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Family Income, Student Achievement, and Educational Costs

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My presentation today is on how the costs to school districts of providing adequate educational services to students vary with the income of the student's family. Educational achievement will obviously vary across individual students based on the student's talents and efforts. But there is no reason to think that the average student from different income brackets differs in their inherent capacity for educational achievement. However, it might cost extra in public services for lower-income students to achieve the same average achievement levels as students from middle-income and upper-income families, in order to overcome some of the disadvantages associated with poverty. If that is so, then leveling the playing field across different students or different school districts would require adjusting the state foundation grant per student for these different costs.

What I'm going to specifically consider is how costs vary with the percentage of a district's students who are eligible for a free and reduced price lunch, which means their family's income is below 185 percent of the poverty line. I use the free and reduced price lunch designation because this is the income data readily available to school districts and the state government. The question is, if we want to create the same potential for achievement levels in different school districts, how much should the state foundation grant vary with a school district's free and reduced price lunch percentage. At an extreme, if we consider one hypothetical district with 100 percent free and reduced price lunch students, versus another district with zero percent free and reduced price lunch students, what should be the percentage in extra revenue support for the first district relative to the second district in order to level the playing field?

Before presenting some estimates of these cost differentials, I want to outline some of the facts on how student achievement varies with income. Both national data, from the National Assessment of Educational Progress, or NAEP, and Michigan data from the MEAP, suggest that the average test score differential between FRL students, and non FRL students, in both reading and math across different grades is about seven tenths or 70 percent of one standard deviation. The standard deviation scaling is done by researchers to better compare tests that might have very different scoring metrics. This scaling means that we express the differential as s percentage of how much on average that particular test score happens to vary across students in the same grade. To give an intuitive idea of what a 0.7 standard deviation means, this differential would mean that the average free and reduced price lunch student would score at about the 25th percentile of the test score distribution of students ineligible for a lunch subsidy. In other words, 25 percent of students ineligible for lunch subsidies would score worse than the average free and reduced price lunch student, but 75 percent would score better than the average free and reduced price lunch student. This is a large differential that takes some considerable effort and costs for school districts to overcome.

In terms of this metric of standard deviation units, test score differentials between different income groups do not vary much from kindergarten to 12th grade. However, it should be understood that a

given standard deviation differential corresponds to a much larger difference in grade levels at higher grades than at lower grades. This is so because student test score differentials across individual students tend to significantly widen as students age. Therefore, at 3rd grade, the 0.7 standard deviation differential corresponds to about a one grade level differential in test scores. At 9th grade, the 0.7 standard deviation differential corresponds to about three grade levels in performance. It seems likely that it is much easier to make up for a one grade level differential than a three grade level differential – it's much easier to help a student with second grade performance move up to a 3rd grade level than to help someone performing at the 6th grade level to move up to a 9th grade level. Therefore, this points to the importance of intervening early. The natural tendency of test score differentials across groups is for them to fan out in terms of grade levels and difficulty of intervention as students age.

Another important aspect of test score differentials across income groups is that they have widened by about one-third over the past 25 years (Reardon, 2011). The causes of this trend are not well understood, but it has been speculated that it may be due to one or more of the following causes: increased income inequality; an increased tendency for parents to be more similar in education; increased parental investment by upper income parents; increased income segregation of neighborhoods.

How much does it realistically cost in public services to overcome these income-based average test score differentials? There is a research literature that explicitly estimates how a school district's costs of reaching the same achievement levels varies with the percentage of students who are eligible for a free and reduced price lunch. This research is based upon comparing costs and achievement levels for school districts with different percentage of students eligible for a free and reduced price lunch, along with other cost factors. This research finds that the extra costs of reaching a given achievement level for free and reduced price lunch students are considerable. In most relatively urbanized states, the extra costs of reaching the same average achievement level are from 100 percent to 150 percent higher for each additional free and reduced price lunch student. That is, for each additional free and reduced price lunch student, the required spending per student to reach the same predicted achievement level is 2 to 2.5 times as much. In more rural states, these extra costs tend to be somewhat lower, in a range from 60 percent to 100 percent. (See the review by Duncombe and Yinger, 2008.[1]) One study specifically of Michigan implies that the extra costs per each additional free and reduced price lunch student are around 180 percent (Papke, 2005.)[2]

To be as clear as possible, consider two extreme districts. One district has 100 percent of students eligible for a free and reduced price lunch, the other district has zero percent. Suppose the zero percent district receives a foundation grant of $7,000 per student. Suppose we use the assumption, which seems reasonable from the literature, that each extra free and reduced price lunch student requires 100 percent extra funding. Then to level the playing field across the students in these two districts would require a foundation grant of $14,000 in the high-poverty district, 100 percent extra than in the low-poverty district.

