



Measuring Equity: Creating a New Standard for Inputs and Outputs

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What is the appropriate measure of equity in student achievement? An emerging theme in the literature is the convergence of the standards movement and school finance litigation and reform. Ryan (2008) noted that the intersection of standards and testing with school finance litigation has dominated the world of education law and policy. Superfine (2009) argued that the evolution of school finance litigation from equity to adequacy has led to legal consideration and interpretations of laws and evidence regarding standards, testing, and accountability. Despite the hoped for improvements to school finance distribution models that were foreseen in the adoption of standards, little has changed in the way that states distribute revenues to schools (Verstegen, Jordan, and Amador 2009; Verstegen, Knoeppel, and Della Sala 2012).

As the concept of educational adequacy has emerged, it has begun to be examined from multiple perspectives. For example, Alexander (2004) developed a conceptual map for understanding definitions of adequacy. She noted that emerging research has moved away from traditional notions of equity and is now specifically identifying the relationships between resources and the different phases of the schooling process. As such, researchers are assessing both the equity of resource allocation and how it is associated with differences in results. According to Alexander (2004), adequacy represents a change in thinking with regard to the appropriate financing of schools and includes three components: equity in inputs, equity in process, and equity in outputs.

Further, the research has addressed the alignment between resources to education and state and federal mandated measures of student achievement (Adams 2008; Verstegen 2002). This new imperative for education finance has emerged from reports calling for the replacement of antiquated models of education finance with new distribution systems that match resources with student need. These calls for a better of alignment of funding mechanisms with intended outcomes necessitate that researchers examine both the equity of inputs to education and the outputs of education.

The purpose of this article is to introduce a new statistic to capture the ratio of equitable student outcomes given

equitable inputs. Given the fact that finance structures should be aligned to outcome standards according to judicial interpretation, a ratio of outputs to inputs, or “equity ratio,” is introduced to discern if conclusions can be drawn with regard to the equity of both the financial resources and educational opportunity. In developing this ratio, the authors were interested in knowing if educational outcomes were equitable given equitable inputs. Previous analyses of the equity of finance systems made use of measures of dispersion; yet a more complete understanding of the equity of the system must also include measures of distribution. As such, part of the discussion of the equity ratio will include both an analysis of both the dispersion and the distribution of the results.

Defining Equity and Adequacy

Multiple terms have been used in the field of education finance to define the term equity. Each connotes a different meaning or policy goal, and each reflects the fact that the notion of equity has evolved. Brimley, Verstegen, and Garfield (2012, 50) noted, “The challenge of distributing and expending available revenues with equity and fairness to schools and to students, regardless of wealth of their parents or the location within a state, is as equally difficult and important as financing education adequately.” Equity often connotes fairness. This may be seen as either equal dollars (horizontal equity) or differential spending (vertical equity).

The issue of equity has been the focus of litigation in 44 of the 50 states and has included an analysis of both the total revenues and services provided for children (Brimley et al. 2012). It is through these class action suits that both the judiciary and scholars have distilled the definition of the term. According to Brimley et al. (2012) and Ladd (2008), scholars seem to have settled on the notion that equity can be thought of in terms of inputs and outputs. When measuring equity by the more traditional focus on inputs, an equitable finance system would be measured by what Berne and Stiefel (1984) identified as horizontal equity. Under such a system, all students would have access to a similar amount or “package” of resources (Ladd 2008). Studies that attempt to discern horizontal equity compare expenditures per child. While many such studies have been conducted, Brimley et al. (2012) noted that the examination of a simple resource allocation model that provides an equal amount of revenue to children can be problematic especially given the fact that these allocation formulae have not been adjusted to reflect research from adequacy studies.

