ESSAYS ON THE ECONOMICS OF SPECIAL EDUCATION

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ABSTRACT

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This dissertation is separated into three independent chapters. The first chapter examines the effect of federal regulations at reducing racial disproportionality in special education identification. Since the 1960s, educators and policymakers have been concerned with the overrepresentation of Black students in special education compared to their White counterparts. In 2004, Congress reauthorized the Individuals with Disabilities Education Act (IDEA) and included in it financial incentives for school districts to reduce their level of racial disproportionality in special education programs. This chapter presents evidence of the effect of the penalties on the Black-White gap in special education representation in Michigan. Using a difference-in-differences approach, I exploit the variation by race in the marginal cost of an additional special education student for districts close to the policy threshold. The results indicate that the IDEA policy change induced sanctioned districts to lower their relative disproportionality measure by 41 percent, which was achieved by reducing the proportion of all Black students receiving special education services.

The second chapter further investigates disparities in special education placement across multiple dimensions. Factors leading to the placement of students into special education programs have become a central discussion point in special education policy over the past decade. This essay examines the roles that race and socio-economic status play on special education identification. Using data describing Michigan school districts between 2002 and 2010, this chapter analyzes several features of special education: placement, amount of

services provided, and type of disabilities identified. I find evidence that socio-economic status and relative race influence participation rates.

The third and final chapter explores the role of reduced class size on special education placement. In the 1980s, Tennessee implemented the Project STAR experiment, which randomly assigned elementary-school students to different sized classrooms from kindergarten through third grade. Using this randomization of students to classrooms, I estimate that reduced class size net of its effect on test scores increased special education participation by 2.8 percentage points. Evidence of increased special education identification supports the hypothesis that smaller class sizes lead to increased teacher understanding of students' needs for services.

To Samantha.

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Chapter 1

The Impact of Disproportionality Regulations on Identification into Special Education Programs

1.1 Introduction

Despite considerable attention from educators and policymakers, minority children consistently represent a disproportionate share of students in special education programs. The relative difference in identification rates, i.e., special education placement rates, between Black and White students has been at the center of the discussion since the 1960s (Albrecht et al., 2012; Donovan and Cross, 2002; Dunn, 1968; Patton, 1998). In a 2008 paper, racial disproportionality in special education was described as "among the most longstanding and intransigent issues" in education (Skiba et al., 2008). It is commonly argued that these differences in placement rates stem from the inappropriate identification of students, which could harm their educational outcomes (Hosp and Reschly, 2003).

Congress reauthorized the Individuals with Disabilities Education Act (IDEA) in 2004, including in it components designed to reduce disproportionality that were in accordance with the belief that inappropriate placement drives representation differences. Congress emphasized the priority it gave to reducing racial over/underrepresentation by making it one of three monitored target areas of the act. Specifically, the policy required states to collect and analyze enrollment data to determine racial representation levels. If a school district's level of disproportionality was found to be excessive and reoccurring, the district

was labeled as having "significant disproportionality" and mandated to reserve fifteen percent of its federal IDEA funds, originally intended for special education programs, for Early Intervention Services targeted toward students at higher risk of receiving special education services.[1]

This paper evaluates the effect of financial sanctions associated with the IDEA 2004 on Black overrepresentation in Michigan special education programs. I use a difference-in-differences approach at the district level to exploit the variation in Black disproportionate representation before and after the policy. Additional analysis examines whether the change in relative disproportionality was driven by reductions in Black representation or increases in White representation. Finally, I compare districts evaluated by the policy to districts ineligible to participate.

I find that the financial sanctions were successful in reducing Black overrepresentation. A significant disproportionality label lowered relative Black representation by 41 percent in following years. Moreover, this decline in Black overrepresentation was achieved through a reduction in the proportion of Black students receiving special education services. The examination of analogous changes for ineligible districts, a third differencing group, serves as a robustness check of the main estimates and supports the common trends assumption required for the unbiasedness of the estimates. I then show evidence consistent with inappropriate identification practices: the racial composition of one's peers has a significant relationship on one's special education status. These results suggest that the reductions in disproportionality induced by the policy led to positive well-being effects for Michigan students in special education programs.[2]

[1]The term school district replaces the term local education agency (LEA), which is the language used in the IDEA. In Michigan, an LEA refers to traditional school districts, charter schools, state-operated education facilities, and intermediate school districts.

[2]This conclusion focuses on the effect of the policy on special education students but does not speak to

1.2 Background

If one were to assume that all children, regardless of race, are equally likely to have a condition requiring special education services, it is clear why the stark levels of disproportionate representation have been a focal point for researchers and policymakers.[3] Despite the fact that the disparity was identified in the 1960s, the overrepresentation of Black students has persisted in special education programs. In 1975, Black students represented 15 percent of the student body but 38 percent of all students labeled as cognitively impaired. In 1991, 16 percent of all students were Black while 35 percent of those identified as cognitively impaired were Black (Patton, 1998). By 2004, Black students represent 17 percent of the total student population and 33 percent of students with a cognitive impairment placement.[4]

Within the last decade, several studies have expanded the understanding of disproportionality. Evidence indicates disproportionality begins prior to formal schooling and is exhibited in lower skill levels as well as behaviors less conducive to the traditional school setting (Farkas, 2003; Morgan et al., 2012; Morrier and Gallagher, 2010). Even after controlling for economic and demographic variables, Black students are disproportionately likely to be labeled as cognitively impaired (Oswald et al., 1999). Finally, prior academic achievement strongly predicts special education identification and also attenuates the socio-economic estimates (Hibel et al., 2010; Hosp and Reschly, 2004).

the effect on general education students.

[3]In Michigan, a student with a disability is a student, within certain age limits, who was designated by a team of professionals as having at least one impairment that necessitates special education services. After the district has identified a student as being a candidate for services, the student is given several assessments, so an individual education program team can discuss the findings and determine whether the student is eligible for services. If the student's parent or guardian accepts the offer for services, the student may then begin receiving special education services. The declassification out of special education follows a similar structure of recommendation, evaluation, and ending with the determination of the multidisciplinary team.

[4]The 2004 numbers were based on the author's calculations using the National Center for Education Statistics' Common Core of Data and the Data Accountability Center's IDEA Data.

The appropriateness of racial disproportionality in special education has been discussed through two channels: inappropriate and appropriate causes. The arguments that point to inappropriate sources highlight the subjectivity in the identification process, inherent bias in the tests, discrimination, and socio-cultural differences between teachers and students (Dunn, 1968; Patton, 1998). Alternatively, disproportionality may be due to appropriate reasons. Donovan and Cross (2002) argue that certain minority groups are more likely to be exposed to poverty and environmental toxins, such as lead paint, which in turn increase the need for special education services. Hence, racial disproportionality in poverty could cause racial disproportionality in special education programs. Under the premise that disproportionality in poverty is causing disproportionality in special education, the overrepresentation in special education of the racial group most subjected to poverty and poor living conditions would be based on the students' need for additional services and would thus be an appropriate form of disproportionality in special education.

If participation in special education programs created strictly positive effects, then the overrepresentation of Black students seen since the 1960s would not be a concern. However, Hosp and Reschly (2003) summarize two avenues that would lead to deleterious consequences of special education programs. First, the actual label of special education may lower the teacher's expectations for the student. Second, the physical act of separating the special education students from the general education classroom could lead to lower levels of access to the curriculum. Therefore, if disproportionality was due to inappropriate identification practices, students incorrectly placed into special education programs would be unnecessarily exposed to these negative impacts.

This paper studies the effect of the financial regulations associated with the 2004 reauthorization of the IDEA in Michigan. The IDEA was originally passed in 1975 as an extension

of the Rehabilitation Act of 1973 with the goal of ensuring a free and appropriate public education to all students. The reauthorization passed in 2004, became effective during the 2005-06 academic year, and began sanctioning in Michigan during the Fall of 2007. It marked a clear change towards outcomes-based enforcement similar to No Child Left Behind (Ramanathan, 2008). In an attempt to lower disproportionality, Congress created financial penalties for districts found to have significant disproportionality, i.e., repeated instances of high levels of representational disparities.[5] The consequence for a significant disproportionality label is the reservation of 15 percent of federal IDEA flow-through funds for one year. In total, the Federal share of special education revenue represents 15 percent of all special education revenue since 2007.[6] These reserved funds must be used for Early Intervention Services targeted at the overrepresented racial group.[7]

In addition to the reallocation of the IDEA funds, districts with significant disproportionality face additional incentives to comply with the reduction of disproportionality. Penalized districts bare the time and resource cost of a state audit into the district's identification policies and practices. The IDEA reauthorization also required public reporting of the significant disproportionality label and the findings of the state audit, which could lead to public relations issues and pressure from the community.

In Michigan, significant disproportionality labels are determined by eligibility conditions and relative representation measures. For a district to be eligible for representation calculations within a particular racial group, it must include at least 10 members of the racial subgroup in the special education program, 30 or more students aggregated across all races

[5]While Congress outlined the structure for the sanctions, it gave states discretion over the formula, upper threshold, and repetition pattern.

[6]The estimate of the federal share of total special education revenue was based on the author's calculations using the baseline analytic sample of Michigan districts.

[7]Early Intervention Services are designed to provide young students on the margin of a special education label with additional support in an attempt to prevent the need for more extensive special education services.

in the special education program, and more than 100 total students not of the targeted race. Once eligibility is confirmed for a particular race, the state calculates what is called the verified ratio. The verified ratio can take on six different forms depending on the size of the district and its racial subgroups.[8] One common component across the formulae is the risk of special education, e.g., the Black risk of special education measures the number of Black students in special education divided by the total number of Black students.[9] The simplest form of the verified ratio divides the risk of one racial group by the risk of all other racial groups. Thus, a Black verified ratio of 2.7 means a Black student is 2.7 times more likely to receive special education services than a non-Black student. Finally, a district obtains a significant disproportionality label if its verified ratio for a particular race exceeds 3.0 for two consecutive years.

1.3 Data

While previous work studied the existence and causes of disproportionate representation, this paper is the first to quantitatively analyze the impact of significant disproportionality regulations under the IDEA 2004 on special education identification rates. To conduct this analysis, I use three data sources: the Michigan Compliance Information System (MI-CIS) Special Education Operating LEA Summary Report, the MI-CIS Special Education State-ISD Summary Report, and the Michigan Center for Performance and Information (CEPI) data reports. The MI-CIS data provide special education head counts by race while the CEPI data contain information on total enrollment by race and percent of students receiving free

[8]The six forms are designed to create comparability across the district and subgroup size distributions. The appendix provides a detailed discussion of the verified ratio calculation procedures.

[9]The Black risk is defined as the number of Black special education students divided by the total number of Black students enrolled in the district times 100: $\text{Black Risk} = \frac{\text{Number of Black Sp Ed Students}}{\text{Total Number of Black Students}} * 100$.

and reduced-price meals. The full panel data set covers 9,112 district-year observations for 851 traditional school districts and charter schools between the Fall terms of 2001 through 2011.[10,11]

The LEA Reports provide information regarding the district in which a student received her special education services. Three of the formulae for the final verified ratio used by the state employ this district of service data while the remaining three use district of residence data as a way to account for school of choice induced mobility. Because the state uses the lower of the verified ratios calculated with either the district of service or residence data, the verified ratios used in this paper are larger than or equal to those used by the state. As a result, my estimation strategy will treat some districts as affected by the policy when they were in fact not under pressure from the regulations. Assuming inaccurately labeled districts do not respond to the policy more than the districts actually facing the sanctions, the estimates of the effect of the IDEA 2004 will be attenuated toward zero.

