Education Funding and Student Outcomes: A Conceptual Framework for Measurement of the Alignment of State Education Finance and Academic Accountability Policies

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The conceptualization and measurement of education finance equity and adequacy has engaged researchers for more than three decades. At the same time, calls for increased academic accountability and higher student achievement in K-12 public education have reached new levels at both the national and state levels. Aligning these represents an emerging area of research with many challenges. For example, recent efforts by the authors to measure the alignment of fiscal equity and student outcomes using an equity ratio faced challenges, particularly because traditional education finance statistical measures do not fully account for factors that either impeded or contributed to their alignment.[1] Hence, the purpose of this article is to expand upon our previous work not only by identifying contributing factors, but also by proposing a conceptual framework that explains their role in measurement and alignment of state education finance and academic accountability policies.

In this article, we first review the process we used to create an equity ratio used to measure alignment. We then turn to our subsequent and related research to identify relevant contextual factors. Based upon these studies, we propose a conceptual framework that illustrates the interrelationship of factors associated with the alignment of education finance and accountability policies.

Refining and Testing the Equity Ratio

In 2013, we proposed an equity ratio to measure the alignment of education finance systems with measures of student performance described in accountability policies for the states of Kentucky, Massachusetts, and New York (Knoeppel and Della Salla 2013a). Our inquiry was guided by the question: Given equitable resources or finance inputs, what is the level of equity in educational outcomes? Rather than relying upon measures such as achievement gaps and student performance trend data, we suggested that a statistic that included the use of measures of distribution and dispersion of student performance outcomes was more appropriate. We proposed a three-step process to calculate an equity ratio that involved the measurement of finance inputs

and accountability outcomes, and the relationship between them. We used the coefficient of variance to discern the equity of both funding inputs and measures of student achievement, and included a discussion establishing standards of equity.

The coefficient of variance measures the amount of variation around the mean and ranges from zero to infinity—a value closer to zero, such as 0.10, is generally accepted as an equitable distribution of funds. The measure is calculated by dividing the standard deviation of a distribution by the mean value. Reasoning that an equity standard of 0.10 for the coefficient of variance of finance systems was too large and allowed for too much variation around the mean, we suggested that the standard should be reduced to 0.05. Next, guided by the notion that an equitable distribution of student achievement would be nonnormal and leptokurtic per Figure 1,[2] we proposed a coefficient of variance of .03 for measures of student performance. In our estimation, this represented an ideal distribution of student achievement that would best measure the success of a state's consequential academic accountability policy defined as student achievement at the "proficient" level.[3]

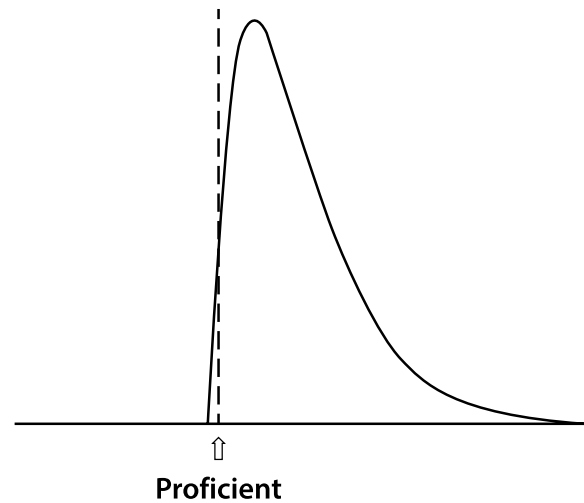Figure 1 | **Ideal student performance distribution**

⇧
Proficient

Table | **Summary of Research on the Alignment of State Education Finance and Academic Accountability Policies**