The definition of equity in terms of outputs would, according to Ladd (2008), require that schools be provided sufficient resources to achieve similar outcomes. Because schools are differentially situated, this may require that some schools require more or different resources than others. Differential treatment of unequals is termed vertical equity (Berne and Stiefel 1984). This concept is especially relevant in the current policy context of schooling that requires equitable outcomes for all children. Some have characterized vertical equity in the ideal as adequacy (King, Swanson, and Sweetland 2003) while Ladd (2008) made the distinction that adequacy is not just about differential treatment, but rather sufficiency of

resources. An adequate school finance system provides sufficient resources so that schools provide equal opportunities to learn at high levels for all students (Ladd 2008; Darling-Hammond and Snyder 2003; Odden 2003; Verstegen 2002; Brown 2001; Reschovsky and Imazeki 2001; Picus 2001a, 2001b).

To accomplish vertical equity goals, state financing systems include reimbursements to districts in the form of flat grants or per pupil weightings. Brimley et al. (2012) argued that determining the proper allocations to address vertical equity goals may be more problematic than defining horizontal equity. Ladd (2008) responded to calls for a changed revenue distribution model that is premised on weighted student funding. She acknowledged the clear benefits of such a system, but she also argued that costs of providing an adequate education are not easily calculated at the individual student level. According to Baker (2005), the concentration of the students in individual schools increases the cost of providing an adequate education. Weighted student funding fails to consider this situation and other issues that may increase the cost of providing an adequate education. The second concern raised by Ladd (2008) is that weighted student funding does nothing to ameliorate historic underfunding of education, especially for underrepresented populations.

The standards movement may be seen as an attempt to provide equality of educational opportunity. Moreover, the alignment between equity of inputs and equity of outputs that is the cornerstone of the adequacy movement is the latest iteration of the term equity. No longer can equity of inputs and equity of outputs be examined in isolation; there must be a way to examine them simultaneously. Because educational achievement cannot be allowed to differ due to factors outside of the child’s control (Roemer 1998), policymakers must provide additional resources to students or districts to assist these students to reach proficiency standards. More recently, researchers have called for changes to the means by which schools are funded (Adams 2008). They noted the disconnect between finance policy and state and federal mandates for equitable learner outcomes, the lack of decision making authority at the local level, and the inability of principals to apply the principles of strategic management to align resources with intended learner outcomes and suggest a distribution model that links funding to children.

Equity and Adequacy in the Courts

Judicial interpretation of the terms equity and adequacy has occurred in multiple states where courts have closely examined the constitutional requirement to provide a system of common schools. States such as Kentucky and New York provided clarity to this discussion. For example, the *Rose* court (*Rose v. Council for Better Education* 1989) in Kentucky defined adequacy as substantial uniformity of both inputs and outputs of schooling while in New York, the Campaign for Fiscal Equity (CFE) decision (*Campaign for Fiscal Equity, Inc. v. State of New York* 2006), the courts used the phrase “sound basic education” and adequacy interchangeably. Indeed, these decisions have implications for the outcomes that the court expects from the state education system.

Springer, Liu, and Guthrie (2009) examined changes to education finance systems as a result of cases that were premised on equity and those argued on the grounds of adequacy. In their examination of the impact of school finance litigation, the authors found significantly decreased within-state revenue disparities in states where the finance system was overturned based on an equity challenge. Further, they found significantly smaller within-state revenue disparities in states where the finance system was overturned based on adequacy challenges as compared to states where the state finance system was upheld. However, these decreases in horizontal equity were not as great as those found in states with an equity challenge. Lastly, they found that adequacy challenges did not result in increased revenues for disadvantaged children. Terming this phenomenon, the “right kind of inequity,” the authors found no evidence to support findings that would suggest that resource allocation patterns have changed to meet the needs of children in underrepresented populations (Springer, Liu, and Guthrie 2009, 439). No changes in resource allocation patterns may impact equity of student performance. Thus, the research question, have equitable funds resulted in equitable performance, is pertinent to policy and judicial discussions related to equity, adequacy, and equality of educational opportunity. The creation of the equity ratio is an attempt to examine how resource equity can be associated with a difference in student outcomes.