To analyze the effect of disproportionality regulations, I restrict the full sample to district-year observations with eligible verified ratios, at least three consecutive years of prior eligibility, and non-missing lagged sanctions variables. The analytic sample includes 1,249 district-year observations for 183 districts from 2004 to 2011.[12]

[10]For simplicity, I will continue to refer to both traditional school districts and charter schools as school districts; however, the baseline analytic sample includes only traditional school districts.

[11]To protect the identity of individual students, the LEA Reports censor cells with low numbers of students. Prior to 2011, cells with less than 6 students were reported as missing while the cutoff was reduced to 5 students in 2011. This type of censoring does not affect the main results as districts need at least 10 students of a particular race in the special education program alone to qualify for disproportionality calculations. One of the validity checks of the baseline results extends the analysis to districts not eligible for calculations due to low student counts. In this case, I am only able to determine the special education head counts by race if the district had at least 6 total students of that race, which leaves 380 district-year observations in my sample period with unaccounted total special education enrollment out of the analysis. Note that I am able to determine the special education head count by race for districts with at least 6 total students of that race by using within race risk estimates in the LEA Reports through 2010.

[12]Charter schools are excluded from the base sample. When they are included in later analysis, 36 charter schools add 150 district-year observations. Of the 6,098 non-charter school district-year observations, 68 percent were dropped from the analytic sample because they failed to meet the disproportionality eligibility

Table A.1 presents district characteristics broken up by policy period and disproportionality status, i.e., a Black verified ratio above 3. Columns 2 and 4 show that Black overrepresentation existed in Michigan during the sample period. Prior to the 2007 policy change, a Black student was approximately 1.3 times as likely to receive a special education label compared to her non-Black counterpart when averaging across the state. Disproportionate districts during that same time identified Black students as needing special education services 4.3 times more often than their non-Black counterparts. Looking across the columns, the overall risk of special education remained relatively constant at 14 percent, which means that disproportionately Black districts do not also tend to have higher identification rates compared to the state as a whole. Separating the two main components of the Black verified ratio, Black and White risk, reveals that the overrepresentation is due to drastically larger shares of the total Black population in special education but not significantly lower shares of White students. Prior to the policy, the Black risk of 55.41 percent is 2.96 times larger than the average Black risk of 18.75 percent.

Comparing the total student populations across these groups shows that disproportionate districts had between 20 to 30 percent fewer students than the state average. Additionally, disproportionate districts have nearly 50 percent lower rates of free and reduced-price meal eligibility. The Black share of the total student population in overrepresented districts was roughly a tenth of the state average over the entire sample while the White share was nearly a third larger than the state average.[13] The stark differences in the White composition across district types suggests that students are more likely to be placed into a special education program the more dissimilar they appear to their peers, a relationship further investigated

requirements, i.e., they were not subject to the policy in that year.

[13]White (Black) composition is calculated as the total number of White (Black) students in a district divided by the total student population.

in Section 1.5.5.

The final three rows of Table A.1 attempt to describe the amount of services delivered to the average special education student.[14] The total special education expenditures and special education revenue from Federal sources, which is included in the total expenditure value, are higher in disproportionate districts.[15] Additionally, special education student-teacher ratios are 30 percent lower for districts with overrepresentation.

1.4 Identification Strategy

To examine the effects of the IDEA, I use a difference-in-differences approach, demonstrated in Figure D.1. The figure plots policy period means of the Black verified ratio for two types of districts: ones in penalty phases and ones in neither threat nor penalty phases. A district is in a penalty (threat) phase when it has two (one) consecutive years with a Black verified ratio above 3. Provided reducing disproportionality is within the scope of districts' abilities, financial sanctions associated with high levels of overrepresentation should cause districts to lower their levels of disproportionality. Figure D.1 shows that districts in a penalty phase prior to the existence of the disproportionality sanctions had average verified ratios of 5.57 while districts in a penalty phase during the policy period had lower mean Black verified ratios of 3.47: a statistically significant reduction of 38 percent. Making the same comparison for districts in neither threat nor penalty phases, we see an insignificant increase in the verified ratio. The crude difference-in-differences estimate of the effect of the significant disproportionality sanctions on the Black verified ratio is a reduction by 2.16

[14] These summarizations of the special education services delivered do not account for variation in student need across districts.

[15] The expenditure and revenue variables are per special education pupil and expressed as 2000 inflation-adjusted dollars.

mean points. The significant reduction in disproportionality for overrepresented districts and insignificant increase for non-overrepresented districts suggests that the financial regulations of the IDEA 2004 were successful at lowering the disproportionality levels in the targeted districts.

A regression-based difference-in-differences approach offers the advantage of estimating the effect of the policy while controlling for district observable characteristics and systematic differences between the treatment and control groups. The parameters of the policy determined the classification of the differencing groups. Because a significant disproportionality label requires two consecutive years of overrepresentation, the treatment group consists of districts with cases of disproportionality within the last two years. Whereas, the control group does not have a history of disproportionality within the past two years. Given that it takes two consecutive years of excessive overrepresentation to be penalized, it is possible that districts respond not only to the penalties themselves but also to the threat of penalty, i.e., exceeding the threshold for only one year. Thus, the empirical method must account for the differential effects of both threat and also penalty phases across the policy periods.

Looking only at districts eligible for calculations by the state, I compare the verified ratios of districts in either threat or penalty phases before and after the policy to districts not in any danger of penalty before and after the policy. I implement this approach using the following pooled OLS regression:

$$\begin{aligned} Y_{rdt} = \beta_1 + Z_{dt}\beta_2 + \beta_3 IDEA_t + \beta_4 Threat_{rdt} + \beta_5(IDEA_t * Threat_{rdt}) \\ +\beta_6 Penalty_{rd,t-1} + \beta_7 Penalty_{rdt} + \beta_8(IDEA_t * Penalty_{rdt}) + \epsilon_{rdt}. \end{aligned} \tag{1.1}$$

Y_{rdt} represents a relative measure of the probability of receiving special education services

for race r in district d at time t. The outcome variables, Y, used in this study are the Black verified ratio, Black risk, and White risk. The vector Z_{dt} contains a cubic in years since 2000 and control variables such as percent of students eligible for free and reduced-price meals and a quadratic of the White composition. $IDEA_t$ equals one for the post-policy years, i.e., 2007-2011. The indicator $Threat_{rdt}$ equals one when the verified ratio exceeded the cutoff of three in the previous year. $Penalty_{rdt}$ is an indicator variable equal to one if the district had two consecutive years with a verified ratio over three.[16] Thus whenever $Penalty_{rdt}$ equals one, $Threat_{rdt}$ must also equal one. The inclusion of $Penalty_{rd,t-1}$ allows the model to differentiate between districts in penalty once from districts in penalty for consecutive years. The use of the threat term means that both β_7 and β_8 are interpreted as the additional effect of being in the penalty phase. The interaction terms, $(IDEA_t * Threat_{rdt})$ and $(IDEA_t * Penalty_{rdt})$, are indicator variables that discern districts in threat or penalty phases between the pre and post-policy periods. In this specification, β_5 identifies the effect of the threat of penalty while β_8 isolates the additional effect of the penalty itself. Given this specification, the total effect of the policy equals the sum of β_5 and β_8. Lastly, standard errors are clustered at the district level, making them robust to heteroskedasticity and serial correlation (Bertrand et al., 2004). The benefit of the difference-in-differences specification is that it compares district-years over the disproportionality threshold to those below the threshold before and after the policy and thus yields easily interpreted results of the policy.

[16] Since the penalty and threat variables are functions of the lagged dependent variable, the inclusion of district fixed effects would violate the exogeneity assumption of the fixed effects model (Wooldridge, 2010).

1.5 Results

1.5.1 Difference-in-Differences Estimates

Table A.2 reports the estimates of the impact of the financial regulations of the IDEA 2004 on Black overrepresentation, based on Equation 1.1. Negative interaction terms would show that the policy caused districts with excessively high levels of overrepresentation to reduce their disproportionality compared to similar districts prior to the policy introduction. Column 1 presents the estimated effect on the Black verified ratio, the disproportionality measure of interest to the policy. The total effect of the disproportionality regulations of the IDEA 2004 on the Black verified ratio is -2.31, which means that districts in penalty phases after the policy had an average verified ratio 2.31 points lower than their similar pre-policy counterparts. This decline yields an average verified ratio much closer to the significant disproportionality threshold at 3.26. The estimate of the total effect represents a 41 percent reduction in the pre-policy mean for in-penalty districts.

The magnitude of the policy's effect is influenced by the fact that the districts targeted by the regulations have roughly 2 percent Black composition, resulting in larger relative changes in the Black risk and verified ratio for every reduction in Black special education head count. Putting the impact of the policy on students in context, penalized districts during the post-policy period provided special education services to 701 Black students and 8,742 non-Black students while enrolling a total of 1,901 Black students and 80,096 non-Black students.[17] While the total effect of the policy represents a large reduction in percentage terms, it is clear that a small number of Black students were directly affected by the policy.

Looking separately at the two components of the total policy effect for the Black verified

[17] The head count totals were calculated using district enrollment counts from the first year of penalty.

ratio, I find that the additional effect of the penalty, not the effect of the threat, is driving the significantly negative total effect. The post 2007 penalty estimate of -2.92 reveals that the sanctions induced a decline in disproportionality. Contrary to the hypothesis that districts in threat of sanctions during the policy period would lower their levels of disproportionality before actually being placed in a penalty phase, I find evidence that these districts had an insignificant, positive estimate of 0.61.[18] In sum, column 1 of Table A.2 shows that districts do not respond to the threat of sanctions but do reduce their levels of Black disproportionality once financial penalties are exacted.

Since the Black verified ratio compares the Black risk of special education, i.e., the proportion of Black students in special education out of the total number of Black students, to the non-Black risk, the verified ratio could be reduced by either decreasing the Black risk or increasing the non-Black risk. Column 2 of Table A.2 shows a similar pattern of effects as Column 1. The post-policy threat term is still positive and largely insignificant while the estimate for the additional effect of the penalties remains both negative and significant at -34.4. Overall, these estimates indicate that the policy reduced the proportion of Black students receiving special education services by 29.6 percentage points, a 44 percent reduction in the pre-policy mean among districts in a penalty phase. Given the racial distribution in Michigan and the fact that districts with high Black overrepresentation have a White composition of 89 percent, looking at the effect of the policy on the White risk should closely approximate the effect on the non-Black risk, which is the group of students most likely to see an increase in the verified ratio when the district is in a penalty phase for Black

[18] A *LexisNexis Academic* search for documents and articles discussing disproportionality was performed for each district that the State found to have significant disproportionality. The search produced zero results in news sources. The lack of evidence of the communities discussing the districts' threat or penalty statuses supports the evidence of financial penalties driving the reductions in disproportionality.

overrepresentation.[19] The estimated total effect of the policy on White risk is a statistically insignificant reduction by 1.83.

Columns 4 to 6 expand the first three columns by including charter schools into the analysis. While the regulations of the IDEA 2004 treat both traditional public school districts and charter schools the same, the baseline analysis excludes charter schools for two reasons. First, charter schools may be able to respond differently to the policy than the average school district because charter schools have total and special education enrollment counts 88 and 91 percent smaller than districts, respectively. Secondly, selection over the disability categories serviced between school districts and charter schools could lead to different impacts of the IDEA sanctions. Despite these concerns, the inclusion of the charter schools does not drastically alter the estimates or their interpretations. Thus, Table A.2 provides evidence that the financial regulations of the IDEA 2004 caused districts with significant disproportionality to lower their levels of Black overrepresentation, with this reduction achieved by curtailing the Black risk of special education.

1.5.2 Differential Effects

Because the districts are held accountable to disproportionality regulations each year, it is possible that the policy has differential effects between districts in their first penalty phase and districts with consecutive penalty phases.[20] The empirical specification used in Equation 1.1 does not distinguish separate policy effects between these two types of districts. I estimate these differential effects by partitioning the penalty variable into two mutually

[19] The censored nature of the special education data prevent me from accurately estimating the risks separately for members of the American Indian, Asian, Hispanic, and Multiracial subgroups.

