴ Refer to Chapter 3 for further discussion.

¹⁵ These local factors include increases or decreases in local average daily membership or population, as appropriate, and changes in the three indicators, true real and public service corporation property, adjusted gross income, and taxable retail sales receipts.

III. The Unanticipated Consequence

The LCI appeared to perform satisfactorily in establishing the fiscal capacities of Virginia's local public school divisions for almost three decades. Yet, upon closer examination there seemed to be distinct, and sometimes, opposing trends over its tenure. These trends seem to suggest a loose linkage between the current LCI value for a school division and the type of change (increase, decrease) in that LCI for the subsequent biennium. As a basis for this study three trends for changes in the LCI have been identified; Balanced Change, Divergent Change, and Convergent Change.

Two characteristics have been identified to discern these trends: (1) the Pearson's r correlation coefficient to determine the strength of the relationship between the two variables (LCI value, type of change), and (2) the slope of the best-fit regression line to elucidate the direction and type of the relationship. The relationship of these characteristics to the trends is described below.

Trend One: Balanced Change.

Balanced Change in the LCI occurs, when there is an approximately equal number of low and higher fiscal capacity school divisions exhibiting positive and negative LCI Biennial Change Rates. In the early 1980s, the Biennial Change Rate varied without an apparent pattern. That is, significant relationships could not be discerned between an LCI value and the magnitude or direction of its rate of change, when contrasted to a prior biennium.

The correlation between 1984-86 Biennium School Division LCI and its 1984-86 through 1986-88 Biennial Change Rate is shown in Figure 1.5. The small correlation coefficient ($r = 0.072$) indicates the absence of a definitive relationship, and the "balanced" dispersion of points allowed almost no slope ($m = 0.379$) for the line of "best-fit." Essentially, this dispersion indicates that low and high LCI values bore no strong relationship with the direction of their LCI Biennial Change Rate for the succeeding biennium. There was no distinct relationship between the magnitude of a school division's LCI value and the direction of its future change. Displayed in Figure 1.6 the percentage of low fiscal capacity school divisions exhibiting increases in their LCI appears to be approximately fifty percent as indicated for the 1984-86 through 1986-88 Biennia.¹⁶

¹⁶ Note that the data used to calculate the LCI values for the 1984-86 Biennium were from the Base Year 1982 for Average Daily Membership (ADM) and 1981 for all other data. The data used to calculate LCI values for the 1986-88 Biennium were from the Base Year 1984 for Average Daily Membership (ADM) and 1983 for all other data.

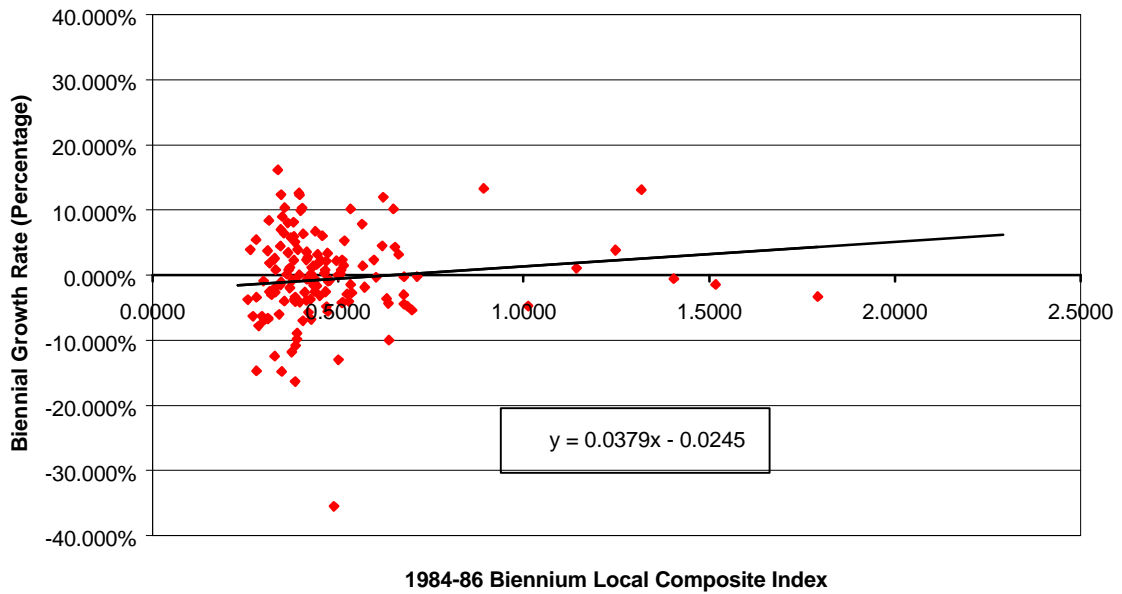


Figure 1.5: Correlation of 1984-86 Biennium Local Composite Index with Biennial Growth Rate Percentage, 1984-86 through 1986-88 Biennia