Conceptualization of Adequacy and State Standards

Adequacy studies attempt to align resources with results. Attempts to define the emerging concept of adequacy have coincided with an effort to determine the costs of an adequate education. Calculations of an adequate education must begin with an answer to the question what is adequacy? The consensus in the literature, according to Brimley et al. (2012) and Ladd (2008), is that an adequate education enables all students to fully participate in both the economic and political life of the country. Standards have been seen as the conduit for ensuring that students have been equipped with the necessary skills to achieve this goal. Identifying the cost of an adequate education has not been nearly as easy. Predominantly, adequacy studies have made use of professional judgment panels. Other studies have used the successful schools approach, the “state of the art model,” or econometric modeling to estimate the cost of an adequate education (Downes and Stiefel 2008; Rebell 2006). Ladd (2008) argued that these studies must address two interrelated questions: What level of spending is required for students with no special circumstances, and how much additional spending per student is required to compensate for the challenges associated with educating children in special circumstances?

Baker (2005) introduced a conceptual model to aid in the understanding of adequacy that made use of economic theory. He proposed six assumptions for use in understanding the cost of an adequate education. First, the cost of an adequate education varies based on the desired outcomes. Simply stated, the achievement of greater student outcomes will require the investment of greater resources. Second, marginal costs of achieving desired outcomes vary based on the

district scale. Baker (2005) argued that there are economies of scale associated with the cost of education and that those costs vary as school sizes vary from the optimal. Third, the cost of an adequate education varies based on student need. Costs are associated with student circumstances, such as poverty and disability. According to Baker (2005), these students may require greater resource intensity or quality. Fourth, the cost of an adequate education varies based on the prices that districts must pay to produce similar results. Here, Baker (2005) has argued that the cost of resources varies based on the location of the district. For example, it may cost more money to hire and retain high quality teachers in rural areas. Fifth, the interaction of district size, student need, and price of inputs may increase the cost of an adequate education multiplicatively. This assumption assessed the concentration of student need with district size and location in an attempt to discern how costs may be different. Lastly, the marginal costs of achieving desired outcomes increase as the performance standards increase and those same costs decrease as performance standards decrease. As performance standards continue to increase, the cost of educating populations with high concentration of at risk children will increase exponentially.

Efforts made to assess the rigor and, therefore, the cost of an adequate system may be found in studies that align state proficiency standards to National Assessment of Educational Progress (NAEP) test scores (Bandeira de Mello 2011; Bandeira de Mello, Blankenship, and McLaughlin 2009; McLaughlin et al. 2008a; McLaughlin et al. 2008b, U.S. Department of Education, 2007). Because each state has a different assessment and a different definition of proficiency, these studies provide a common metric to compare the difficulty of state assessments and they also allow states to see how their respective standards may have changed over time. Analyses were conducted for two subject areas, reading and mathematics, and at two different grade levels, fourth and eighth grade. The most recent study (Bandeira de Mello 2011) revealed that an overwhelming majority of states (35) set proficiency standards at below basic for the fourth grade reading test. The remainder of states in the study (15) defined proficiency on their respective state test at basic for fourth grade reading. Slightly different results were for reading standards in eighth grade. Study results revealed that 16 of 50 states defined proficiency as below basic on the NAEP scale, with the remaining 34 states setting standard scores at or above basic. No states used the NAEP definition of proficiency in either fourth or eighth grade as their standard of proficiency.

Overall, scale scores were higher for mathematics. In fourth grade, seven states set proficiency standards below basic while 42 states set their respective standards above basic. One state, Massachusetts, set its standard at the NAEP definition of proficient. For eighth grade mathematics, 12 states defined proficiency below the NAEP score of basic, 36 states defined proficiency at or above the NAEP defined score of basic, and one state, Massachusetts, set its proficiency standard at the NAEP scale score for proficiency.¹

The states examined in this article were Kentucky, Massachusetts, and New York. Kentucky set fourth grade proficiency targets for reading at below basic and set mathematics

proficiency targets at basic. In eighth grade, Kentucky proficiency targets for reading and mathematics were both found to be in the basic range. Massachusetts set fourth and eighth grade mathematics proficiency at NAEP's defined level of proficiency. For fourth and eighth grade reading proficiency, the state targets were found to be at the basic level. New York, on the other hand, set fourth grade proficiency targets for reading and mathematics at below basic. Additionally, eighth grade proficiency levels for New York were set at basic for reading and below basic for mathematics. As we conceptualize the equity ratio that is discussed later in the paper, the definition of proficiency in each state is an important piece of evidence to discern state ability to provide equitable resources that result in equitable outcomes.