Title	Authors	Contextual Factors	States	Findings	Implications
Measuring Equity: Creating a New Standard for Inputs and Outputs	Knoeppel and Della Sala (2013a)	Testing of equity ratio and accounting for differing levels/rigor of proficiency in each state	Kentucky Massachusetts New York	A universal equity ratio is difficult to interpret for all states. There are other factors involved.	Equity ratio must be analyzed in accordance with judicial interpretations and other policy components in each state.
Finance Equity, Student Achievement, and Justice: A Five-State Analysis of Equality of Opportunity	Knoeppel, First, Della Sala, and Ordu (2014)	Judicial interpretations	Colorado Massachusetts New York Ohio Washington	Interpretations of opportunity in the courts matter in how equity of funds and achievement are conceptualized by policymakers and researchers.	Researchers must account for components of finance and accountability policies as well as timing of implementation of both policies.
Measuring The Alignment Between States' Finance and Accountability Policies: The Opportunity Gap	Della Sala and Knoeppel (2015)	Student demographics and state socioeconomic contexts	Colorado Kentucky Massachusetts Minnesota New York Ohio South Carolina Texas Washington	Social/economic context helps researchers discern the degree to which opportunity is difficult to obtain in each state.	There is a need for a conceptual framework to include all contextual factors that affect the alignment of both policies.

We conceptualized the equity ratio as a simultaneous measurement of finance inputs and student performance outcomes. The equity ratio was calculated by dividing the coefficient of variance of student achievement by the coefficient of variance of the equity of finance inputs, as follows: Equity Ratio = $CV_{achieve}/CV_{finance}$. Using this metric, we established the ideal range for the equity ratio between zero and 0.6. However, because it is possible to achieve an equity ratio in the ideal range without having an equitable finance system or measure of student achievement, we concluded that the equity ratio would only be valid if the coefficient of variance for finance inputs and student achievement outcomes approached 0.05 and 0.03, respectively. We also suggested a post hoc analysis that included measures of the mean, kurtosis, skew, McLoone and Verstegen indices, as well as statewide contextual factors to draw final conclusions about the equity and alignment of these two policies.

During development of the equity ratio, we realized that several factors that could not be accounted for by using equity statistics could impact the degree of alignment between finance and accountability policies, meriting further inquiry to determine the usefulness of the equity ratio. In order to test and improve the equity ratio as well as determine factors that were associated with the alignment of both policies, we expanded the scope of our research (Knoeppel et al. 2014; Della Sala and Knoeppel 2015). As can be seen in the summary table, these two studies served as part of the process of isolating contextual factors. Based on the findings, we were able to account for more factors, hence improving the external validity of the equity ratio.

In our 2013 study, we found that the equity of student performance was impacted by the rigor of the assessments; specifically, student achievement levels were influenced by the difficulty of content associated with each state's definition of proficiency. Although Kentucky was found to have the highest level of equity in finance and student performance, state accountability standards were rated as either basic or below basic by the National Assessment of Educational Progress (NAEP). We found that Massachusetts had the most rigorous standards—mathematics scoring was consistent with NAEP's definition of proficiency while reading scoring differed. It was consistent with NAEP's definition of basic rather than proficient performance. Despite the relatively higher level of rigor in Massachusetts, the equity of student performance in reading and mathematics was found to be above our 0.03 standard. Lastly, New York had a high degree of equity in measures of student achievement, but their performance standards were found to be the least rigorous; that is, their scoring schema in both content areas was below NAEP's definition of basic. None of the three states achieved the standard of education finance equity we set, although Kentucky was closer than Massachusetts and New York. In considering alignment, we relied heavily on the language of the 1989 *Rose* decision that mandated "substantial uniformity" in both finance and student achievement (*Rose v. Council for Better Education* 1989).