These extra costs for free and reduced price lunch students far exceed differentials in most states' school aid formulas. Most states provide between 15 percent and 30 percent extra for free and reduced

price lunch students in state aid. However, at least a few states have in the past provided up to 100% extra aid for free and reduced lunch students.

One response to this is to say that perhaps these estimated cost differentials, which are based on observing average school districts' test scores and student characteristics, may reflect that many districts may not adopt the most productive practices to increase test scores. However, we get considerable cost differences even if we assume that school districts are able to spend money on the most highly productive activities.

For example, among the services for which there is good evidence of very strong effects on achievement are high-quality preschool, lower class size in kindergarten through third grade, and high-quality targeted summer school programs. Suppose a district had 100 percent free and reduced price lunch students, and wanted to provide these three services to every student in the district in an attempt to eliminate the 0.7 standard deviation achievement gap by the end of 3rd grade. I estimate that these three additional services would come close to eliminating the high-poverty achievement gap by the end of 3rd grade, in that they would raise student achievement at 3rd grade by 0.65 standard deviations, 0.25 due to preschool, 0.20 due to lower class size, and 0.20 due to one year of mandatory summer school. However, the combined cost of these three interventions would be about 72 percent of total normal K-3 school costs.

If these three early interventions PERMANENTLY increased student achievement after third grade by close to 0.70 standard deviations, then their cost would be a considerably lower percentage of total K-12 costs.[3] But we know there will be considerable fading of these third grade test scores. Early elementary class size reduction's test score effects may fade in later grades to half their third grade level, in standard deviation units. Some fading also takes place also takes place for preschool, but not quite as much. In the case of summer school, we would expect even more fading. As a result, the long-run effect of these three programs is probably only about half of what is needed to close the achievement gap in later K-12 years. To overcome the remaining one-half of the achievement gap in later K-12 years might well require a 70 percent or more increase in spending in later grades, given that later interventions tend to be more difficult and costly than early interventions.

Another critique is to wonder whether perhaps some very different approach to education, such as charter schools, might achieve better achievement results for the same cost. Can charter schools boost the achievement of lower-income students without spending more money, or at least without spending as much as double the per student allotment.

I think it is fair to say that the research on the effects of charter schools is mixed. The most rigorous studies find that some charter schools are worse than the average public school, some are better, and many others are similar in performance to the average public school.

More recently, some researchers have tried to get inside the "black box" of charter school performance to see what makes some charter schools effective, and others less so. A good example is a recent paper (2012) by Roland Fryer and Will Dobbie of Harvard on New York City charter schools. They try to identify the practices of high-performing charter schools vs. low-performing charters. Among factors they

identify as being distinctive of high-performing charters are: a longer school day; a longer school year; more frequent tutoring of students in small groups; more frequent assessment of students each semester; more frequent feedback provided to teachers by outsiders doing classroom visits. They don't estimate the costs of all these activities, but it is apparent that all of these activities are likely to involve extra costs, and the cumulative cost of the whole package might be considerable. Now, high-performing charters also more frequently have a "No Excuses" philosophy towards student performance, but the high-performing charters combine that philosophy with a variety of interventions that involve some considerable extra costs.

In sum, if we want to realistically level the playing field in student achievement across districts with different percentages of students eligible for a free and reduced price lunch, this will require providing considerable more aid per free and reduced price lunch student. It is easy to find support for state aid formulas that will increase revenue per student for free and reduced price lunch students by 60 percent, 100 percent or more. Such differential state aid should then be used for highly productive activities to improve student achievement, which, in my view, should include early interventions with proven research evidence of long-run effectiveness.