Conceptualizing a Ratio of Performance to Resources

Measures to assess the horizontal equity of finance systems include the range, federal range ratio, coefficient of variance, McLoone Index, and Verstegen Index (Berne and Stiefel 1984; Odden and Picus 2004; Brimley et al. 2012). Others have extended this discussion about the equity of finance systems to the concept of the equity of student performance (Knoepfel and Rinehart 2011). To date, no measure has been developed to assess the interaction between finance and student performance. Because the Kentucky high court mandated equality of both inputs to education (resources) and outputs of student achievement (performance), the development of the equity ratio begins with a consideration of what should be considered equitable. The literature clearly defines equity of inputs while the consensus on how to define equity of outputs is less clear. Our process in developing the equity ratio included consideration of measures of equity, but we also considered the distribution of both resources and measures of student achievement. The development of the equity ratio included a three step process: (1) measurement of the equity of the finance system; (2) measurement of the equity of student outcomes; and (3) calculation of the equity ratio with post hoc consideration of the distribution of both the revenues and student outcomes by examining the kurtosis and skew of both distributions as well as the McLoone and Verstegen Indices.

Standards of Equity for Finance Systems – Step One

We used the coefficient of variance to determine the horizontal equity of the finance system. The coefficient of variance is the standard deviation divided by the mean and is usually expressed in decimal form. In essence, the coefficient of variance describes the variation about the mean and varies from zero to one. The statistic includes all data, does not change with inflation, and is easy to interpret. Odden and Picus (2004) suggested a coefficient of variance of .10 as the standard for an equitable finance system.

However, given the standard of .10, a state finance system is equitable when about 68% of its districts are within 10% of the mean and about 95% of its districts are within 20% of the mean. Indeed, we anticipate variability in the distribution due to vertical equity; however, the standard of .10 results in a wide range of revenues available to districts across a state. Rather, we suggest that a finance system is equitable with a coefficient of variance that approaches .05. Using a .05

standard, 68% of the districts would be within 5% of the mean and 95% of the districts would be within 10% of the mean, reducing interdistrict variability in spending.

The McLoone and Verstegen Indices were also used to assess the equity of the finance system. The McLoone Index is the ratio of the sum of all values below the 50th percentile to the sum of all observations if those observations had the value of the median. The value of the McLoone Index ranges from zero to one. A McLoone Index of .95 or greater suggests an equitable bottom half of the distribution. The Verstegen Index is the ratio of the sum of the values of all observations above the median to the sum of all observations if they were all at the median. The value of the Verstegen Index begins at 1.0 and increases as disparities increase at the top half of the distribution. An increasing Verstegen Index indicates that districts at the top half of the distribution are receiving dollars at a rate faster than districts in the lower half of the distribution.

Whereas existing equity statistics only measure dispersion of resources, the equity ratio also includes an analysis that describes the shape of the distribution. The distribution's shape may provide necessary information to assess the vertical equity of finance systems. We postulate that a finance system has achieved vertical equity if the distribution is normal. A normal distribution would suggest that some districts received more funding than others, e.g., districts with special needs received more resources than districts without such needs. Therefore, we suggest that a finance system is equitable if the coefficient of variance approaches .05 and the finance distribution does not differ significantly from a normal distribution.

Standards of Equity for Student Outcomes – Step Two

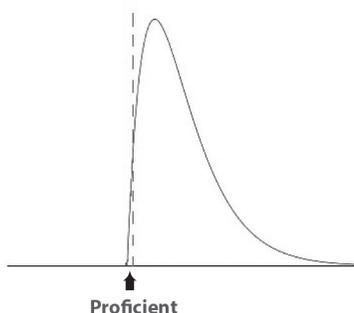
State achievement gaps and trends data have been used to assess student performance (Adkins, Kingsbury, Dahlin, and Cronin 2007). This approach ignores measures of dispersion and the distribution of student outcomes. Further, school finance litigation literature has found consistent arguments for equality of student performance (Alexander 2004). Because no measure exists to discern the equity of student performance, the development of the equity ratio included consideration of existing measures of equity used in finance. Next we describe our process to establish a standard for equity. This process was guided by the language of court interpretations, such as *Rose*, which required substantial uniformity in student achievement (*Rose v. Council for Better Education* 1989).