We next examined the language of state statutes and judicial interpretations in Colorado, Massachusetts, New York, Ohio, and Washington to discern how each state defined opportunity (Knoeppel et al. 2014). Using Betts and Roemer's (2005) theoretical framework of equality of educational opportunity,[4] we used a quasi-experimental design to: (1) analyze court decisions and statutory language; (2) calculate the equity of the finance system; (3) calculate the equity of measures of student performance; and (4) calculate the equity ratio and perform post hoc analyses to provide clarity about the shape of the distributions for each of the states.[5] Courts in these states defined opportunity as student performance on state criterion-referenced exams. Each state court specified equal student performance outcomes and the provision of resources as conditions that were to be met in order for the state education finance system to be deemed constitutional. Because none of the states examined in the study achieved both finance and student performance equity, we concluded that there was no policy alignment. We proposed that the timing of the implementations of both policies was a contributing factor to the lack of alignment. Unlike Kentucky, where a new finance distribution model was adopted the same year as the adoption of criterion-referenced student performance standards, none of the states in this study adopted finance distribution models in the same year that the state education accountability policy was adopted.

Reasoning that the alignment of finance and accountability policies was not only impacted by different definitions of opportunity or funding weights for differentially situated students, we sought to understand the challenges in the provision of opportunity faced by states based on variations in economic conditions and demographics (Della Sala and Knoeppel 2015). We noted that the conceptualization of the equity ratio did not allow for the consideration of mediating factors that impacted the provision of opportunity and suggested that a broader analysis of these factors should be used to support changes to resource distribution models in support of accountability goals. To calculate a metric, or "opportunity gap" to measure the degree of misalignment between the equity of states' education finance systems and student performance outcomes, we used census data and district level finance and performance data from nine states: Colorado, Kentucky, Massachusetts, Minnesota, New York, Ohio, South Carolina, Texas, and Washington.

We placed these states into groups of three based on demographic characteristics and need. Need was defined as low median household income, a larger percentage of people living below the poverty level, and a high unemployment rate. States with the greatest need included Ohio, Kentucky, and South Carolina while states with moderate need were identified as Washington, New York, and Texas. States with low need were Minnesota, Massachusetts, and Colorado. Census data used in the study included student demographics (e.g., race and students qualifying for services like special education, English language learner (ELL) programs, and free and reduced-price meals), graduation rate, percentage of individuals with a bachelor's degree or higher, and the major industry in the state other than educational and health

services.

We computed equity statistics for each state to include the coefficient of variance, McLoone and Verstegen indices, and the equity ratio in addition to looking for patterns based on student demographics and need. None of the states under study were found to have aligned finance and accountability policies according to the equity ratio; patterns describing the equity of finance systems and measures of student achievement were inconclusive. Only two states, South Carolina and Kentucky, were found to have equitable finance distribution systems; both of these states were characterized as high needs states. In the states with the least need, Massachusetts was found to have performance equity in both reading and mathematics while Colorado had performance equity in reading and was approaching performance equity in mathematics. Minnesota was well below the standard of equity in performance with a coefficient of variance of 0.28. In states with moderate need, New York and Texas provided performance equity in both reading and mathematics while performance equity was not found in Washington. In states with the greatest need, none was found to have performance equity. Based on the opportunity gap, we placed states in four categories: (1) approaching alignment; (2) input equity; (3) output equity; and (4) inadequate systems (neither input nor output equity). In our analysis, we found that only Kentucky approached policy alignment. South Carolina was found to have input equity while Colorado, Massachusetts, New York, Texas, and Washington were found to have output equity. Ohio and Minnesota were found to have inadequate systems.

In summary, the two subsequent studies that were conducted to refine and test the external validity of the equity ratio revealed six interrelated contextual factors that were found to impact the alignment of education finance and academic accountability policies: (1) judicial interpretations in school finance litigation; (2) components of academic accountability policy; (3) components of education finance policy; (4) the timing of finance and accountability policy implementations; (5) student demographics and state socioeconomic contexts; and (6) other factors not captured by academic accountability policy but associated with schooling. The next section expands upon each of these factors.

Factors Impacting the Alignment of State Education Finance and Accountability Policies

Judicial Interpretations in School Finance Litigation
Judicial interpretations of education clauses in state constitutions have informed equity and adequacy lawsuits. These class action suits have led to recommendations for reform, not only in education finance but also, in some cases, in academic accountability. Specifically, we posit that courts can define opportunity as inputs-based, outputs-based, or a combination of both. In the states we examined, opportunity was defined as the achievement of proficiency standards (outputs) and the provision of sufficient resources to help students realize those content standards (inputs).