Key Points of Student Achievement, Family Income, and Educational Costs

- Question: How much extra revenue per free and reduced price lunch (FRL) student is needed if we wish to equalize educational opportunities?
- Average achievement differential between FRL students and non-FRL students is 0.7 standard deviations (standard deviation=measure of average differences in some test score in a given grade)
- This 0.7 standard deviation (SD) differential corresponds to the average FRL student scoring at the 25th percentile of the non-FRL student test score distribution: a large difference, but with overlap.
- This 0.7 SD difference does not change much K-12. But it corresponds to larger "grade level" differences because student test scores vary much more within grades as students age. At 3rd grade: 0.7 SD=1 grade level. At 9th grade: 0.7 SD=3 grade levels.
- Income differences in test scores have grown by one-third over past 25 years.
- **Most important point:** Direct estimates of how school district costs to achieve a given achievement level vary with FRL percentage imply that each extra FRL student costs an extra 100–150 percent in urban states, 60 percent to 100 percent in non-urban states.
- **What this means:** If each extra FRL student costs extra 100 percent, and we provide a $7,000 per student foundation grant to a district with zero FRL students, then a district with 100 percent FRL students should get $14,000 per student if we want to level the playing field=equalize student achievement across income groups.
- Most states only provide extra 15–30 percent per FRL student, although some states have done more.
- Are costs a lot lower if we invest in high-productivity activities? No. As table on back shows, investing in research-proven programs such as preschool, lower early el class size, and summer

school can eliminate achievement gap at 3rd grade, but require spending more than 70 percent more from pre-K to 3rd grade.

- Can charter schools solve the problem? Studies of effective charter schools, compared to ineffective charter schools, suggest that effective charter schools have: longer school days; longer school years; more small group tutoring; more feedback to teachers via classroom visits; more frequent assessments. All of these features cost money.
- In sum, equalizing the playing field across schools requires significant additional revenue per FRL student, probably at least as great as 60 percent extra.

Table 1: Costs and Effects of Three Research-Proven Interventions to Improve Student Achievement of Low-Income Students

	Cost per student of intervention	Achievement effect by end of 3rd grade (in standard deviation units)	Longer run effects (in standard deviation units
Preschool	$ 5,895	0.25	0.2
Lower class size	$ 13,160	0.2	0.1
Summer school	$ 1,000	0.2	0.05
Sum of 3 interventions	$ 20,055	0.65	0.35
Cost of K-3 at $7,000 per year	$ 28,000		
Intervention costs as percent of K-3 costs	72%		

Notes: Preschool costs are derived by assuming that combined state and local costs for Michigan's Great Start Readiness Program are $4,500 per half day slot, and that 69 percent of slots are half-day, and 31 percent are full-day, based on data from State Yearbook of National Institute for Early Education Research, along with $3,400 per slot state aid figure for GSRP. The 0.25 and 0.20 effects of preschool are based on estimates that GSRP's initial effects at kindergarten entrance are 0.50, and estimates by Barnett on how preschool effects depreciate over time. Lower class-size costs are based on a 47 percent extra cost differential for class-size reductions similar to the Tennessee class-size study, which then are multiplied by $28,000 total K-3 costs. Effect sizes of lower class size are also based on Tennessee study. These costs and effects are taken from Krueger (2003). The summer school immediate effects are based on Jacob and Lefgren (2004), and assumption that 1 grade level at third grade is about a standard deviation of 1.0. Fading of summer school effects is simply assumed.

[1] One prominent study that is an exception is a study by Gronberg et al. (2004) of Texas, which concludes the required extra expenditure to reach the same achievement level for the average free and reduced price lunch student is only 23 percent to 31 percent greater.

[2] This calculation is derived from column 3 of Papke's Table 7, and solves for the extra spending required to hold math pass rates constant as marginal variations occur in the free lunch percentage. These marginal variations are calculated at an initial free lunch rate of 50 percent. I use column 3 because her paper clearly implies that IV estimates are required, but fixed effect estimation clearly yields too imprecise estimates for the effects of lunch percentage, and in fact such as specification arguably does not reflect true long-run effects of poverty on achievement.

[3] In that case, we divide the $20,000 cost of these three interventions by the $91,000 cost of $7,000 per year costs for the 13 years of K-12, and get 22 percent extra costs.