Odden and Picus (2004) suggested that the coefficient of variance, McLoone Index, and Verstegen Index may help researchers determine whether overall disparities and differences in the bottom and top halves of the distribution have improved. These finance statistics are appropriate to describe the equity of student performance and suggested that they provide valuable information regarding the dispersion of students' scores (Knoepfel and Rinehart 2011). Additionally, a standard for student performance equity was hypothesized to be a coefficient of variance that approaches .03 (Knoepfel and Rinehart 2011). With this standard, 68% of a state's districts would be within 3% of the mean and 95% of the districts would be within 6% of the mean. Along with the coefficient of variance, the McLoone and Verstegen Indices

provide information as to whether the top and bottom halves of the distribution are progressing towards the proposed distribution for student performance. A McLoone Index of .95 or greater suggests an equitable bottom half of the distribution and a Verstegen Index closer to one suggests students performing at the top half of the distribution are not growing at a rate faster than students performing at the lower half of the distribution.

Because policy goals and school finance litigation mandates equality of student performance at a proficient level, we postulated that the distribution of student performance should mirror that interpretation. Thus, most districts should cluster around proficiency and other districts that scored higher should tail off from the distribution (See Figure 1). We suggested that the distribution of student performance should be positively skewed, approaching or exceeding 1. The distribution should also be leptokurtic, approaching 10, and should differ significantly from normal. Additionally, the McLoone Index for student performance should be at least .98. Such a distribution of measures of student achievement would have nearly all students performing at proficient and above with the lowest part of the distribution performing at a level that is approaching proficiency. Thus, student performance would mirror policy goals and judicial decisions.

Figure 1 |



Standard for the Equity Ratio – Step Three

The equity ratio was created to discern the equity of student performance given the equity of resources. It may be used to assess policymakers' attempts to create equality of educational opportunity. The ratio measures equity of outputs over inputs; that is, it is the coefficient of variance of student performance divided by the coefficient of variance of the finance system.

We determined that an ideal equity ratio would consist of our suggested standards of equity for finance and student performance. Therefore, the ideal ratio approaches .6. Student performance was determined to be adequate if all students met proficiency. This interpretation suggests that the goal is uniformity of performance among all students. Thus, an acceptable coefficient of variance for student performance may be 0. In turn, this would cause an equity ratio of 0. Therefore, a range of 0 to .6 was determined to be acceptable.

It became evident that the ratio could be found to be in the acceptable range yet neither the finance system was equitable nor the distribution of performance measures was meeting policy goals. As such, a post hoc analysis was necessary. This

included revisiting the measures of distribution to include the mean, kurtosis, skew, the McLoone index, and the Verstegen Index.

Method, Data, and Interpretation

The analysis included district level finance and eighth grade reading and mathematics achievement data for 2006-2008 from three states: Kentucky, Massachusetts, and New York. For Kentucky, finance data from the Support Education Excellence in Kentucky (SEEK) funding program and achievement data collected from the Commonwealth Accountability Testing System (CATS) were used. For Massachusetts, finance and achievement data were collected from the Chapter 70 program and the Massachusetts Comprehensive Assessment System (MCAS), respectively. New York finance data from their general state aid program and achievement data from the New York State Testing Program (NYSTP) were utilized.

The three step process described in the previous section was used to calculate the equity ratio. First, equity statistics and measures of distribution were calculated for each state school finance system. (See Table 1.) Next equity statistics and measures of distribution for reading and mathematics scores on each state's respective test were calculated. (See Tables 2 and 3.) The data in Tables 2 and 3 were then used to calculate an equity ratio and plot the distribution of student achievement. (See Figures 2 and 3.) The equity ratio and the figures were used to draw conclusions as to the success of each state in providing equality of educational opportunity.