[20] By first penalty, I mean first occurrence in a sequence of penalties and not the first penalty ever seen in a district.

exclusive variables based on the lag of the penalty variable: first penalty and consecutive penalty. If a district is currently in a penalty phase but was not in a penalty phase during the previous year, the first penalty indicator variable is set to one. Alternatively, when both current and lagged periods are in a penalty phase, the consecutive penalty indicator has a value of one. Replacing the penalty variable in Equation 1.1 with the first penalty and consecutive penalty variables allows me to estimate the total effects for districts in their first penalty phase separately from districts in multiple penalty phases.

Table A.3 presents the results from this differential effects estimation. Similar to Table A.2, the total effects are listed at the top of the table while the bottom of the table consists of the additional effect of each phase. Looking across the top section of Table A.3 shows that there is a difference in the impact of the sanctions depending on the district's pattern of disproportionality, i.e., the effect is larger for districts in their first penalty phase. The estimated total impact on Black verified ratio for districts in their first penalty phase is -2.57, and the estimate for districts with consecutive penalty phases is -2.05. These total effects of the policy fail to be significantly different from one another with a p-value of 0.77 and represent a 46 and 37 percent decrease in the Black verified ratio, respectively. The lower section of column 1 highlights the fact that the entire negative additional impact of the policy comes from districts entering their first penalty phase, as documented by the -3.18 estimate on the post-policy penalty interaction. Moreover, districts beyond their first penalty phase have a positive, though insignificant, additional effect of the IDEA 2004 sanctions. This pattern implies that the policy was effective at reducing the levels of disproportionality in districts first entering into a penalty phase but ineffective at continuing to lower Black overrepresentation in districts with consecutive penalty phases.

Given these findings and the lack of evidence of an effect of the threat phase from Ta-

ble A.2, it appears that the combination of financial sanctions, state audits, and reputation costs initiated in the first year of penalty drive the overall impact of the policy. While it is feasible that the reallocation of funds into Early Intervention Services would assist districts both in more appropriately identifying special education students and also in preventing the need for placement into special education programs, there are two reasons it is unlikely that this reallocation of funds led to these results. First, the policy has a strong effect in the first year but not in subsequent years, which would imply both immediate and short-lived benefits of the Early Intervention Services program. Secondly, districts had the opportunity to reallocate 15 percent of the IDEA funds towards Early Intervention Services regardless of their penalty status, so the districts could have achieved these results without being sanctioned.

Columns 2 and 3 of Table A.3 describe how the policy affected the two key components of the Black verified ratio, Black and White risks. Similar to the baseline difference-in-differences results, I find strong negative effects on Black risk but insignificant estimates on White risk. Again, the policy had the greatest impact among districts in their first penalty phase with an estimated 37 percent reduction from pre-policy levels. Among districts who remained in the penalty phase for multiple periods, the policy induced them to lower their Black risk rates by 16 percent. The differential total effects on Black risk are statistically different from each other with a p-value of 0.02. The bottom section of column 2 shows a 21 percent increase in Black risk as the additional effect of the sanctions on districts remaining in the penalty phase. Columns 1 and 2 demonstrate the effectiveness of the policy weakened for districts continually in penalty phases.

Incorporating eligible charter schools into the differential effects analysis yields results similar to those in columns 1 through 3. The estimates on Black verified ratio are slightly attenuated, and the total effect for first penalty exposure is imprecisely estimated. Comparing

the total effect estimates for Black and White risks shows that although the impact of first penalty on Black risk was 13 percent larger than the estimate without charter schools, the effect on White risk was 113 percent larger. Table A.3 also presents the first indication of statistically significant evidence of an effect of the policy on White risk. The additional effect of consecutive penalties on the sample including charter schools has an estimate of 4.76 while both differential total effects are still statistically insignificant. The weakly positive impact of the policy on districts in consecutive penalty phases would point to districts perversely lowering their disproportionality levels by increasing the denominator of the Black verified ratio, as opposed to reducing Black overrepresentation. The consistently large and significant effects on Black risk, however, provide overwhelming evidence that districts lowered disproportionality by reducing Black risk.

Table A.3 confirms the findings of the baseline difference-in-differences analysis. The financial penalties of the 2004 IDEA induced districts and charter schools to lower their levels of disproportionality by reducing their levels of Black risk. Moreover, the effects of the policy were strongest for districts in their first penalty phase and then slightly attenuated for districts in consecutive penalty periods.

1.5.3 Impact of Regulations on Other Outcomes

Extending the comparison of means evaluated in Table A.1, I investigate the impact of the IDEA regulations on outcomes not directly targeted by the policy. The existence of an effect could suggest important changes between the treatment and control groups across time that would compromise the difference-in-differences strategy. Table A.4 applies the empirical specification of Equation 1.1 on the following outcome variables: overall risk, total enrollment, Black composition, White composition, percent of students eligible for free and

reduced-priced meals, and special education student-teacher ratio.[21]

Table A.4 reports no effect of the policy on any of the independent variables. The overall risk of special education placement could have been affected either positively or negatively as an unintended consequence of the sanctions; however, there exists no evidence of either a total effect or an additional effect of the policy. Changes in the size, racial shares, or poverty status of the total student population would represent compositional changes in the control and treatment groups across time. I find no evidence of these types of compositional changes. Despite the penalties reallocating Federal funds away from special education services and also mandating greater Early Intervention Services, Table A.4 shows no impact on the special education student-teacher ratio. The only consistently significant effect across the columns of the table is the threat estimate, which was expected given the differences in means for the disproportionate districts compared to all districts observed in Table A.1.

In addition to the above outcomes, it is possible that the type of student receiving special education services changed in response to the reauthorization of the IDEA. To examine this issue and drawing upon prior evidence of overrepresentation of impoverished students in special education identification, I test for socioeconomic disproportionality in special education programs (Dunn, 1968). To implement this test, I analyze the relative rate at which special education students are eligible for free and reduced-price meals compared to general education students.[22]

Over the sample period, special education students had similar eligibility rates as to the

[21] The quadratic in White composition as a control variable was dropped from the regressions for Black and White composition. Likewise, percent of students eligible for free and reduced-priced meals was eliminated as a control in its own regression.

[22] Due to data limitations, special education student eligibility in free and reduced-price meals is available during the 2005-06 through the 2011-12 academic years. Similar to other variables collected from the LEA Reports, special education student eligibility in free and reduced-price meals also suffers from censored observations. Due to the data being censored when the headcount fell below 6, the following analysis relies upon 642 observations matching the baseline difference-in-differences sample.

total population of students, 44.8 percent compared to 44.3 percent, respectively. Calculating a verified ratio by free and reduced-price meal eligibility comparing special education students to general education students reveals that special education students were overrepresented in eligibility status by 28 percent. Table A.5 presents a crude difference-in-differences estimate of an insignificant reduction of 0.74 mean points for the impact of the penalties of the IDEA on socioeconomic overrepresentation. Additionally, Table A.5 shows that data availability and limitations force for the analysis of socioeconomic disproportionality to rely upon only 2 pre-policy instances of penalty phases. Finally, I applied the regression specification outlined in Equation 1.1 to the socioeconomic disproportionality measure; this analysis resulted in an estimated penalty effect of -1.71 (with a p-value of 0.36) and threat effect of 0.24 (with a p-value of 0.05). Thus, I find evidence of overrepresentation of students with lower socioeconomic status in special education programs but no effect of the regulations at reducing this disproportionality or changing the composition, outside of race, of students participating in special education services.

1.5.4 Validity of Difference-in-Differences Approach

The validity of the difference-in-differences results from Table A.2 depends upon the assumption of a common time trend. This assumption requires that without treatment, the treated and control groups would have followed common paths. If this assumption does not hold, the main results are biased.

To address this concern, I incorporate a third differencing group: districts ineligible for disproportionality calculations. Districts were classified as ineligible under Black special education identification if any of the following enrollment requirements were true: fewer than 10 Black students receiving special education services, fewer than 30 students of any race

in the special education program, or fewer than or equal to 100 non-Black students in the total student body. Due to a change in the availability of data in 2011, I am only able to identify the ineligible districts through 2010, which leads to an additional 201 districts with 705 district-year observations entering into the analysis.[23,24] The inclusion of the ineligible districts addresses the common trends assumption. If the eligible treated districts exhibited a different trend than the eligible control districts, by lowering their levels of Black overrepresentation over this time period for reasons other than the IDEA, we would expect to see a similar reduction in disproportionate representation for ineligible districts with Black overrepresentation.

Figure D.2 illustrates the policy period means of the Black verified ratio for ineligible districts by penalty phase. Calculation ineligible districts in penalty phases increased their pre-policy average Black verified ratio of 3.54 by a statistically insignificant 0.11 mean points. Likewise, the ineligible districts in neither threat nor penalty phases saw an increase in their average Black verified ratio from 1.29 to 1.51. These differences suggest that the policy had a statistically insignificant reduction of -0.11 mean points on ineligible districts in penalty.

In the difference-in-differences approach, I compared districts with a recent history of disproportionality to districts without that history before and after the policy. The difference-in-difference-in-differences approach extends this analysis by including ineligible districts

[23]For an ineligible district to avoid censored special education head counts for a given race, it must have at least six students of that race in either special or general education. Including the ineligible charter schools leads to the addition of 290 units with 1,007 observations.

[24]I also drop all district-year observations from the 2011-2012 academic year for the eligible districts.

with and without histories of disproportionality using the following specification:

$$Y_{rdt} = \theta_1 + Z_{dt}\theta_2 + \theta 3 E_{rdt} + \theta_4 IDEA_t + \theta_5(E_{rdt} * IDEA_t) + \theta_5 Threat_{rdt}$$
$$+\theta_6(E_{rdt} * Threat_{rdt}) + \theta_7(IDEA_t * Threat_{rdt}) + \theta_8(E_{rdt} * IDEA_t * Threat_{rdt})$$
$$+\theta_9 Penalty_{rd,t-1} + \theta_{10} Penalty_{rdt} + \theta_{11}(E_{rdt} * Penalty_{rdt}) + \theta_{12}(IDEA_t * Penalty_{rdt})$$
$$+\theta_{13}(E_{rdt} * IDEA_t * Penalty_{rdt}) + \upsilon_{rdt}. \tag{1.2}$$

E_{rdt} is an indicator variable equaling one when the district is eligible for the verified ratio calculation.[25] The inclusion of the eligibility term creates six new estimators and differentiates the effect of the policy between the district eligibility types.

Table A.7 presents the key estimates from Equation 1.2 and strongly supports the results from Table A.2. Including the third differencing group yields a similar estimated policy effect of -2.17 where again the impact of the penalty, $Post2007 * Elig * Penalty$, itself – not the threat, $Post2007 * Elig * Threat$ – is driving the result. In accordance with the hypothesis that ineligible districts with disproportionality would have no incentive to reduce their levels of overrepresentation, the estimates of $Post2007 * Penalty$ and $Post2007 * Threat$ are close to zero but imprecisely estimated. Similar to the difference-in-differences estimates, columns 2 and 3 indicate that the reduction in overall Black disproportionality was achieved by reducing the Black risk and not by increasing the White risk. Finally, the inclusion of the smaller charter schools in columns 4 through 6 only mildly dampens the estimated effect of the policy on the Black verified ratio and Black risk. Using the difference-in-difference-in-differences approach, I calculate that the penalties associated with the IDEA 2004 caused the Black verified ratio to drop by 39 percent and the Black risk to drop by 52 percent, which compare

[25] There are no cases of a district switching eligibility status while in either a threat or penalty phase.

closely to the difference-in-differences total effects of 41 and 44 percent, respectively. Since the difference-in-difference-in-differences approach served as a validity check of the baseline difference-in-differences identification strategy, the similarity of the estimates across models supports the use and reliability of the difference-in-differences results.