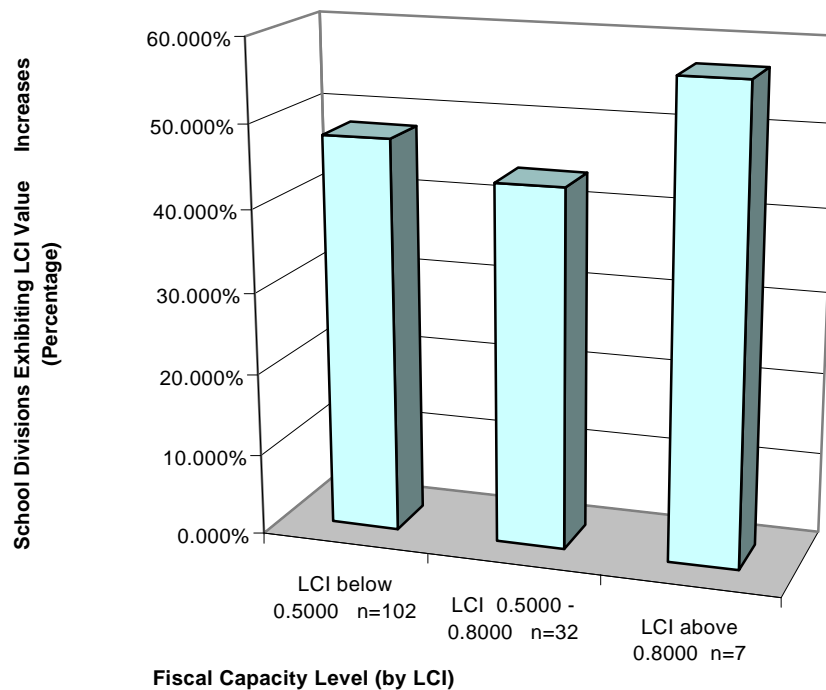


Figure 1.6: Virginia Public School Divisions Exhibiting an Increase in Local Composite Index Value by Fiscal Capacity Level, Biennia 1984-86 to 1986-88

Trend Two: Divergent Change.

Immediately prior to the close of the 1980s, a second trend emerged regarding the direction of change among LCI values with respect to the fiscal capacities of the school divisions. Apparent with the onset of the 1990-92 Biennium (Base Years 1985-87), a few as ten percent of the lower fiscal capacity school divisions exhibited increases in their LCI values.¹⁷ Moreover, LCI values tended to *increase* for a larger proportion of localities exhibiting the highest fiscal capacities of Virginia's public school divisions as shown in Figure 1.7. This trend indicated an upward LCI change for school divisions with existent high LCI values and a downward change for school divisions having low LCI values. A correlation between the 1988-90 Biennium LCI values with the respective LCI Biennial Change Rate (shown in Figure 1.8) illustrated the 0.3167 Pearson coefficient indicative of a stronger relationship (compared to earlier biennia) between the two variables. The greater positive slope ($m = 0.1566$) indicated a striking change in the regression line of best-fit from that of the first trend.

This pattern of LCI change supported the much discussed observation of increasing polarization between prosperous communities, which exhibited high rates of economic change, and poorer jurisdictions, who seemed trapped in a downward economic spiral that was noted among many researchers.¹⁸ Operationally, these decreases for the lower fiscal capacity school division LCI values relieved these divisions of paying a larger share¹⁹ of their State Basic Aid. Since fiscal capacity formulae were designed to uniformly distribute State Basic Aid funds in an inverse proportion to a locality's wealth and/or fiscal capacity, this emergent trend of the LCI seemed to remain philosophically consistent.

It is important to recognize the relative or normative nature of the LCI, and it is evident that economic changes (affecting the indicators of property base, adjusted gross income, and taxable retail sales) external to the LCI formula were largely responsible for the increases in many of the LCIs of the higher fiscal capacity localities. However, the reason behind the "loss" that the lower fiscal capacity jurisdictions were exhibiting was less discernable and was often division-specific. The question was

¹⁷ Note that the percentage of low fiscal capacity school divisions exhibiting increases in their LCI declined steadily from 48% (Biennia 1984-86 to 1986-88) to 10% (Biennia 1988-90 to 1990-92). Thus, by the latter biennium almost 90% of the low fiscal capacity school divisions, as identified so by the LCI, were experiencing a decrease in their LCI values.