Table 1 | **Education Finance Statistics by State, 2006-2008**

Statistics by State	Year		
	2006	2007	2008
Kentucky:			
CV	.058	.057	.059
McLoone index	.95	.95	.97
Verstegen Index	1.05	1.04	1.02
Mean	4,737.32	4,822.32	5,255.72
Skew	-.223	-.226	-.109
Kurtosis	.113	.185	.162
Massachusetts:			
CV	.250	.250	.260
McLoone Index	.90	.91	.90
Verstegen Index	1.27	1.29	1.29
Mean	10,666.59	11,241.54	11,452.51
Skew	1.894	1.802	1.865
Kurtosis	4.11	4.11	3.99
New York:			
CV	.360	.359	.359
McLoone Index	.69	.69	.69
Verstegen Index	1.29	1.28	1.29
Mean	8,095.09	8,772.89	9,506.56
Skew	-.01	-.016	-.043
Kurtosis	-.394	-.247	-.524

Note: CV = Coefficient of variation

**Table 2 | Equity Ratio and Student Performance
Equity Measures for Eighth Grade Reading
by State, 2006-2008**

Statistics by State	Year		
	2006	2007	2008
Kentucky:			
Equity Ratio	1.53	1.08	1.05
CV Performance	.089	.062	.062
McLoone Index	.93	.96	.97
Mean	85.21	92.65	91.73
Skew	.350	.532	.258
Kurtosis	.994	1.834	1.533
Massachusetts:			
Equity Ratio	.31	.30	.28
CV Performance	.078	.075	.072
McLoone Index	.93	.93	.93
Mean	52.88	53.40	55.04
Skew	-.596	-.562	-.664
Kurtosis	.251	.488	.284
New York:			
Equity Ratio	.053	.05	.038
CV Performance	.019	.018	.014
McLoone Index	.98	.99	.99
Mean	661.54	661.41	664.85
Skew	.104	-.214	.315
Kurtosis	-.03	2.07	.144

Note: CV = Coefficient of variation

Consistent with research by Picus, Odden, and Fermanich (2001), the state system of education finance in Kentucky was found to be equitable. In each of the three years of study, the coefficient of variance (CV) was found to be less than the standard of 0.1. In developing the equity ratio, the authors suggested a coefficient of variance for finance of 0.05. The equity of the finance system in Kentucky is approaching this standard as well. Further, the McLoone Index was found to be in the acceptable range, measuring below 0.95 for each of the three years of study. The distribution of finance was found

Figure 2 |

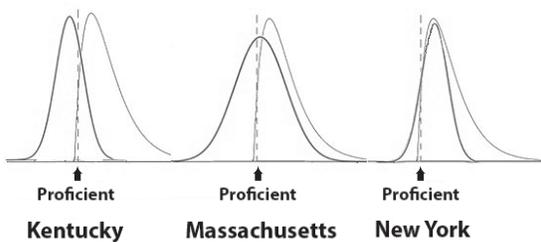
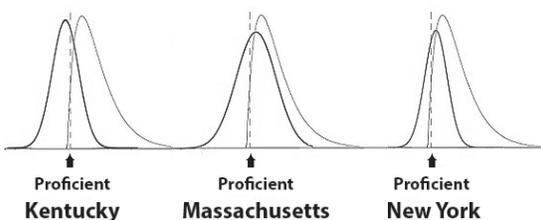


Figure 3 |



**Table 3 | Equity Ratio and Student Performance
Equity Measures for Eighth Grade
Mathematics by State, 2006-2008**

Statistics by State	Year		
	2006	2007	2008
Kentucky:			
Equity Ratio	2.12	2.10	1.81
CV Performance	.123	.120	.107
McLoone Index	.91	.92	.93
Mean	73.45	78.89	83.03
Skew	.953	.627	.618
Kurtosis	2.46	2.13	2.45
Massachusetts:			
Equity Ratio	.52	.50	.54
CV Performance	.130	.125	.140
McLoone Index	.88	.88	.89
Mean	40.96	40.81	38.46
Skew	-.554	-.565	-.297
Kurtosis	.376	.798	-.269
New York:			
Equity Ratio	.067	.061	.047
CV Performance	.024	.022	.017
McLoone Index	.98	.97	.98
Mean	660.55	669.13	677.89
Skew	-1.156	-.754	-.884
Kurtosis	5.536	4.188	5.517