1.5.5 Did IDEA Reduce Inappropriate Disproportionality?

Figure D.3 further investigates the role of total White student composition on special education risk. Looking across the White composition distribution, I find that the risk for Black students increases as the percent of White students increases. Likewise, the special education risk for White students is largest in districts with the lowest shares of White students and decreases as the percent of White students grows. Figure D.3 demonstrates that for both White and Black students, the risk of special education increases the less the student looks like her peers, which is evidence supporting the existence of inappropriate identification.

This graphic, however, does not account for the possibility that poverty, or even relative resources, across races drives the levels of Black overrepresentation.[26] I address this alternative cause of disproportionality by assessing the role of White composition on risk of special education placement controlling for available financial resources and other possible factors using the following OLS specification:

$$R_{rd} = \gamma_0 + \gamma_1 F_d + \gamma_2 W_d + \gamma_3 Inc_{wd} + \gamma_4 Inc_{bd} + \eta_{rdt}. \tag{1.3}$$

R_{rdt} represents the median risk of special education placement for race r in district d for

[26] I looked at the potential role of teacher gender on risk of special education and found that it magnifies (attenuates) the estimate of White student composition on Black (White) risk. Due to limited data availability on teacher racial shares, the variable was excluded from the following regression.

years 2004 through 2009.[27] F_d is the median percent of students eligible for free and reduced-price meals in the district. W_d equals the median White composition of the district. The median White and Black incomes, in logs, within the district are represented by Inc_{wd} and Inc_{bd}, respectively.

Table A.8 reports the estimates of the factors in special education placement, based on Equation 1.3. Even after accounting for the impact of financial resources for White and Black households, the district's White composition plays both an economically and statistically significant role on the risk of special education placement with an estimated effect ranging between 9 and 11 percent. While Figure D.3 and Table A.8 do not provide conclusive causal evidence of inappropriate identification in Michigan special education placement, they do point to inappropriate identification as at least a partial reason for the disproportionality seen in the data.

1.6 Conclusion

The inappropriate identification of students into special education programs in the United States remains a legitimate concern. As Hosp and Reschly (2003) describe, placement into a special education program may harm a student by simply lowering the teacher's expectation for the student or limiting the curriculum and peer exposure the student experiences. In other words, inappropriate placement may jeopardize a student's achievement. Coupled with the fact that Black students are historically overrepresented in special education programs, it is apparent why Congress chose to include disproportionality regulations in the 2004 reauthorization of the IDEA.

[27] Median values during this time period were used to match the available income data from the 2009 5-year American Community Survey.

This study presented the first quantitative estimates of the effect of the financial sanctions associated with the IDEA 2004 using Michigan enrollment data. Unlike prior work, which analyzed endogenous variation in disproportionality, I was able to exploit the exogenous variation induced by significant disproportionality sanctions. The policy's requirement of two consecutive years of excessive disproportionality allowed for the analysis of the impact of the threat of sanctions separately from the impact of the sanctions. After confirming the existence of Black overrepresentation in Michigan during the sample period, the study showed that the financial sanctions themselves, not their threat, lowered disproportionality levels by 41 percent, The reduction in disproportionality effectively positioned the penalized districts at the threshold for the verified ratio. The lack of an estimated impact of the policy for districts in the threat phase shows that districts failed to lower their levels of Black overrepresentation before incurring penalties associated with the IDEA 2004, which further strengthens the impact sanctions had on district behavior. The results for the total effect of the IDEA 2004 show not only that the policy reduced disproportionality among overrepresented districts but also that lowering disproportionality is within the scope of school districts, a contested issue by itself (Byrnes, 2011).

Evaluating the potential success of the regulations hinges crucially on which groups are affected by lowering Black disproportionality. The baseline approach found that a 44 percent drop in the risk of special education for Black students created the reduction in overall Black disproportionality. Since the policy's sanctions were based on a disproportionality measure comparing the risk of special education placement among Black students to the risk among non-Black students, districts with high levels of Black overrepresentation could have avoided penalties by solely increasing the risk of the non-Black student population. Extending the baseline analysis to the risk of special education for White students, the racial majority in

Michigan, failed to reveal this perverse behavior, as estimates were insignificantly negative.

To address the concern of differential effects of the policy, the baseline specification was modified to account for the effect of the first penalty separately from the effect of consecutive penalty phases. The results echo the original findings in that sanctioned districts reduced their levels of disproportionality by lowering the risk of special education for Black students. Moreover, this analysis also revealed that the policy had its strongest effect on districts in their first penalty phase.

As a means to verify the validity of the assumptions needed by the difference-in-differences strategy, a third differencing group of ineligible school districts was added to the study. The addition of this group provided evidence of the common time trends assumption. The results of the difference-in-difference-in-differences specification upheld the earlier estimated total effects of the policy and thereby support the difference-in-differences approach.

This paper demonstrates policy-induced reductions in Black overrepresentation and sheds light on the student well-being effects of disproportionality regulations. If disproportionality existed due to inappropriate identification, perhaps due to discrimination, then the policy successfully lowered the unnecessary exposure to special education for some students, thereby increasing student well-being for those students who would have otherwise participated in special education programming. Alternatively, under the assumption that disproportionality exists due to justifiable reasons, e.g., racial disproportionality in poverty rates, the IDEA 2004 may have in fact harmed students by creating artificial costs to placement and thus preventing students from receiving the services they need. By showing that the racial composition of one's peers correlates with one's own risk of special education after accounting for the relative income gap between races, I argue that this relationship provides evidence of inappropriate identification partially leading to Black overrepresentation in Michigan. The

indications of inappropriate identification combined with the policy's requirement of Early Intervention Services for students of the overrepresented race leads me to conclude that the disproportionality regulations of the IDEA 2004 increased student well-being for students otherwise likely to participate in special education programs.

Chapter 2

Disparities in Special Education Identification: Evidence from Michigan

2.1 Introduction

Special education programs provided by the Michigan Department of Education served nearly 218,000 of Michigan's 1.6 million students in 2011. Those students received individualized instruction and assistance for disabilities including vision, hearing, cognitive, and emotional impairments. The Michigan Office of Special Education provides those services in an effort to guarantee a free and appropriate public education.

Beyond its size, Michigan's special education program is costly. In 2010, Michigan received 389 million dollars in federal funds for special education services and contributed over 964 million dollars of its own funds for special education. The instruction of these special education students required over 19 thousand full-time equivalent (FTE) special education instructors and aides. Overall, the Michigan special education program educates over thirteen percent of the students in the state while employing thousands of teachers and using over 1.3 billion dollars.

Given the value of the services provided as well as the cost, it is important to understand the determinants of special education placement. This paper addresses this need by examining disparities in special education participation, intensity, and services across racial, socio-economic, and school-level dimensions. To what degree does special education identification vary by family and community resources? How does the composition of students

in a district correspond with the level and type of special education services provided in the district? To analyze the socio-economic dimension, I focus on three measures of family and community resources: the share of students eligible for free and reduced-price meal programs, the taxable values of homes within the district, and the median household income within the district. The potential disparities in special education across racial dimensions are investigated by focusing on the share of White students in the district. Finally, I analyze the role of district characteristics by focusing on district financial budget, urbanicity, and standardized test score performance.

The motivation to examine disparities in special education stems from a large literature documenting known differences in participation rates. Beginning in 1960s, researchers and policymakers have discussed the racial and socio-economic disproportionalities in special education programs (Dunn, 1968).[1] Between 1975 and 2004, Black students have maintained nearly double their expected participation rate in the cognitively impaired category conditional on their share of the student population (Patton, 1998).[2] More recently, researchers have shown that conditional on demographic and economic variables, the overrepresentation of Black students labeled as cognitively impaired persists; however, the inclusion of prior academic achievement diminishes those findings (Hibel et al., 2010; Hosp and Reschly, 2004; Oswald et al., 1999). Evidence supports the claim that it is within the scope of districts

[1] While medical health outcomes are a separate entity from special education outcomes, it is important to note that racial disparities also exist in youth health outcomes. Research has documented that Black students are less likely to receive mental health services compared to their White counterparts. Additionally, the relationship between health services receipt and education switches sign across races: an increase in education is associated with a decrease (increase) in service receipt for Black (White) young adults (Broman, 2012). In a similar vein to this paper, a recent study demonstrated that Black young adults who attended schools with higher White student composition report poorer health outcomes than Black young adults from lower White composition schools (Goosby and Walsemann, 2012).

[2] The 2004 estimates are from the author's calculations using the National Center for Education Statistics' Common Core of Data and the Data Accountability Center's IDEA Data (National Center for Education Statistics, U.S. Department of Education, 2013).

to affect their levels of disproportionality: districts have been shown to respond to financial incentives to lower the overrepresentation of Black students (Enayati, 2014). Focusing specifically on Michigan, variation in special education services may be the result of the four-part system of funding special education programs (Jalilevand and Conlin, 2014).

The remainder of this paper will proceed as follows. Section 2 outlines the data sources used in this analysis. Section 3 provides both a graphical illustration of dimensions of special education disparities and also a regression framework to quantify the associations between the dimensions and the special education measures. Finally, I provide concluding remarks in Section 4.

2.2 Data

This paper relies on six different data sources to generate variables and trends of value to its objective. The data are broken down into four categories: special education specific data, general Michigan school data, district characteristics data, and finance data. The special education head count data come from the Michigan Compliance Information System (MI-CIS). MI-CIS provides district-level reports on special education variables for the academic years 2002-2003 through 2010-2011. The advantage of the MI-CIS is that they provide special education head counts by race and disability category, separately.[3] The MI-CIS reports detail head counts for thirteen disability categories: cognitive impairment, emotional impairment, hearing impairment, visual impairment, physical impairment, speech and lan-

[3]In an attempt to protect the identity of individual students, the LEA Reports censor disability category and race cells with less than six students of that disability category or race (across special and general education) in the district, respectively. This censoring introduces missing values into the data set. The concern over the reliability of measures based on counts from districts with less than six relevant students gives perspective to the value of these cells.

guage impairment, early childhood developmental delay, specific learning disability, severe multiple impairment, Autism spectrum disorder, traumatic brain injury, deaf-blindness, and other health impairment.[4] The special education FTE data come from the Michigan Department of Treasury's Tax Policy Analysis division.[5,6] The ratio of a district's special education FTE and its special education head count measures the average amount of special education time each student with a special education label receives. This metric provides a sense of the intensity, in terms of time, of special education services provided to special education students.

The general education enrollment and student count data come from the Michigan Center for Performance and Information (CEPI). CEPI offers multiple data sets at the district level. This paper uses CEPI data to determine measures of total enrollment, total enrollment by race, special education enrollment, share of eighth grade students who met or exceeded the standardized math test, and percent of students eligible for free and reduced-price meals.[7] Among the students present on the days the MEAP is administered, the population of exam takers includes general education students as well as the special education students whose individualized education plans hold them, with the addition of test accommodations, to the same standards as the general education students. The combination of the special education and CEPI data creates the special education participation rates used in the analysis.

The urbanicity measure was obtained from the National Center for Education Statis-

[4]In this paper, I aggregate hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness into a single category called Physical. This aggregation does not suggest equivalence among the needs of students with these disabilities; rather, these variables were grouped together to assist in the analysis due to their small share of all special education students.

[5]The Michigan Department of Treasury obtained the FTE values from the Department of Education.

[6]The author thanks Michael Conlin for sharing these data.