¹⁸ Numerous authors have analyzed the change trends evident in the 1980s: Steven D. Gold, *The Fiscal Crisis of the States: Lessons for the Future* (Denver, CO: National Conference of State Legislatures, 1995.) and Kevin Phillips, *The Politics of the Rich and Poor* (New York: Random House, 1991).

¹⁹ See "State Basic Aid" in Appendix A: Glossary for an explanation of a school division's "share."

'how could one discern the amount of the change in the division LCIs that was due to the mathematical structure of the formula?'

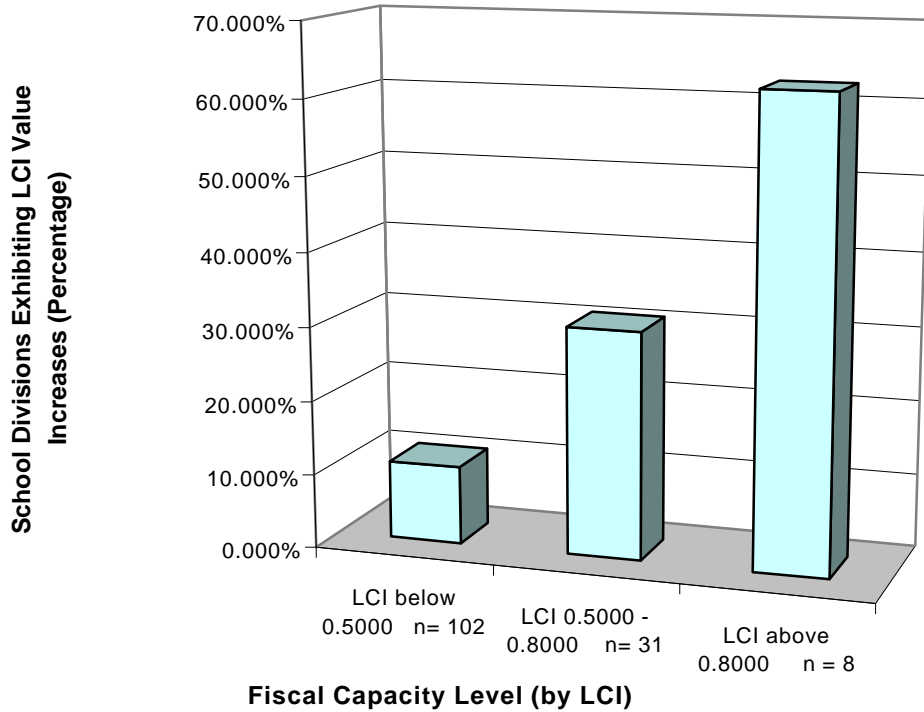


Figure 1.7: Virginia Public School Divisions Exhibiting an Increase in Local Composite Index Values Fiscal Capacity Level, Biennia 1988-90 to 1990-92

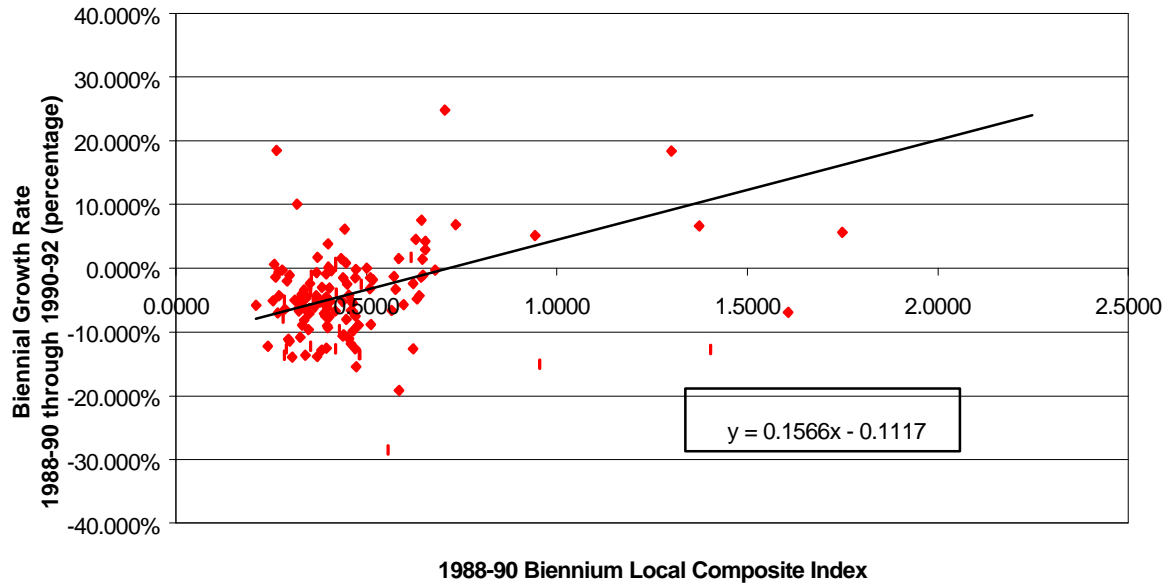


Figure 1.8: Correlation of the Local Composite Index with the Biennial Growth Rate, Biennia 1988-90 through 1990-92

Trend Three: Convergent Change.