Note: CV = Coefficient of variation

to be normal in Kentucky with a slight negative skew in each of the years of study. Conversely, the state system of public finance was found to be unequal in both Massachusetts and New York. In both states, the coefficient of variance was found to be greater than the standard of 0.1. In Massachusetts, the distribution of finance was found to differ significantly from normal. The distribution was both positively skewed and peaked indicating that there were more districts at the lower end of the distribution. In New York, the distribution also differed significantly from normal. The finance distribution had a negative kurtosis which indicated that the distribution was flat representing more disparity. We postulated that a finance distribution should resemble a normal distribution. As such, only Kentucky's finance formula was found to be equal when examining measures of dispersion and distribution.

The analysis next focused on the equality of measures of student achievement. This was accomplished both by an examination of the measures of dispersion and distribution found in Tables 2 and 3 as well as an examination of Figures 2 and 3. A review of the scores from the three states showed an upward trend in mean scores across the three years of study. In some states, such as Kentucky, trend scores were used as evidence of the improved performance of the system.² However, sole reliance on this measure does not consider the link between finance and student achievement nor does it consider the distribution and the provision of opportunity. In examining the equity statistics, only New York was found to have equality in performance in reading. The coefficient of

variance in each of the three years was below the standard of .03. In addition, the McLoone Index revealed scores of .98, .99, and .99 respectively indicating that the lower half of the distribution was performing close to the mean. Further, the distribution of scores in New York closely resembled the ideal distribution in Figure 1. Improvement was found in the equity of the student scores in reading in Kentucky; however, those scores did not meet the standards set in this study. In Kentucky, the coefficient of variance improved over time from .089 to .062 and the McLoone Index increased from .93 to .97. This indicates that the scores were more closely distributed around the mean and that the bottom portion of the distribution was also performing closer to the mean. The trend data in Kentucky revealed that scores were improving, but the mean score was not yet at proficient. The equity measures in Massachusetts revealed that student performance in reading was not equitable and there was little improvement in achieving equity. While the mean score for the state was above proficient, the lower portion of the distribution was falling further from the mean as evidenced by the McLoone Index. The coefficient of variance improved over time from .078 to .072, but this still revealed great disparity in student achievement in reading. When compared to New York and Kentucky, the kurtosis of the distribution of reading scores in Massachusetts was the lowest, indicating a flatter and, therefore, more disparate distribution.

For mathematics, an upward trend in mean scores was found for New York and Kentucky. The coefficient of variance for New York remained below the standard of .03 for the three years of study, suggesting an equitable distribution. The McLoone Index remained around .98, indicating that the lower half of the distribution was close to the mean. Additionally, the distribution was leptokurtic, ranging from 4.188 to 5.536. For Kentucky, the coefficient of variance did not meet the standard of equity; however, it improved from .123 to .107. The McLoone Index also was not found to be equitable although it approached the standard increasing from .91 to .93. Additionally, the kurtosis for Kentucky ranged from 2.13 to 2.46. This suggests a peaked distribution with less variability in scores. Massachusetts, on the other hand, was found to have a downward trend. Mean scores decreased from 40.96 to 38.46 over the three years. Furthermore, the coefficient of variance increased from .13 to .14, suggesting that the distribution of scores was becoming more inequitable over time. The McLoone Index, though, did increase from .88 to .89; however, these values suggest that the lower half of the distribution still had variability, with many scores further away from the mean. Finally, analysis of the kurtosis for Massachusetts revealed a decrease from .376 to -.269, suggesting that the distribution had become less peaked over time.

Analysis of the equity ratio revealed different results for each state. For Kentucky, the equity ratio did not meet the standard of .6 set forth in this paper. However, the equity ratio did improve from 1.53 to 1.05 in reading and from 2.12 to 1.81 in mathematics. Although the state did not reach its goal of substantial uniformity, the finance system was found to be near equitable and performance for reading and mathematics

were approaching equity. Thus, Kentucky was approaching their court mandates and policy intentions.