[7]Proficiency is determined by the student's performance on the eighth grade math section of the MEAP exam. The Michigan Department of Education assembles a panel to determine the cut scores required for a student to met or exceed proficiency standards (MDE, 2008).

tics' Elementary/Secondary Information System's urban-centric locale variable. Using 2000 Census geography and the district's address, the urbanicity measure describes a district's proximity to populous areas by assigning it into one of twelve categories. The categories are a function of two sets of labels, area type and size. For the purposes of this essay, the size dimension was eliminated, which reduces the categorizations to four types: city, suburb, town, and rural.

Finally, the financial data were obtained from the Michigan Department of Education Bulletin 1014, which houses district-level data on revenue and expenditure categories, and the American Community Survey. Homestead taxes are determined by the taxable value for primary residences but do not include businesses, rentals, and secondary homes. Homestead taxable values serve as a good proxy for the value of the homes occupied by the students of that district and act as a finer measure of family resources than the binary variable of free and reduced-price meals. To allow for comparability across districts, taxable values were adjusted to measure per pupil dollars.[8] The per pupil adjustment is by the total number of pupils in the district. District budgets are defined as the operating income's percent of total revenue.[9] This measure of budget attempts to capture the short-run financial stress faced by districts. The median household income variable comes from the American Community Survey's 2009 five-year measure, which draws upon data collected between 2004 and 2009. Given that the district-level household income measure requires five years of collection, each district has one median income value replicated for all years where the district is observed in the panel.

The sample of districts used in this paper pulls information from the five sources detailed

[8]Homestead taxable values were converted into 2010 U.S. dollars using the Consumers Price Index.

[9]District budget equals the difference between total revenue and total expenditures divided by total revenue times one hundred.

above. In total, I have 4,198 district-year observations covering 505 traditional public school districts between the 2002-03 and 2010-11 academic years. The analysis of this sample relies upon figures generated using kernel-weighted local polynomial regressions. The advantage of this type of scatterplot smoothing procedure is that it allows me to avoid making functional form assumptions about the relationship between variables.[10]

Table B.1 presents the summary statistics for the sample of districts. On average, districts identified 13.6 percent of their students for special education programs. The average student in a district spent 3.6 percent of their time in school receiving special education services. The special education intensity measure of 0.26 means that the average special education student spent a quarter of her day receiving special education services.

A courser measure of intensity is represented by the share of special education students that spend at least 80 percent of their school day in the general education classroom. While the special education FTE variable is a continuous measure within the unit interval, the share of students in general education classrooms for at least 80 percent of the day is a function of a dichotomous variable. Additionally, this new measure is only available for the 2011-12 academic year, which is outside of the sample used in this paper. As a check of the data quality of the FTE measure, I examined the correlation between the 2010 district-year observations of special education intensity and the 2011 district general education value, which is -0.65.[11] This analysis supports the use of the FTE measure within this paper.

A summary of demographic characteristics shows that the average district is located in communities with an average homestead taxable value of 130 thousand dollars per pupil

[10]It is important to note that this style of analysis is meant to provide a description of the correlation between special education participation and several dimensions. It does not allow the author or reader to draw causal claims.

[11]Figure H.2 presents a scatter plot of the relationship between special education intensity and the share of students in general education classrooms for at least 80 percent of the day.

and had a median household income of 50 thousand dollars. Districts report 38 percent of their students eligible for free and reduced-price meals. As indicated by the budget measure, districts' total revenue exceed their total expenditures by six-tenths of one percent of their total revenue. Considering district racial composition, 86 percent of districts' total student body identify as White. The urbanicity measure reveals that the majority of districts are categorized as either rural or suburban, 49 and 26 percent, respectively. The final district demographic is the percent of students who met or exceeded the eighth-grade math standard. Table B.1 shows that the average district had over 68 percent of its eighth graders score as proficient or above.

Finally, the risk of special education measures describe the likelihood that a student of a particular race participates in special education programs.[12,13] For example, the White risk measure of 14.2 means that, for the average district, one-seventh of all its White students are identified into special education programs. The risks for both White and Hispanic students are close to the average participation rate of 13.6 percent. On the other hand, Black students are more likely to receive a special education label - as they have a risk of 19.4 percent. This overrepresentation of Black students in special education programs is initial evidence of disparities in special education placement by race, which will be examined further in the following section.

[12]The lower number of observations for the risk of special education variables is due to the censored special education by race data from the MI-CIS reports.

[13]The risk of special education is not reported for American Indians, Asians, or Multiple Races students, but their enrollment counts are included in the calculations.

2.3 Findings

2.3.1 Special Education Identification and Services Delivered

Variation in family resources corresponds with disparities in special education placement. One potential explanation for the disproportionate representation of Black students in special education is that race acts as a proxy for poverty which induces appropriate disproportionality (Donovan and Cross, 2002; Dunn, 1968; Patton, 1998).[14] Figure E.1 plots the relationship between special education participation and a proxy for family resources, the natural log of homestead taxable values per pupil. All three measures of participation decline over the taxable values distribution. The 5 percent drop in special education head counts per total pupil count from 14.1 percent to 13.3 percent indicates that districts with higher taxable values tend to identify more students into special education programs. The 54 percent drop in participation rates by FTE, from 6.1 percent to 2.8 percent, shows that high taxable value districts provide less special education services to the average student from the total student population compared to districts in communities with lower taxable values.[15]

The special education intensity measure focuses on the amount of time a special education student receives special education services. Confirming findings by Jalilevand and Conlin (2014), Figure E.1 shows that, on average, special education students from districts in the highest taxable value per pupil communities spend 22.1 percent of their time in special

[14]Here, the racial disproportionality in special education participation is driven by the racial disproportionality in poverty. This type of disproportionality is considered "appropriate" because exposure to poverty has been shown to increase the need for special education services. The alternative to appropriate disproportionality is inappropriate disproportionality, which is often explained by discrimination.

[15]In this paper, the amount of services received, when discussing special education intensity and FTE measures, refers specifically to the amount of time spent receiving those services.

education programs; whereas, special education students attending districts in communities from the far left tail of the distribution spend only 35.6 percent of their time at school receiving special education services.[16] This difference represents a 38 percent reduction in the amount of services received.

Jalilevand and Conlin (2014) assert that the negative relationship between special education intensity and homestead taxable values is due to differences in the disability categories served in districts across the taxable value distribution. Figure E.2 considers this claim by examining the identification patterns by disability category. Figure E.2 shows that the least wealthy communities have 14.6 percent of their special education students identified with a cognitively impaired label while the wealthiest communities have only 6.6 percent. Likewise, moving from the left to the right tail of the taxable value distribution corresponds to 113 percent, 81 percent, and 19 percent growth in other health impairments, Autism spectrum disorder, and speech and language impairments, respectively. A relative comparison of disability category intensities reconciles the drop in intensity seen in Figure E.1 with the results of Figure E.2. The average intensity measure for students with Autism is 0.89 while cognitively impaired students have an average intensity of 0.83 (Michigan Department of Education: Office of Special Education, 2008).[17] Thus, the drop in overall intensity is due to the larger decline in the share of students with a cognitively impaired label.

While the shares of students with cognitive impairments and Autism spectrum disorder move in opposite directions as the wealth of the community increases, it is unclear whether these patterns are driven by different types of students across districts or differences in how

[16] The taxable value measure is adjusted to represent the taxable values per total student in the district. The special education intensity measure reports the share of a special education student's day that is spent receiving special education services.

[17] Within disability category intensities were calculated by the author using the tables provided in the 2008 MDE OSE Report.

districts are labeling students into special education programs. Focusing on the features which may lead to differences in the way districts label students, two elements are examined: the extent to which the categories have overlapping criteria and the cost of servicing categories.

Overlapping criteria present the greatest concern in this context for the categories described as "soft" due to the subjective judgments factored into the determination of a special education label (Harry and Anderson, 1994; Hibel et al., 2010).[18] In their 2010 paper, Hibel et al. argue that, among the soft categories, it is necessarily true that the normative standards used in the labeling process are based on the sample of peers within the school. Thus, we would observe differences in who is identified under various categories when we look across districts. Focusing on the malleability, as a function of the Michigan guidelines for special education identification, of cognitive impairment and Autism spectrum disorder reveals that the categories have one overlapping condition, low academic performance. However, Autism spectrum disorder does not demand an academic deficiency while a cognitive impairment label requires below average academic performance, i.e., two standard deviations below the mean on intellectual assessments and standardized math and reading scores in the bottom six percentiles. Additionally, Autism spectrum disorder has been described as a "cognitive style" not a "cognitive deficit," as evidenced by local cognitive strengths, e.g., savant skills with a specific topic, alongside "weakened [global] coherence" (Happé, 1999; Happé and Frith, 2006). While it is true that cognitive impairment and Autism spectrum disorder share common criteria, the Michigan Department of Education clearly describes cognitive impairment as lying in the cognitive domain whereas Autism spectrum disorder manifests

[18]Soft categories include cognitive impairment, Autism spectrum disorder, specific learning disability, as well as speech and language (Harry and Anderson, 1994; Hibel et al., 2010).

primarily through impairments with social interaction and communicative behavior.

The second element that may contribute to the way in which districts label students is the related cost of providing the services. The average costs per special education pupil for programs and services varies greatly by category (Michigan Department of Education: Office of Special Education, 2008). Among students in the general education setting receiving services only, the per pupil cost ranged from $2,569 for speech services to $6,304 for learning disability services. Special education programs have higher individual costs and a wider distribution with early childhood programs costing only $17,687 per pupil and visual impairment programs costing $76,877. The expense of the program may by a key factor in the observed pattern in the relative shares of students with cognitive impairments and Autism spectrum disorder. The cost of cognitive impairment programs ranges between $19,737 and $35,645 per pupil for mild to severe labels, respectively. Alternatively, the average cost of an Autistic impairment program is $52,762. One important factor in the cost of the programs is the maximum student-to-staff ratio requirements: 2.5:1 for Autistic impairment and between 3.75:1 and 15:1 for cognitive impairment.[19] Thus, districts in economically disadvantaged communities may not be able to afford the additional expense of providing Autistic impairment services, which may lead to the observed opposite trends seen in Figure E.2.

Figures E.3 and E.4 illustrate the role of household income on special education disparities. Median household income within a district provides another measure of the socioeco-

[19]The student-to-staffing requirements are complex functions of both the maximum number of students allowed in a single classroom program and also a additional number of students that would require an additional aide (Michigan Department of Education: Office of Special Education, 2008). If a district offers just one classroom program for Autistic impairment, the maximum number of students is five. If the district offers multiple programs for Autistic impairment, the average student-to-staff ratio can not exceed five. In both of the prior two cases, an aide is required if there are more than two students in the program. On the other hand, the ratios for cognitive impairment programs depends upon the type of impairment: mild, moderate, or severe. In high schools, the maximum number of students with a mild cognitive impairment label allowed in a program with just one teacher is fifteen. The cap of fifteen students with a severe cognitive impairment requires one teacher and three aides.

nomic status of families within the community. As with homestead taxable values, both the participation rate and intensity decline over the income distribution, by 18 and 46 percent respectively. While the percent of special education students with a cognitively impaired label fell by 8 percentage points over the homestead value distribution, it dropped by 10.6 percentage points moving across the income distribution. When using a different measure of family and community resources, this paper continues to demonstrate large disparities in special education participation, intensity, and category.

The percent of students eligible for free and reduced-price meals serves as another proxy for family resources. Figure E.5 shows that participation via head count and FTE is increasing but that the FTE rate is growing faster, illustrated by the rise in intensity. Districts with less disadvantaged students have the lowest intensity as well as participation by either head count or FTE. Again, I find that as districts serve more disadvantaged students they tend to also have higher shares of students with cognitive impairments and lower shares of students with other health impairments, Autism spectrum disorder, and speech and language impairments. The sharp drops seen at the far right tails in Figures E.5 and E.6 are supported by far fewer observations than the rest of the distribution, as shown by the wide confidence intervals and the fact that the 95^{th} percentile of the free and reduced-price meal distribution has a value of 69 percent. Given the correlation of -0.49, the similar results between free and reduced-price meal eligibility and the examination of disparities along homestead taxable values provides evidence of the robustness of the findings along the family and community resources dimension.