Recently, however, for the 1992-94 and 1996-98 Biennia the Local Composite Index exhibited yet another, unexpected and perplexing trend that contributed to concern among education policymakers. In reversal of previous behavior (for approximately 87% of school divisions traditionally viewed as low fiscal capacity entities whom had declining LCIs over the previous biennia), the Local Composite Indices increased sharply as shown in Figure 1.9. Operationally, these increases in LCI values translated into higher percentages of State Basic Aid contributions required by these school divisions. Furthermore, because the vast majority of categorical funds also were allocated through the LCI mechanism, these increased LCIs had a profound effect throughout the entire allocation of state revenue to individual school divisions.

Simultaneously, and curiously so, Biennium 1996-98 LCI values for some localities decreased. It was quite apparent that most such public school divisions were geographically located in northern Virginia, a region of the state known for its prosperity and rapid pace of economic development. However, other public school divisions exhibiting decreased LCI values appeared to have few characteristics in common with their colleagues in northern Virginia. Accordingly, school divisions having the lowered LCIs individually garnered a greater percentage (as compared with the previous biennium) of State Basic Aid funding. This situation was perplexing, particularly as some of these localities continued to be among the state's wealthiest jurisdictions despite their apparent "loss" in relative fiscal capacity as depicted by the LCI.²⁰

This third trend indicating a reversal to the previous change trends exhibited by the correlation of the 1994-96 Biennium LCI with its subsequent Biennial Change Rate is shown in Figure 1.10. The negative correlation coefficient ($r = -0.2938$) can be interpreted to be an inverse relationship of approximately the same strength as earlier for Trend Two between the LCI and the Biennial Change Rate.

²⁰ Figure 1.9 shows that the percentage of high fiscal capacity school divisions exhibiting increases in their LCI values decreased from 62% for the 1990-92 Biennium to 40% for the 1992-94 Biennium. Thus, it can be inferred that 60% of these school divisions exhibited decreases in their LCI values for the 1992-94 Biennium.

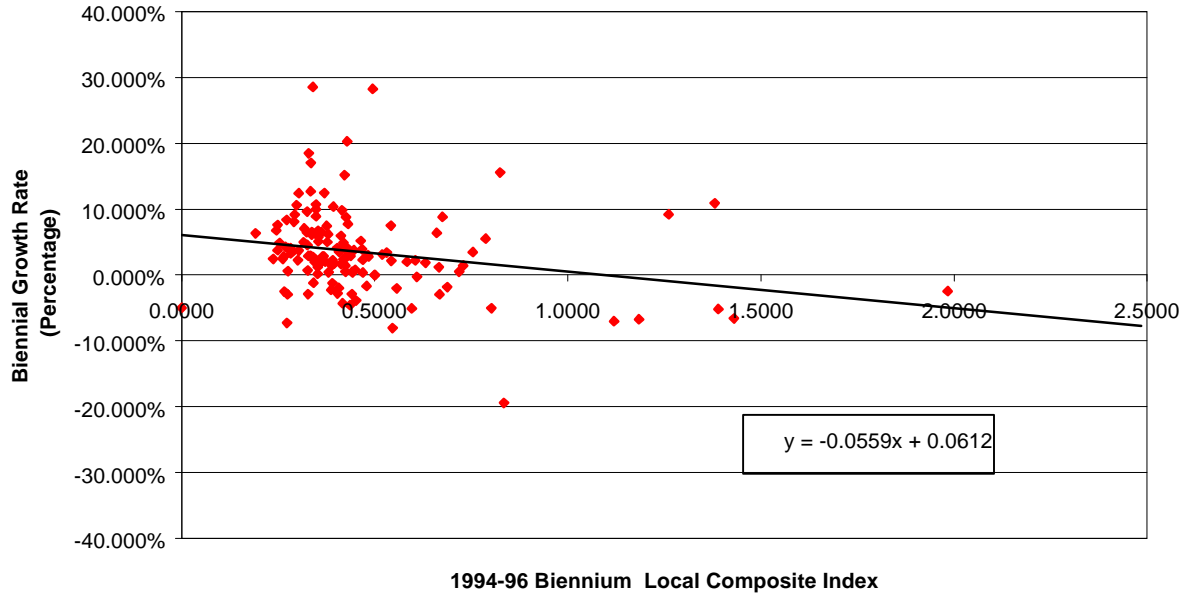


Figure 1.9: Correlation of the Local Composite Index with the Biennial Growth Rate, 1994-96 through 1996-98 Biennium