Components of Academic Accountability Policy
Our investigation of the language of state academic accountability policy revealed two components that can impact the alignment of finance and accountability policy. These were the state's definition of academic proficiency and the range of scores used on the state's student performance accountability assessment to measure proficiency. Since comparisons across states cannot be made due to the use of different tests and performance standards, we compared those states we studied to NAEP (McLaughlin et al. 2008; Bandeira de Mello, Blankenship, and McLaughlin 2009; Bandeira de Mello 2011). In turn, the equity ratio is influenced by how states define proficiency standards. Similarly, the range of possible scores on state assessment has an effect on the coefficient of variance for student performance outcomes; that is, a state's academic accountability policy affects the degree to which the equity ratio correctly measures the alignment between finance and accountability policy.

Components of Education Finance Policy
Some assert that little has changed in the way that states allocate revenues in support of public education (Verstegen and Jordan 2009; Verstegen 2014; Verstegen and Knoeppel 2012). Foundation programs continue to be the revenue distribution model in the majority of states, sometimes in combination with another form of general aid. However, it should be noted that pupil weightings can be used with foundation plans to direct additional funds to particular groups of students who may need more resources to be academically successful. These include students living in poverty, those with disabilities, and students for whom English is not their first language, also referred to as English language learners (ELLs). At the same time, the level of state funding for education is decided in the political arena, where there are many competitors for limited resources, rather than on a rational cost basis.

Timing of Education Finance and Academic Accountability Policy Implementation
In our research, we found that implementation of both of these policies at the same time had a strong positive impact on their alignment. In measuring the degree of alignment, we found Kentucky to have the smallest gap. Kentucky enacted the Kentucky Education Reform Act of 1990 (KERA) immediately following the 1989 *Rose* decision. KERA included both the creation of an education finance system and a new academic accountability policy. Their simultaneous development and implementation resulted in greater alignment between resource allocation and student achievement than the other four states in our 2014 study whose foundation programs were enacted before their respective accountability policies. Only Massachusetts made changes to both their accountability policy and changes to their finance distribution model, which may account for the equitable results in their measures of student achievement. As a result, we postulated that gaps in time between implementation of these policies indicated a lack of policy coherence, and hence would impact the equity ratio.

Student Demographics and Socioeconomic Contexts

In our 2015 study, we sought to expand our understanding of the equity ratio by examining both the equity and alignment of finance and accountability policies in relation to student demographics and socioeconomic factors using census data and district level finance and performance data for nine states (Della Sala and Knoeppel 2015). Although the findings with regard to equity were mixed, a few patterns emerged that have informed the development of our conceptual framework. First, wealth of the state strongly impacted student performance equity and other outcomes to schooling such as the percentage of individuals holding a bachelor's degree. Other demographic factors, such as race, percentage of students with individualized education plans (IEPs), and the percentage of students receiving special education services appeared to negatively impact the equity of performance. It would appear that the impact of these demographics on equity and alignment is mediated by the definition of the standard of proficiency. Although many of the states under study had academic performance equity or were approaching that standard, all, with the exception of Massachusetts, used the NAEP definition of "basic" or "below basic" to define proficiency, and only two states had students performing at or above proficiency in the aggregate.

*Other Factors Not Captured by Academic
Accountability Policy but Associated with Schooling*

In two studies published in 2013, we took a different approach and examined the efficiency of allocation patterns of schools in Kentucky and South Carolina, using data envelopment analysis (Della Sala and Knoeppel 2013; Knoeppel and Della Sala 2013b).[6] Economic efficiency research models use a mix of inputs to maximize outputs, using multiple measures. The use of a single output, such as scores on state-mandated criterion-referenced tests, would likely be considered insufficient. For example, additional outcome measures, such as college-going rate and career readiness, might more fully capture the education production function. In addition, although schools may have high scores on these tests, they may still be considered inefficient because the test scores could be viewed as a minimum standard.[7]

A Conceptual Framework to Explain the Factors Impacting Policy Alignment

According to Maxwell (2005, 44), there are four main sources used in the construction of a conceptual framework: the experiential knowledge of the researchers themselves; existing theory and research; exploratory research of the researchers; and thought experiments. Our framework, depicted in Figure 2, is based upon experiential knowledge.