The next set of dimensions considered in this analysis are the characteristics of the districts themselves. The district budget measure used in this paper reports total revenues in excess of total expenditures as a percent of total revenues. While there is variation in the

budget variable, as evidenced by the standard deviation of 3.14, Figures E.7 and E.8 demonstrate no relationship between the distribution of budgets and special education disparities. Participation rates drop by only 1.1 percentage points, and moreover have maximum and minimum values with overlapping 95 percent confidence intervals. Overall, the graphic evidence does not support the existence of a relationship between district budgets and special education disparities.

Another potentially impactful characteristic of districts is the urbanicity. Figure E.9 shows participation is fairly flat over the four categories of urbanicity but the FTE measure drops more substantially, as seen by the 31 percent drop in special education intensity. Although the urbanicity and community resource measures, i.e., homestead taxable values and median household incomes, portray similar patterns in intensity, the urbanicity measure is not simply another proxy for community resources. Calculating the average median household incomes for each urban locale, I find a non-monotonic relationship: 46 thousand dollars in cites, 57 thousand dollars in suburbs, 47 thousand dollars in towns, and 48 thousand dollars in rural locations. While Figures E.1 and E.3 would suggest that cities, towns, and rural locations have similar special education intensities with a lower value for suburbs, Figure E.9 illustrates a monotonic decline in intensity as proximity to populous areas decreases. Similar to the above findings, Figure E.10 shows that lower intensity districts have relatively higher shares of students with specific learning disabilities and other health impairments.

Figures E.11 and E.12 illustrate the relationship between special education disparities and district academic performance. The results follow the same patterns as the disparities seen over the community resource dimensions. Namely, large declines in both participation and intensity, reductions of 34 and 60 percent, respectively. Also, the districts with the highest intensity have the highest share of students with a cognitive impairment label and

the lowest shares of students with Autism, speech and language impairments, and other health impairments.

The final dimension considered in this analysis of disparities in overall special education participation is the racial composition of the district. Here, I examine the relationship between special education status and the share of the total student body that is White. Figure E.13 demonstrates that having a higher White student composition corresponds with both lower proportions of students participating in special education programs and also lower intensity of services. The share of students with a special education label falls by 23 percentage points while the intensity of services drops by 48 percentage points. As seen in earlier graphics, Figure E.14 shows that higher shares of cognitively and emotionally impaired students correlates with higher overall intensity. Matching well with the literature documenting racial disproportionality, Figures E.13 and E.14 illustrate the observation that the districts with the fewest White students, which in Michigan corresponds with high Black student composition (correlation of -0.88), have the highest special education participation rates, highest intensity, and largest shares of cognitively impaired students (Donovan and Cross, 2002; Oswald et al., 1999).

2.3.2 Differential Participation Patterns by Race

This section of the analysis dives deeper into racial disparities in special education by examining within race participation rates, i.e., risks of special education. Figure E.15 extends the analysis of Figures E.13 and E.14 by plotting the risks of special education for White, Black, and Hispanic students over the White composition distribution. The White risk is highest in districts with the fewest White students and lowest in the districts with the most White students: dropping by 29 percentage points. Likewise, Figure E.15 illustrates that as the

White composition of a district increases, the Black risk steadily increases by 6.0 percentage points, which represents growth of 40 percent. As in Enayati (2014), Figure E.15 portrays a system where the more dissimilar a student looks to her peers, the more likely she is to participate in special education programs.

Comparing the socio-economic dimensions in Figures E.16 through E.18 reveals similar patterns. Hispanic participation rates are relatively flat across all three dimensions. Black students are more likely to participate in special education programs if they are enrolled in less disadvantaged districts. On the other hand, the White risk increases as districts become more disadvantaged. These patterns could be explained by the relative relationship between each of these dimensions and White composition. The percent of free and reduced-price meal eligible students drops by 44 percentage points over the White composition distribution while taxable values increase by 0.81 log points.[20]

The role of school characteristics on racial disparities in special education placement are examined in Figures E.19 through E.21. Similar to the earlier results, separating the risk of special education participation by race over the budget measure does not reveal any strong patterns of disparities. On the other hand, racial risk by urbanicity and academic performance reveal stronger results. White risk drops by 16 and 75 percent over the urbanicity and performance measures, respectively. Over the same two dimensions, Black risk increases by 19 and 27 percent, respectively. The patterns observed in the socio-economic and school characteristic measures are strikingly similar, which then suggests that some variables may be acting as proxies for other impactful dimensions. In the following section, I use a regression framework analysis, which allows me to examine the correlations between participation and the socio-economic and school characteristics dimensions while controlling for the White

[20]See Appendix Figure H.1 for the relevant analysis.

composition.

2.3.3 Regression Framework

Figures E.1 through E.21 illustrate the piecemeal relationships between special education participation rates and racial, socio-economic, as well as school characteristic measures. To provide a sense of the relative correlation of each disparity dimension on placement rates while also accounting for the other dimensions, I consider the following linear probability model:

$$Y_{it} = \beta_0 + \beta_1 HTV_{it} + \beta_2 FARM_{it} + \beta_2 W_{it} + \beta_3 B_{it} + \beta_4 M_{it} + C_i\beta_5 + \delta_t + \epsilon_{ij}, \qquad (2.1)$$

where Y_{it} represents the special education participation measure of interest for district i in year t.[21] Special education participation measures include special education rates by head count and FTE, intensity, and risk of special education by race. To facilitate the interpretation of the table, I convert all special education participation measures to percent values, laying between zero and one hundred. HTV_{it} is the log of per pupil homestead taxable values. $FARM_{it}$ and W_{it} refer to the percent students in the district that are eligible for free and reduced-price meals and the White student composition of the district, respectively. B_{it} and M_{it} represent the budget and math test scores, respectively. School characteristics are contained within C_i: log of median household income and urbanicity measures. The δ_t term accounts for year fixed effects. Standard errors are made robust by clustering at the district level.

Columns 1 through 3 of Table B.2 report the estimates of the disparities in special

[21] These estimates describe the associations between the dependent and independent variables and do not support causal claims.

education identification using Equation 2.1. Looking across these three columns reveals that only a subset of the analyzed regressors have a statistically significant association with the dependent variable after conditioning for the full set of independent variables. Notably, the special education measures considered in columns 1 through 3 do not have a strong relationship with either the budget or median income measures but do have statistically significant associations with taxable homestead values, free and reduced-price meal eligibility, racial composition, academic performance, and urbanicity. For example, column 1 indicates that increasing the homestead taxable value by one percent corresponds to a 0.008 percentage point increase in the special education participation rate. Likewise, increasing the share of students who at least met the math standards by 1 percentage point is associated with a 0.6 percentage point reduction in participation. The intensity measure in column 3 shows similar results to column 1 with the exceptions that the impact of homestead taxable values now dominates over the impact of free lunch. Additionally, the White compositon of a district is a significant predictor of intensity. A benefit of the regression framework over the graphical analysis is that we are able to observe that both the homestead taxable values and free and reduced-price meal eligibility are both significant predictors of participation rates even after controlling for the other, with a one percentage point increase in free lunch eligbility linked to a 0.05 percentage point increase in participation.

The disparities in racial risk levels are considered in columns 4 through 6. The evidence suggests that community resources, as measured by homestead taxable values, are positively associated with White and Black risks of special education. Alternatively, academic performance and urbanicity are now only significant in one of the two main risk categories.[22]

[22] As evidenced by the graphical analysis, the variation in Hispanic risk is poorly captured by the dimensions examined in this anaylsis.

Finally, the White composition of the school district has estimates of opposite sign between White and Black risks, i.e., increasing the White composition by one percentage point corresponds to a 0.1 percentage point decrease in White risk but a 0.08 percentage point increase in Black risk. Thus, the regression framework supports the eariler conclusion that looking dissimilar to one's peers increases the probability of special education participation.

2.4 Conclusion

Special education programs in Michigan provide services to one in every seven public school students. The average additional cost of educating a special education student in 2007 was $11,551 compared to the average K-12 student cost of $9,177 (MDE, 2007). Given the prevalence and cost of the program, it is crucial for educators and policymakers to understand the current patterns and disparities in special education participation.

This paper first addressed disparities in overall special education identification and services by exploring the role of family and community resources on special education participation. Evidence consistently indicates that districts serving more economically advantaged families and communities provide less intense special education services, which appears to be driven by lower participation rates. Specifically, the share of a special education student's day spent receiving special education services is the lowest in the most advantaged districts. The reasons for this pattern should be investigated further. It could be due to variation in the need for special education services, as in poverty leading to higher special education participation, variation in the involvement of and advocacy by parents in the identification process, or as a consequence of the special education funding system in Michigan (Donovan and Cross, 2002; Dunn, 1968; Jalilevand and Conlin, 2014; Patton, 1998).

Disparities associated with school district characteristics were the next dimension examined in this essay. While the district's budget is not correlated with the special education disparities investigated in this study, both district academic performance and urbanicity are strong predictors of special education participation and intensity. There exists a monotonic reduction in intensity levels as the proximity to an urban locale decreases. Evidence strongly supports a negative relationship between district-averaged academic performance and both special education participation and intensity. Moreover, the urbanicity and performance relationships persist after controlling for the influence of community financial resources.

Finally, this paper demonstrated a strong correlation between special education placement and district racial composition. Special education intensity drops as the White composition of a district increases. Moreover, I support earlier suggestive evidence of inappropriate identification practices by showing that a student's probability of being in a special education program increases as she looks, in terms of race, more dissimilar to her peers (Enayati, 2014). Hosp and Reschly (2003) document that a special education label may harm some students by either lowering the teacher's expectations for the student or reducing the access to the general education curriculum. Given special education costs as well as the potential for negative side effects, the disparities of who is placed into special education programs and why they are identified needs to be further understood so as to assure the most beneficial learning environment for all students.

Chapter 3

Class Size and Special Education Placement: Revisiting Tennessee's Project STAR

3.1 Introduction

In 2011, federal grants allocated to states for special education programs totaled over 12 billion dollars, representing 35 percent of all federal funds distributed to elementary and secondary programs. These funds provided services to 13 percent of all K-12 students (National Center for Education Statistics, U.S. Department of Education, 2013). A central tenet of the Individuals with Disabilities Education Act, the federal act under which special education funds are distributed to states, is access to free and appropriate public education, which among other criteria is designed to meet the individual needs of the student and result in educational benefits. Special education programs are large in scale, costly to fund, and provide critical services to disadvantaged students. It is thus essential to understand the factors that influence the identification of students with disabilities.

Early research in the field documented the roles of race and socio-economic status in determining special education placement by demonstrating racially disproportionate representation of Black students with a cognitively impaired label (Dunn, 1968). Between 1975 and 1991, Black students represented roughly double the expected share of students with a cognitively impaired label given their share in the total population (Patton, 1998).[1] In addition to the overrepresentation of Black students in special education programs, male

[1]This expectation is under the assumption that all children, regardless of race, have the same propensity for conditions requiring special education services.

students have a history of out numbering female students with an odds ratio of at least 2:1 since 1976 (Coutinho and Oswald, 2005; Oswald et al., 2003).

More recently we have gained a richer understanding of how school-level characteristics influence special education participation rates. Hibel (2010) found schools with higher minority populations corresponded with a lower likelihood of a special education label while increases in socio-economic status were associated with higher participation rates. A potential explanation for these findings is that wealthier schools have more resources available for special education programs and thus offer services to more students. Recent work in health economics has shown that both the absolute and relative age of a student within his or her school effects the likelihood of a determinant of mental health diagnoses (Elder, 2010; Elder and Lubotsky, 2009; Evans et al., 2010). Overall, a large body of literature has documented the significance of student-specific and school-specific characteristics on the probability of participating in a special education program.