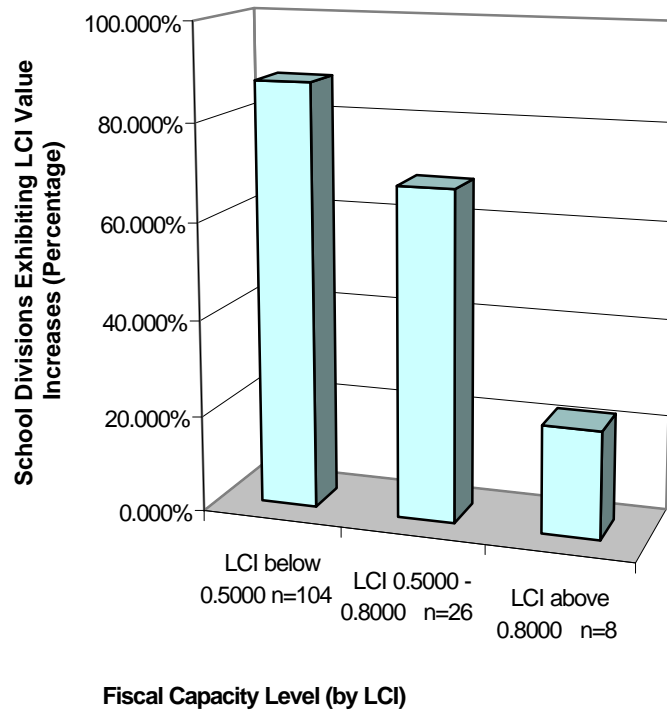
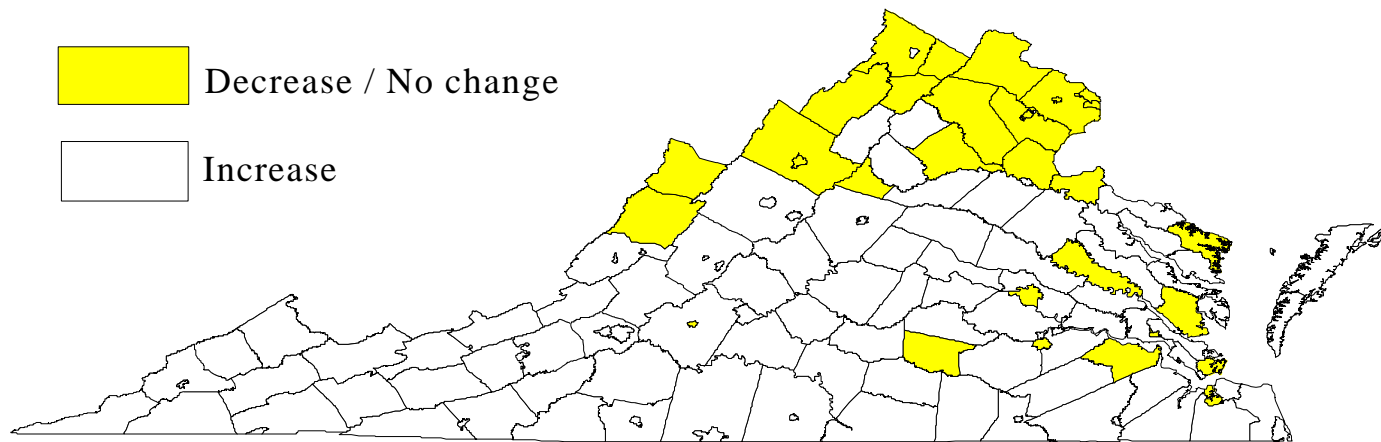


Figure 1.10: Virginia Public School Divisions Exhibiting an Increase in Local Composite Index Values by Fiscal Capacity Level, Biennia 1994-96 to 1996-98

A geographic representation of the changes in the LCI values as calculated by the Virginia General Assembly for local public school divisions is shown in Map 1.1: Changes in Local Composite Indices for Virginia Public School Divisions, Biennia 1994-96 through 1996-98. In the figure the public school divisions exhibiting a decrease or no change²¹ in their Local Composite Indices are shaded in yellow. The counties of Bath, Clarke, Culpeper, Fairfax, Fauquier, Frederick, Greene, Highland, King George, King William, Loudoun, Northumberland, Nottoway, Prince William, Rockingham, Shenandoah, Stafford, Surry, Warren and the cities of Alexandria, Arlington, Bedford, Fairfax, Falls Church, Hampton, Harrisonburg, Manassas, Petersburg, Portsmouth, Richmond, and Williamsburg experienced, either a decrease, or no change in the value of their Local Composite Indices. Shown unshaded are all other counties, cities, and towns operating school divisions that experienced increases in their individual Local Composite Indices comparable to the previous biennium.