The conceptual framework begins with a consideration of judicial interpretations in school finance litigation. Where plaintiffs have prevailed, court decisions have resulted in requirements for reform of the education finance system, generally along the lines of providing greater equity or adequacy--or both. Some courts extended their scrutiny to academic accountability as well, resulting in either the adoption of new accountability policies to include a system of assessment or a review of the current accountability

Figure 2 | **Conceptual Model of Factors Associated with the Alignment of Finance and Accountability Policies**
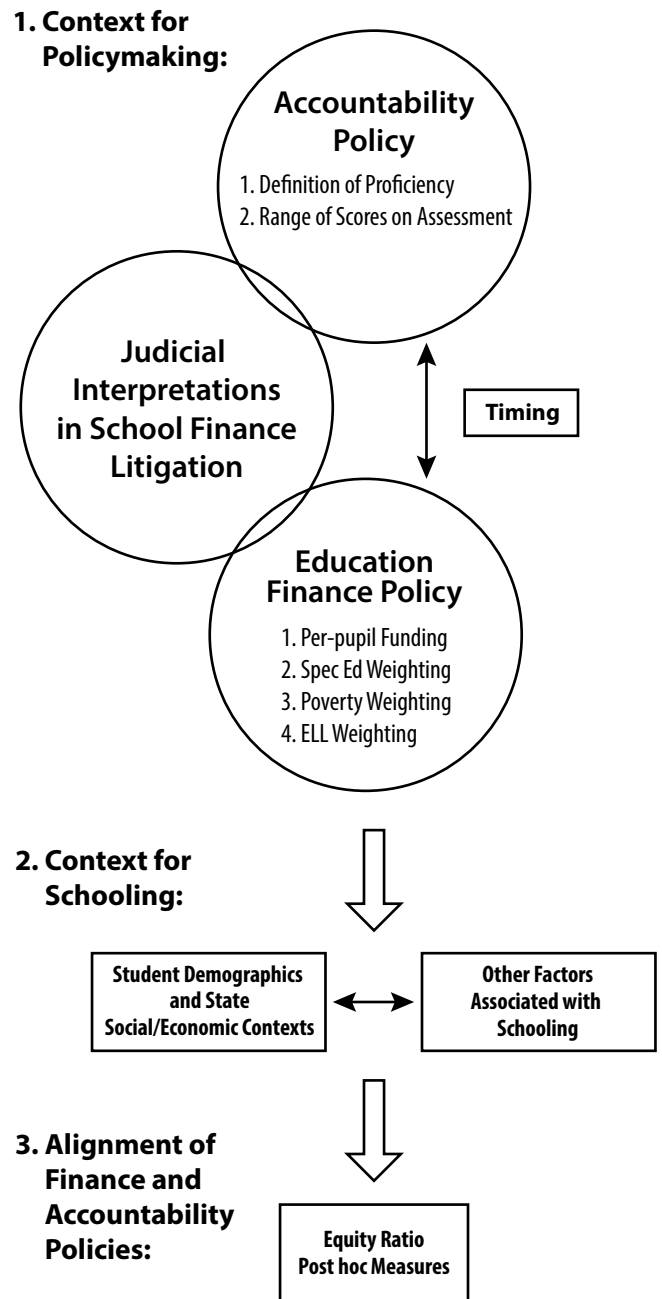
policy and a conclusion of the degree to which that system measured opportunity as defined by student achievement measures. As noted in the conceptual framework, the timing of the enactment of the accountability and finance policies also impacts the degree of alignment found between the policies. The next set of factors relates to the context for schooling. Student demographics and socioeconomic variables can be a powerful influence on the degree of alignment of education finance and academic accountability.