A current method of special education identification is the Responsiveness to Intervention (RTI) approach (Fuchs et al., 2003). One of primary goals of RTI is to accurately identify students with disabilities (Fuchs and Fuchs, 2009). With the support of the professional community, Congress included provisions in the 2004 reauthorization of the Individuals with Disabilities Education Act that permit states to use strategies similar to those outlined under the RTI framework (Zirkel and Krohn, 2008). RTI methods follow a tiered approach of delivering research-based instructional strategies to students (Canter et al., 2008). A crucial component in multiple tiers of RTI is increased instructional intensity, which can be achieved by decreasing class size (Mellard et al., 2010).[2] Zahorik (1999) demonstrated that

[2]Mellard et al. (2010) outline ten variables to increase instructional intensity; one of which being reduced class size.

smaller class sizes leads to increased individualized instruction through increased knowledge of students as well as more instructional time as result of fewer behavioral problems.

While reduced class size is a way to increase instructional intensity, it is important to understand its total impact on special education identification. The total effect of class size on special education participation is an empirical question. Smaller class sizes should lead to increases in individualized instruction compared to regular-sized classrooms (Zahorik, 1999). The effect of this extra instruction is ambiguous. It could allow students on the margin of joining a special education program the additional support needed to avoid a formal placement.[3] On the other hand, it is also possible that the higher levels of individualized instruction allow the teacher to more accurately understand the needs of her students and hence increase placement.

This paper aims to enrich the understanding of reduced class size's role on special education identification by using Tennessee's Project STAR (Student/Teacher Achievement Ratio) experiment. The randomization of Project STAR offers a prime opportunity to test the effect of class size on special education placement. It allows me to exploit the exogenous variation in class size induced by the random assignment of students to classrooms to address the concern of omitted variables bias.

Evidence from this paper supports the hypothesis that the primary impact of small classes on identification is to afford teachers the time to more fully understand their students' needs for special education services. Exploiting the variation in special education participation induced by class size reductions, I estimate the total effect of small class size as an imprecise increase in the special education placement rate of 1.8 percentage points. When the model

[3]Special education need and programs vary significantly by disability category and intensity. While this paper discusses special education participation as a binary outcome, it represents a spectrum of services offered to students. With this in mind, the margin along which I expect class size to affect special education participation is directly affected by a student's ability to catch up to grade-level expectations.

controls for prior academic performance, I find that small classes increased the probability of special education placement by 2.8 percentage points. This increase represents a 25 percent rise in the odds of placement rates among fourth-grade students.

The paper is organized as follows. In Section 2, I briefly describe the experimental design and discuss the sample of students. Section 3 outlines the identification strategy. Section 4 reports the results of the analysis of the role of reduced class size on special education participation. Section 5 concludes.

3.2 Project STAR

Project STAR was a large-scale randomized experiment conducted in seventy-nine schools throughout Tennessee. It randomly assigned students to one of three class types based on size: small with a goal of thirteen to seventeen students, regular with a goal of twenty-two to twenty-five students, and regular with a teacher's aide. The assignment of teachers to classrooms was also randomized. Notably, all randomization took place within the school, so the following analysis focuses on within-school variation.

Project STAR followed one cohort of students as they moved from kindergarten to third grade between 1985 and 1989. In total, the experiment included observations on 11,600 students. At the time of the experiment, kindergarten was not required, so only 55 percent of all students participated in the first year of the experiment. Students enrolling in Project STAR schools after kindergarten were also randomly assigned to one of the three class size types. Students entering in first, second, and third grades represent 20 percent, 14 percent, and 11 percent, respectively.

While the experimental stage of Project STAR ended in the third grade, students were

tracked through high school. Of particular importance to this paper, fourth-grade teachers were asked to complete a questionnaire, the Fourth-Grade Student Participation Questionnaire (FGSPQ), for a random subset of the former Project STAR students in their class. Included in this survey was a question asking if the student attends special education classes outside of the classroom. While measures of special education participation in kindergarten and first grade are available, Finn et al. (2007) caution against the use of these variables due to concerns with the distributions of the measures. Special education participation rates are low overall and even drop from 3.2 percent in kindergarten to 1.2 percent in first grade. Additionally, the dynamics of participation are concerning with only 6.6 percent of students observed in a special education program in first grade given they participated in kindergarten. Of those same kindergarten special education students, 29.3 percent were observed in fourth-grade special education programs.[4] Given the data quality concerns, I focus on the fourth-grade special education measure in this paper.

The full FGSPQ sample consisted of 2,207 students. The analytic sample used in this paper restricted the observations to 2,025 students from each of the seventy-nine schools.[5] One hundred seventy-three observations are dropped due to missing special education status, gender, or free lunch status information. An additional nine observations are dropped to create a dichotomy in race between White and Black groups.[6]

Two well documented threats to the experimental design were the moving of students across class types and the addition of new experiment participants in the later grades.

[4]Appendix Tables I.1 and I.2 document the kindergarten and first-grade special education measures in greater detail. Of the first-grade special education students who were enrolled in kindergarten, only 22.2 percent were also in a kindergarten special education program. First-grade special education students also have lower small class assignment and higher free lunch status than kindergarten or fourth grade.

[5]School representation is based on initial school placement in the first year of Project STAR participation. This sample of students entered the experiment in either kindergarten or first grade.

[6]The nine dropped observations consisted of four Asian students, four Hispanic students, and one student with an "Other" race status.

Krueger (1999) finds that roughly 10 percent of students were shuffled across class types in a nonrandom manner. As a way to address this concern, I only use the initial class assignment.[7] By using only the classroom characteristics from a student's initial year in Project STAR, I maintain the exogeneity of classroom assignment created by the experiment's initial randomization.

Table C.1 reports the student characteristics for the analytic sample. Of the 2,025 students with a complete FGSPQ, 11.5 percent of the students participated in a special education program. Using data from the National Center for Education Statistics, I calculate that 12.5 percent of all students in Tennessee were in special education programs during the 1990-91 academic year. The comparability of these percentages gives credence to the external validity, at least within Tennessee and during this time period, of the results. Comparing the participation rates across class types shows that small and regular rooms have the same rate of 11 percent while rooms with aides slightly higher rates of 13 percent.

Student demographics are also shown in Table C.1. The sample is evenly mixed between males and females. Black students constitute 23 percent of the observations, which is 13 percentage points lower than the full Project STAR sample.[8] Disadvantaged students, as measured by free lunch status, represent 41 percent of the sample. All three of the demographic measures are evenly represented in the three classroom types.

Table C.1 also details the actual number of students in the classroom. This number could deviate from the expected number due to students moving between room types after the initial assignment. Columns 2 through 4 demonstrate that the initial assignment appears to

[7]This approach can not address the potential heterogenous effects of created by the length exposure to the studied classroom characteristics.

[8]The difference in the racial composition between the samples is due to the fact that inner-city Memphis schools did not participate in the Tennessee Comprehensive Assessment Program in 1989, which precluded them from participating in the FGSPQ.

correspond appropriately to the number of actual classmates, which is evidence of compliance with the randomization in the initial year for this analytic subsample.

Finally, Table C.1 reports the averaged performance of the math and reading scores of the Stanford Achievement Test (SAT-9) in a student's initial year in the project as well as in fourth grade. Following Schanzenbach (2006), separate z-scores for math and reading exams are calculated by standardizing by the mean and standard deviation of the scores from the full sample of Project STAR, non-small class students. I then averaged the two z-scores to produce a single performance measure.[9] Column 1 shows that in both the initial year and also in fourth grade, the FGSPQ subsample performed better on the SAT-9 than the full sample, which is observed by the positive, non-zero means among regular and aide classrooms. Students from small classrooms scored 0.50 standard deviations higher on the SAT-9 compared to the full-sample, non-small classroom students and roughly 0.3 standard deviations higher than their FGSPQ non-small class peers. While these numbers do not account for within-school fixed effects, they do suggest that the impact of small classes on test scores was large in the FGSPQ sample, a relationship explored in further detail in Table C.4.

3.3 Identification Strategy

The contribution of this paper to the literature examining special education placement stems from the randomization of students to classrooms under Project STAR. In his 1999 paper,

[9] If one of the math or reading scores was missing, I used the non-missing score as the single performance measure.

Krueger outlines the following model:

$$Y_{ij} = \alpha_1 S_{ij} + \alpha_2 F_{ij} + \xi_{ij}, \tag{3.1}$$

where Y_{ij}, S_{ij}, and F_{ij} refer to achievement level, school characteristics, and family background for student i from school j, respectively. He argues that the omitted variables bias due to excluded relevant variables, such as innate ability, is remedied by Project STAR's randomization. The random assignment of students to various class sizes means that class size is independent of the omitted variables. Thus, Project STAR created exogenous variation in class size.

The randomization under Project STAR allows me to estimate the impact of class size reductions on special education placement by comparing average participation rates across class types. Because the randomization occurred within schools and only for the initial assignment, the analysis must control for school-by-entry-wave fixed effects. Following the framework developed by Krueger and Whitmore (2001), I first estimate the impact of classroom characteristics on special education placement using the following fixed-effects linear probability model:

$$Y_{is} = \beta_0 + \beta_1 SMALL_{is} + \beta_2 AIDE_{is} + \beta_3 X_{is} + \alpha_{sw} + \epsilon_{is}, \tag{3.2}$$

where Y_{is} is a fourth-grade special education status indicator variable for student i who initially entered Project STAR in school s. $SMALL_{is}$ and $AIDE_{is}$ are indicator variables equal to one if the student was originally assigned to a small class and a regular class with an aide, respectively. Given the linear probability model specification, β_1 is interpreted as

the change in the probability of participating in fourth-grade special education induced by an initial small class assignment. X_{is} is a vector of covariates including gender, race, and free lunch status. To control for school-by-entry-wave effects, α_{sw} is included as a fixed effect, where w represents the wave the student joined the experiment, i.e., kindergarten, first grade, second grade, or third grade. Finally, standard errors are clustered at the school-by-entry-wave level to account for heterogeneity.

3.4 Results

Table C.2 reports the estimates of small class size on special education placement using Equation 3.2. Column 1 presents the estimate of small class size from a regression with no controls beyond school-by-entry-wave fixed effects. The coefficient indicates a statistically insignificant increase of 1.8 percentage points in the likelihood of fourth-grade special education placement, which represents 16 percent increase over the base participation rate of 11 percent. The positive direction of the estimate suggests that the hypothesis that increased individualized instruction led to teachers being able to more accurately identify students who need special education services. Column 2 builds upon the first column by incorporating the indicator for assignment to a regular class with an aide. Given that the addition of an aide to a classroom increases the instructor-to-student ratio, one might expect the introduction of an aide to produce similar results as small class assignment. Like much of the literature examining the impact of class size on test scores, I find a statistically and economically insignificant estimate of 0.01 on assignment to a room with an aide (Krueger, 1999; Krueger and Whitmore, 2001). In an attempt to increase precision, column 3 includes individual demographic variables; however, no additional precision is observed. The similarity in the

small class estimates with no demographic controls supports the exogeneity of class size assignment. Across columns 1 through 3, the estimated effect of small class assignment on special education participation holds steady between 0.18 and 0.19.

Table C.2 extends Equation 3.2 by incorporating the z-score from the initial year a student was in the experiment. The inclusion of this variable allows me to compare the likelihood of special education placement across class assignments after controlling for the academic performance of the student. Because special education services are provided to students with conditions limiting their academic progress, test score measures are strongly associated with special education participation, e.g., the estimate of fourth-grade z-score on contemporaneous special education placement is -0.08 with a standard error of 0.01. The inclusion of the academic performance measure does, however, change the interpretation of β_1 to the impact of reduced class size net of the effect of small class assignment on test scores. The initial z-score is used to most closely capture a student's baseline achievement.