²¹ Local Composite Index biennial changes of zero magnitude apply exclusively to public school divisions whose LCI was truncated at the 0.8000 level. All other school divisions in the Commonwealth exhibited variation in their Local Composite Index value comparable to the preceding biennium. While calculation of the untruncated values may indicate either increases or decreases in the respective LCI value, neither the magnitude nor the direction of these changes is considered in the assignment of an LCI value for a locality exhibiting an LCI over 0.8000.

Map 1.1: Changes in Local Composite Indices for Virginia School Divisions,
Biennia 1994-96 through 1996-98



Source : LCI obtained from the Virginia Department of Education

Note: All Local Composite Indices are standardized using a 0.5 Standardized Composite Multiplier.

Implications of the Third Trend.

Ultimately, if the third trend persisted coupled with the slowdown in state revenue change, there existed a potential to shift millions of dollars in State Basic Aid away from the lowest fiscal capacity localities and toward the highest fiscal capacity localities in the Commonwealth. Apparently, as a compensatory action and an implicit acknowledgement of the aforementioned trend, the Virginia General Assembly moved to fiscally compensate localities equivalent to a small percentage of the increase in their LCI value.²²

In the absence of a definitive explanation for the LCI behavior, the assumption that the LCI Transition Payments constituted an equitable remedy to the volatility inherent in the LCI structure may be shortsighted. The criteria applied to distribute additional funds to divisions pursuant to a percentage of increase in their LCI may have arbitrarily excluded those low fiscal capacity divisions that had *declined* further in capacity to a smaller LCI value. Although these school divisions received proportionally greater amounts of State Basic Aid, the amount of internal volatility present in their decreased LCI values has not been sufficiently or accurately recognized.

Perhaps, the insufficient explanation for LCI internal volatility was complicated by the truncation of the LCI for school divisions over 0.8000. The truncation, which allowed school divisions that had LCI values theoretically exceeding 0.8000, to be "held harmless" at that value and allowed their receipt of twenty percent of their designated Basic Aid costs. The perspective that the state had some, yet variable, degree of responsibility to all school divisions regardless of fiscal capacity, until such divisions had expended a prescribed standard of effort (predetermined to be approximately eighty percent of their designated Basic Aid costs), reverberated in the oft

²² The Transition Payment language placed in the Acts of Assembly: Appropriations Act, for 1998-2000 follows: Direct Aid to Public Education, FY 98-98 \$1,125,420, FY 99-00 \$0..."An additional payment of \$1,125,420 in the first year from the general fund shall be disbursed by the Department of Education to provide a one-time transitional payment to school divisions experiencing a negative state funding impact due to the recalculation of the components of the composite index of local ability to pay for the 1998-2000 biennium. The additional payment shall be made to school local divisions requesting such payment, in an amount equal to five percent of the difference between the funding the division would have received in SB 30, as introduced, in Direct Aid to Public Education payments in the first year under their 1998-2000 composite index and the amount they would have received in SB 30, as introduced, in the first year using the 1996-98 composite index. For purposes of the calculation, state allocations shall include payments from Basic Aid, Salary Supplement, Textbooks, Vocational Education (SOQ), Special Education (SOQ), Gifted, Remedial, Remedial Summer School, Public School Employee Benefits (Retirement, Social Security, Group Life Insurance, Harper Account), Sales Tax, Enrollment Loss, At-Risk, Maintenance Supplement, Primary Class Size, and English as a Second Language....Explanation: (This amendment would provide a one-time transitional payment to school divisions with a higher composite index in 1998-2000, if the composite index from the previous biennium had been used to calculate the state share."

mentioned, yet simplistic, scenario that the higher fiscal capacity school divisions had essentially "topped out" in change, and the lower fiscal capacity school divisions were simply "catching up." What was less evident was that the actual reporting of school division LCIs in the truncated form disguised the influence that extremely wealthy school divisions could wield in the recalculated denominator of the LCI formula. In other words, the range of LCI values appeared to be at least one-half the extent it actually was.

A Query.