Summary and Conclusion

Previous research has discussed the need for alignment of state education finance and academic accountability. The equity ratio represents one method to measure the degree of policy alignment. It was initially developed using language from judicial interpretations of the constitutional duty to provide a system of public education in Kentucky and then applied to Massachusetts and New York. The equity ratio was sensitive to factors that could not be measured using equity statistics, suggesting the need for further research to discern those factors that impact policy coherence. Efforts to refine the equity ratio and to improve its external validity revealed six interrelated contextual variables that allowed for the development of the conceptual framework proposed in this article.

This proposed conceptual framework is the result of a series of inquiries centered on the conceptualization, development, and testing of the equity ratio. Although the research described in this article led to the development of a specific conceptual framework, this does not mean the research on the alignment of finance and accountability policies is complete. Further research is needed on factors within the framework and the degree to which those factors influence the alignment of both policies. Additionally, the metrics described in this paper need to be applied to more states to improve external validity. The conceptual framework outlined in this article provides a starting point for researchers and policymakers to examine the alignment of state-specific education finance and academic accountability policies to better provide equal and adequate educational opportunities for all students.

Endnotes

[1] For a listing and discussion of traditional education finance statistical measures, see "Statistical Approaches to Equalization," in *Financing Education in a Climate of Change*, 11th edition, by Vern Brimley, Jr., Deborah A. Verstegen, and Rulon R. Garfield (Boston, MA: Pearson, 2012), 65-68.

[2] Also referred to as positive kurtosis, or skewing of the mean.

[3] Kress, Zechmann, and Schmitten (2011) defined "consequential" accountability as a model of education reform that includes explicit standards for students, testing students based on their knowledge of standards, and consequences assigned to schools for failure to meet those standards.

[4] Per Knoeppel et al. (2014, 814): "They [Betts and Roemer 2005] reasoned that opportunity is comprised of five components: circumstances, type, effort, objective, and instrument. Type includes the set of individuals with the same circumstances and objective refers to the actual condition that is to be equalized. Student demographics are an example of circumstances; students in similar circumstances are then grouped into types. The instrument, or state finance distribution model, is the intervention or policy used to equalize the condition. As a result of

equalization, effort, or the willingness to fully fund an adequate education would then determine the objective, which is student outcomes. Outcomes may be unequal, yet they cannot be the result of the state's unwillingness to adequately fund public education. Conversely, unequal outcomes may be permissible if all students achieve at or above proficiency. Indeed, one goal of education finance policy is to equalize opportunities for students, yet different definitions of 'what' is to be equalized may result in different conceptions of finance policy and equality of educational opportunity."

[5] The study (Knoeppel et al. 2014, 817) was described as quasi-experimental in the sense that: "The selection of these five states enabled researchers to conduct a case-by-case study comprising geographic diversity as well as diversity in the year of each respective decision."

[6] Della Sala and Knoeppel (2013, 44) described their use of data envelopment analysis (DEA) in this study as follows: "DEA was employed to calculate and examine the relative efficiency of the high schools [in one Midwestern urban school district]. DEA is a non-parametric linear programming model, primarily used in economic research, which accommodates multiple inputs and outputs to construct an efficiency frontier (Ray, 2004). The model supposes a plausible connection between inputs and outputs within Decision-Making Units (DMUs) or, for this study, high schools, in order to measure production (Stiefel, Schwartz, Rubenstein, & Zable, 2005). DEA builds an efficiency frontier in relation to the observed inputs and outputs in the data (Robst, 2001). Therefore, a school's efficiency is calculated based on the production of only the schools included in the analysis rather than an established 'ideal' efficient school." A similar definition was used in Knoeppel and Della Sala (2013b).

[7] In terms of future research, we would argue that an aligned system of education finance and academic accountability policy incorporate efficiency as well.

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