Unlike Kentucky, results for New York and Massachusetts were not easily interpretable. For the most part, both New York and Massachusetts had equity ratios that met or exceeded the standard of .6. However, deeper analysis revealed that neither state had or was approaching an equitable finance system. Thus, it became apparent that the established standard for the ratio may be achieved with inequitable finance systems and performance measures. For example, Massachusetts was found to have an inequitable finance system with a coefficient of variance of .25 and inequitable reading performance with a coefficient of variance of .078. When calculated the equity ratio was .31, exceeding the .6 standard.

Baker's (2005) conceptualization of adequacy provided insights into possible differences in results for the states' equity ratios. All three states had different demographic compositions, student needs, district sizes, proficiency targets, and standards of rigor. These differences in state contexts skewed results of the ratio. Indeed, NAEP studies revealed that New York's proficiency targets were among the lowest standards in the United States. This could, in part, explain why New York's equity of performance was lower than scores for Kentucky and Massachusetts. Comparisons between states may lead to weak conclusions drawn from results of the equity ratio. Interpretations must be made in light of the contextual situation of each state.

Discussion and Conclusion

Judicial interpretations of equity and adequacy necessitate a means by which researchers, practitioners, and policymakers can examine the interaction of inputs to schooling and measures of student achievement. The evolution of understanding of equity has changed significantly over the course of the past several decades. Initially, an equitable system of education finance was premised on notions of horizontal equity wherein equal resources was the goal. Over time, the concept that students who are differentially situated may require different resources, i.e., vertical equity, has been accepted. As such, some state education finance systems adopted formula elements such as weighted pupil units. At the same time, the adequacy movement has adopted of state and national standards for student proficiency. Today, many states are tasked with providing sufficient resources so that all children may reach proficiency standards. The achievement of proficiency, however defined, can be viewed as equality of educational opportunity.

The equity ratio was conceptualized in this article to evaluate the degree to which three states aligned resources for education to measures of student performance on eighth grade reading and mathematics between 2006 and 2008. It included the calculation of equity in finance and student achievement. For Kentucky, the equity ratio suggested that improvement in efforts to achieve equitable results given equitable resources was made over this time period. However, results for New York and Massachusetts were less clear.

In calculating the equity ratio, one of the assumptions was that an equitable finance system was necessary for equity in student performance. Indeed, this notion was influenced by the Rose decision. For states like Kentucky that mandated substantial uniformity of inputs and outputs the equity ratio serves as a valuable tool to interpret the progress of the achieving such policy. However, for states like New York and Massachusetts, that do not necessarily mandate equality of inputs and outputs, judgments about policy evaluations based on the equity ratio may be misleading. The equity ratio may serve to provide insights on a state-by-state basis; that is, much like how the equity ratio standard was influenced by the Rose decision in this paper, the standard for other states may be determined based on interpretations of court decisions and policy intentions in their respective states. Further complicating the analysis was the difference in the way that states define academic proficiency. A lower standard will result in a difference in the distribution of measures of student performance and can lead to flawed conclusions as to both the equity of a system as well as the provision of equity. This was seen in New York where the finance system is largely disparate but student achievement scores were both above proficiency and highly equitable. If the goal was to align resources with achievement, that goal was not met.

Future use and accuracy of the equity ratio will depend largely on determining the appropriate standard for each state in both finance and performance. This may include determining whether states require equality of inputs, equality of outputs, or both through an analysis of court interpretations and relevant statutes. It may also be improved by the introduction of the common core initiative, where content standards will be the same across states. If parameters for the equity ratio are established accurately, then interpretations of the statistic may help researchers, practitioners, and policymakers discern whether states are providing equality of education opportunity as measured as equality of outcomes.

Endnotes

¹ Nebraska was not included in the eighth grade mathematics analysis.

² See, *Tyler Young, et al. v. David L. Williams et al.*, Franklin Circuit Court Division II 03-CI-00055 and 03-CI-01152, February 13, 2007.

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