Perhaps, due to its unforeseen nature, this third trend was regarded by many as highly substantive, and as requiring urgent attention. The possibility that this phenomenon was simply a periodic economic correction to the past behavior of the LCI did not suffice to completely abate the concern. The consequential allocation of greater State Basic Aid support to some affluent Virginia public school divisions appeared to neutralize the efforts, at least philosophically, that the Commonwealth was expending to decrease fiscal disparity among school divisions across the State. Interestingly, this situation facilitated a renewed interest and discussion pertaining to the measurement of Virginia public school division fiscal capacity. At the very least, it queried how such a well-intentioned prescription, such as the Local Composite Index, could produce such unanticipated consequences. Furthermore, no exempting criteria existed that could preclude the compensation of volatility to be exclusive within the province of the latter trend. How should this compensatory precedent be administered once the low fiscal capacity school divisions decline in LCI values and the high fiscal capacity divisions exhibit LCI value increases as surely is to happen once again?

The public school division budget planning process often begins several months prior to its respective fiscal year. At its onset, much revenue information is tentative. Moreover, it is assumed that an increase or decrease in a school division LCI will bear a consistent relationship to the indigenous changes in its local ability to pay. However, public school divisions do not wipe the budget slate clean with each new biennium. Each succeeding local budget to include the school division budget is built upon the responsibilities and revenue base of the proceeding budget. Expectedly so, there is limited tolerance for large degrees of fiscal capacity measurement volatility not entirely attributable to a locality's own change. **There is no more important criterion to annual budget preparation than stable and adequate revenue sources.**

This study will attempt to document the possible explanations for this apparent volatile behavior of the Local Composite Index and to discuss the structural characteristics inherent to the fiscal capacity formula that contributed to this puzzling volatility. It will also attempt to quantify the amount of volatility in the LCI that is due to its formula structure.

IV. The Study

Statement of the Problem.

Since its implementation in 1973-74 and particularly, since 1984-86 through 1996-98, many Virginia public school divisions experienced apparent volatility in their Local Composite Indices. The Local Composite Index, the Virginia measure of fiscal capacity, has exhibited three trends that seem to bear some relationship to a school division's current LCI, which may be explained by an examination of the LCI internal volatility. Ultimately, if left unexplained and unchanged, the current LCI possesses the potential to erratically shift State Basic Aid among localities throughout the Commonwealth. This problem, although present, was largely ignored over most of the LCI's implementation possibly due to truncation disguising effects, the lack of comparability or standardization among LCIs calculated for different biennia, and both local and state wealth were growing.

The Purpose of the Study.

The purpose of this study was to analyze the methodology by which Virginia's measure of public school division fiscal capacity, the Local Composite Index, provided an appropriate measure of indigenous local public school division fiscal capacity for the period extending from the 1984-86 Biennium through the 1996-98 Biennium. This study sought to identify the possible explanations for what appeared to be volatile behavior for the current fiscal capacity formula (used with Virginia's school funding equalization formula) over the specified period.

Objectives of the Study.

The objectives of this study were to document and analyze the effects of the mathematical and structural components of the current formula for measuring Virginia public school division fiscal capacity, the Local Composite Index, beginning with the 1984-86 Biennium and examining each biennial recalculation of the LCI through the 1996-98 Biennium. A secondary objective was to quantify the proportions attributable to the Local and State Standardized Indicators, the Local to State Ratios, and their weighted, summative effects in the calculation of the LCI. Five Virginia public school divisions were selected in-depth case analyses.

Justification for the Study.

In the decade of the eighties many Virginia public school divisions and their localities experienced both high rates of economic change and fiscal stress. These jurisdictions added population, including school-age students, at a rate that demanded a service infrastructure of schools, social services, and transportation before the local tax revenue could fully fund these change needs. Most school divisions that have experienced high rates of pupil change were fortunate to possess high fiscal capacity. Nevertheless, in order to bridge the gap in many localities, the tax effort for public schools had to increase precipitously. The LCI for these school divisions, also, increased rapidly, thus driving down state Basic Aid support. Consequently, in these school divisions the State share of Basic Aid dropped to lower percentages, until the "hold harmless" provision was activated at the 0.8000 threshold.

On the other hand, for the 1996-98 Biennium a proportion of State Basic Aid to Virginia's public school divisions seemed to be shifted from school divisions, which historically were presumed to possess lower fiscal capacity, and was transferred to those having a reputation for greater fiscal capacity. Some school divisions experienced increases in their Local Composite Indices, although their actual indigenous per pupil fiscal capacity appeared to be unchanged. This state resources reallocation seemed to exacerbate the equity-based goal inherent to the principle of fiscal capacity measurement - to provide increased funding to school divisions in an inverse proportion to their ability to finance a minimum level of educational services.

It is, therefore, prudent to analyze the degree to which these disparate trends are uniquely attributable to internal volatility of the LCI mathematical structure. The results of this analysis should assist in the clarification of a problem, which appears to be increasing the fiscal inequities that exist among the public school divisions throughout the Commonwealth.

The Design of the Study.

The study was implemented in the following five phases:

1. A literature review related to the normative foundations of the public school fiscal capacity concept, the types of formulae utilized among states, and components of index construction and ratio mathematics,
2. A review of the Local Composite Index historically and conceptually,
3. The development of a database to facilitate exploratory trend analyses of index components,
4. An analysis that involved the identification and examination of the Biennial Change Rates of the component indicators, and
5. The development of five school division case studies and the Commonwealth of Virginia to examine the interaction of the mathematical and structural components relating to their Local Composite Index calculation.

The study examined the behavior of the Local Composite Index components for five public school divisions selected to illustrate the experiences of many public school divisions in the Commonwealth. The Biennial Change Rates for the LCI ratios to include: the Standardized Local Indicators, the Standardized State Indicators, and their respective Local to State Ratios.

Limitations of the Study.

1. The study was restricted to public school divisions in the Commonwealth of Virginia. Local Composite Indices applicable to the seven biennia extending from the 1984-86 Biennium through the 1996-98 Biennium were calculated using a 0.50 Standardized Composite Multiplier applied to the final algorithm and untruncated as were its derived Standardized Indicators and Local to State Ratios. **Therefore, the values used in the study will not match the actual LCI values utilized by the localities and the Commonwealth for the specified biennia.** However, the standardization was necessary in order to determine the actual effects exclusive of legislative actions and changes over the duration of the study.

A comprehensive listing of the calculated, truncated LCI, the calculated, untruncated Virginia Department of Education LCI, and the Untruncated, Standardized LCIs is located in Volume II: Technical Appendix, Appendix E. The

application of the standardized and untruncated LCI values is designed to enhance the validity of the study.

2. The study was restricted to cities and counties in Virginia that have Local Composite Indices presently calculated by the Virginia General Assembly. Data for towns with public school divisions was included to enhance consistency for comparison purposes in the study, primarily because some towns were later subsumed under specified city or county public school divisions over the duration of the study period.
3. The study did not consider the inclusion of Federal Impact Aid (P.L. 874) in the calculation of local school division fiscal capacity, where this was applicable.²³
4. The study assumed all localities equivalent in their degree of tax exportation.
5. The study did not address the issue of fiscal effort. While fiscal capacity and fiscal effort are related concepts, especially through the amount of Total Local Revenue actually raised, this study analyzed *fiscal capacity* in isolation from the *fiscal effort* a locality may elect to expend. See Appendix A: Glossary for definitions.
6. The data utilized for the various Biennia in this study have been linked to time dimensions other than the fiscal year, biennium, or biennia to which they have been applied. For example, the LCI calculation applicable to the Biennium 1984-86 relied on true real and public service corporation property valuation, adjusted gross income, taxable retail sales receipts, and resident population for the calendar year January 1, 1981 through December 31, 1981. The Average Daily Membership figure was based upon the March 31, 1983 pupils in membership. This application of data is consistent with its administration by the Virginia State Department of Education and the Virginia Department of Taxation.
7. Inflationary effects on the indicators were assumed consistent across the Commonwealth throughout the study period.

²³ Shepard v. Godwin, 280 F. Supp. 869 (E.D. Va. 1968) in which taxpayers in the city of Norfolk brought suit against the state of Virginia for decreasing their State Basic Aid (as calculated within the Appropriations Act) equal to the amount of federal impact aid received by the school division. The residents of Norfolk advanced that since they received no real property tax revenue from the federal employees that resided on the federal property, that the federal funds were not supplementary funding. The courts ruled the Appropriations Act of 1966 unconstitutional and the school divisions' receipt of federal impact aid should not affect the appropriations of State Basic Aid to localities that receive such aid.

Organization of the Study.

The study was organized into five chapters. The first chapter introduces the three trends observed in the Local Composite Index and their unanticipated effects. The second chapter examines the related literature for the measurement of fiscal capacity. This chapter also summarizes the literature pertinent to the Local Composite Index. The third chapter describes the methodology and calculations utilized by the study. The results and analysis of the LCI components that contribute to internal volatility are discussed in the fourth chapter. The final chapter summarizes the conclusions. Following the final chapter, various Appendices, including a Glossary, are included. A second volume that consists of an in-depth analysis of each public school division case study is included as a Technical Appendix.²⁴

²⁴ The second volume *Technical Appendix* is approximately 400 pages and too voluminous to be included in this document. It may be purchased from the author of this dissertation.