Column 4 reports a significant decrease in the likelihood of special education placement by 3.5 percentage points associated with a one standard deviation increase in test performance. The inclusion of the initial z-score also results in a statistically significant estimate of 0.028 on small class assignment. Thus, assignment to a small class net of its role on test scores increases special education participation by 2.8 percentage points, which represents a 25 percent rise over the regular class rate. Controlling for a measure of academic performance caused the point estimate for small class assignment to increase from 0.019 to 0.028. Given the well documented success of assignment to small classrooms at increasing test scores, the jump in the estimates reveals that the impact of reduced class size on test score was dampening the estimate of small class assignment on special education placement (Krueger, 1999; Krueger and Whitmore, 2001). Again, I find a positive relationship between small class

assignment and participation rates, which points to an increase in teacher understanding of student needs.

The partially functional relationship between standardized test scores and special education participation implies that if increased individualized instruction leads to increases in special education placement rates, the marginal students entering special education programs will likely have higher academic achievement.[10] Figures F.1 and F.2 illustrate the distributions of the z-scores for the initial and fourth-grades scores, respectively, by class type and special education status. Examining the initial z-score, I find that for each class type the special education distribution is shifted to the left of the general education distribution. Moreover, there is evidence that both the general education and special education students from small classes out performed the general education students from regular classrooms. If the mechanism behind the increased likelihood of special education placement is teachers developing a deeper understanding of student need for services, I would expect to see a thicker right-tail of the special education distribution from small classes than the distribution from regular classes. Figure F.1 displays evidence of a higher density of special education students from small classes coming from the right tail of the z-score distribution.

Figure F.2 illustrates the z-score distributions by the time the students are in fourth grade. As expected, I find that the distribution of general education students from small classes is farther to the right than general education students from regular classes. Now, however, special education students from all class types have a similar modal z-score. Despite this alignment of the special education distributions, the larger density of high scorers from the small classes persists.

[10]Special education programs provide additional services to students with disabilities impeding their academic progress. While not all students in special education programs will have low test scores, it has been shown that the average score for a special education student is below the average score for a general education student (Hibel et al., 2010).

This graphical evidence supports the hypothesis that small classes allowed teachers to better understand the needs of their students. Table C.3 reports the means of z-scores by testing period, class type, and special education status.[11] The first row of panel A shows that general education students from small classes outscored their regular class peers by 0.28 standard deviations, the difference between the small class mean of 0.52 and the regular class mean of 0.24. The second row highlights that not only the general education students from small classes but also the special education students from small classes, with an average z-score of 0.40, have higher test scores than the general education students from regular classes. Overall, panel A demonstrates a small-to-regular test-score gap of 0.41 standard deviations for special education students, which exceeded the same gap for general education students by 0.13 standard deviations.

Panel B shows that by the fourth-grade special education students from small classes are performing below the average among students from regular classes. The small-to-regular differential remained positive for both general and special education students; however, the differential for special education students dropped by 59 percent compared to the initial z-score in panel A. The difference in the fourth-grade differentials reveals that the large lead held by special education students from small classes had become a deficit compared to their general education peers. Thus the test-score gap shrunk in both absolute and relative terms for special education students compared to general education students.

Table C.4 utilizes the within school randomization of Project STAR to estimate the impacts of both small class assignment and fourth-grade special education status on academic performance.[12] Panel B replicates the findings from Schanzenbach (2006), which are reported

[11] In Table C.3, the regular classes with and without aides are combined into the single group.

[12] The estimation follows the structure of Equation 3.2 where the dependent variable is the grade-specific z-score. $AIDE_{is}$ is no longer included, which follows the broader Project STAR literature. Finally, the

in panel A.[13] Panel C confirms the earlier indications from Tables C.1 and C.3 that the effect of reduced class size is substantially larger in this paper's analytic sample compared to the full Project STAR population. While the estimated effect for the full population of small class size on kindergarten test performance is an increase by 18 percent of a standard deviation, the same estimate for the analytic sample is 10 percentage points of a standard deviation higher at 0.28.

Panel D further illustrates that the differential between panels B and C is driven by the selection of students who participated in the fourth-grade survey in two ways. First, traditionally worse performing schools from inner-city Memphis and rural areas did not participate in fourth grade testing (Finn et al., 2007). Second, the large coefficients for the interaction term indicate a differential effect of the reduced class size program for the students in the FGSPQ sample. The estimates range between 14 percent and 20 percent of a standard deviation and imply that the small class programs were more successful at increasing test scores in the schools attended by students in the FGSPQ. The reason for this difference remains a question. Overall, the reduced class size program was highly effective at improving academic performance among the students in the FGSPQ, so one might expect this sample of students to be prime candidates for exhibiting an effect of small class assignment on special education placement.

Panel E presents the estimates of interest in this line of inquiry and also elucidates the relationship between reduced class size and special education participation. Looking at both the fourth-grade z-score and earlier z-scores, I find strong positive coefficients for the impact of small classes on academic performance, ranging between 19 and 29 percent of

special education indicator is now an independent variable and is interacted with the small class indicator.

[13] I am unable to replicate the fourth-grade results due to differing data sources for the fourth-grade sample. Because this paper focuses on special education, the FGSPQ data best met the needs of the project.

a standard deviation. With the exception of kindergarten, fourth-grade special education status has a statistically significant negative association with test scores. The interaction term identifies any heterogeneous impact of reduced class size on academic performance by special education status. The estimates are large, ranging between a reduction by 16 percent of a standard deviation to an increase of 8 percent; however, each of the four estimates fails to be significantly different from zero. Thus, I find no clear evidence of an additional impact, either positive or negative, of special education status on reduced class size's role on academic performance.

If the primary effect of reduced class size on participation was providing a stronger learning environment and hence pushing the marginal special education student back into general education status, I would have expected to find a negative estimate of reduced class size on the probability of placement, i.e., assignment to a small class lowered the likelihood of special education placement. This result is a consequence of the partially functional relationship between special education status and test scores as well as the primary effect assumption as long the relative change in the special education threshold between small and regular class types did not exceed the relative growth in test scores between small and regular classes. Also under the primary effect assumption, I would have anticipated a positive interaction term for the estimate of small class size and participation on test scores because the rightward shift of the small class test score distribution implies a thicker left tail for the regular class students in special education. To the contrary, I find weak evidence of a positive impact of reduced class size on special education placement rates, which coincides with the hypothesis that increased individualized instruction led to increased teacher understanding of student need. Additionally, the lack of a clear heterogenous impact, i.e., the small class and special education interaction term, supports the evidence that factors outside of academic

performance influence the special education placement decision.

3.5 Conclusion

A longstanding and large literature has documented the role of individual-level and school-level characteristics on special education identification. Evidence of the overrepresentation of Black students with cognitive impairment labels dates back to the 1960s. More recently, researchers have discussed the high placement rates among males. Even newer evidence supports that not only one's own race but also the racial composition of one's school affects the probability of special education participation (Enayati, 2014; Hibel et al., 2010).

Increased instructional intensity is a main feature of the RTI framework and can be achieved through smaller class sizes. At the same time, lower student-to-teacher ratios have been shown to increase student performance. These two effects lead to a potentially ambiguous impact of reduced class size on special education placement rates.

This paper aimed to determine the impact of reduced class size on special education identification. Examining the total effect of reduced class sizes in the early grades of elementary school, I find weak evidence of an increase in the fourth-grade special education participation rate. Incorporating prior test scores into the model increases the estimate of small class size and indicates that reduced class sizes correspond with increased identification rates. These results as well as further analysis of the joint roles of reduced class size and special education status on academic performance support the hypothesis that the primary effect of class size reduction on identifying students with disabilities is improved teacher understanding of student need. Linking these results to the RTI literature suggests that increased individualized instruction gives a teacher the time necessary to identify student need for services in a way

that standardized-test-score deficiency might not.

APPENDICES

Appendix A Tables for "The Impact of Disproportionality Regulations on Identification into Special Education Programs"

Table A.1: Characteristics of Districts By Verified Ratio

	Pre 2007		Post 2007	
	(1)	(2)	(3)	(4)
	All	Disproportionate	All	Disproportionate
Black Verified Ratio	1.30	4.27	1.35	4.02
	(0.71)	(1.33)	(0.62)	(0.83)
Black Risk	18.75	55.41	18.57	52.53
	(9.25)	(23.60)	(7.97)	(22.82)
White Risk	15.77	13.43	15.42	13.32
	(5.38)	(5.61)	(5.53)	(6.96)
Overall Risk	14.53	13.96	14.22	14.04
	(3.66)	(5.92)	(3.67)	(7.51)
Total Enrollment	6756.93	4889.50	5823.32	4877.94
	(11352.09)	(1668.59)	(7596.17)	(2050.30)
Black Composition	20.69	1.99	20.84	2.43
	(23.29)	(0.67)	(23.46)	(0.87)
White Composition	69.14	90.80	67.09	88.52
	(24.55)	(3.81)	(25.25)	(5.94)
FARM	37.51	17.68	45.22	22.99
	(23.38)	(12.10)	(22.95)	(19.45)
Special Education	8570.42	13332.32	8794.23	14652.14
Costs	(3365.98)	(7372.46)	(3475.50)	(6801.56)
Federal Special	991.74	1278.79	1303.34	1148.12
Education Revenue	(602.34)	(819.82)	(867.81)	(737.42)
Student-Teacher	20.25	15.42	24.26	16.27
Ratio	(7.38)	(4.43)	(34.04)	(5.55)
Observations	428	12	821	16
Threat Count		10		19
Penalty Count		4		15

Note: Standard deviations are reported in parentheses. A district is treated as disproportionate if its current Black verified ratio exceeds 3.

Table A.2: DD Effect of IDEA Sanctions on Racial Disproportionality

	(1) Black VR	(2) Black Risk	(3) White Risk	(4) Black VR	(5) Black Risk	(6) White Risk
Total Effect	-2.31***	-29.55**	-1.83	-1.98***	-31.29**	-3.06
	(0.38)	(13.94)	(2.94)	(0.49)	(13.77)	(3.40)
Post 2007 * Penalty	-2.92***	-34.41**	-2.71	-2.60**	-36.20**	-4.09
	(0.96)	(16.63)	(3.76)	(1.03)	(16.73)	(4.32)
Post 2007 * Threat	0.61	4.85	0.88	0.62	4.91	1.03
	(0.76)	(9.72)	(2.31)	(0.76)	(9.74)	(2.32)
Penalty	2.40***	23.68**	1.06	2.53***	23.51**	0.64
	(0.77)	(10.27)	(2.62)	(0.83)	(10.45)	(2.83)
Threat	1.36***	23.38**	0.10	1.36***	23.31**	0.07
	(0.41)	(10.86)	(1.78)	(0.41)	(10.85)	(1.80)
Post 2007	-0.05	-0.93	-0.14	-0.06	-0.82	-0.07
	(0.04)	(0.77)	(0.17)	(0.04)	(0.71)	(0.24)
Charters Included	No	No	No	Yes	Yes	Yes
Observations	1249	1249	1249	1399	1399	1399
R^2	0.57	0.35	0.39	0.56	0.39	0.37
F	49.62	9.26	11.95	37.39	19.02	9.84

Note: Each specification contains controls including a cubic in years since 2000, percent of students eligible for free and reduced-price meals, and a quadratic of the White composition. Standard errors are reported in parentheses and clustered at the district level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.3: Differential Effects of IDEA Sanctions on Racial Disproportionality

	(1) Black VR	(2) Black Risk	(3) White Risk	(4) Black VR	(5) Black Risk	(6) White Risk
Total Effect:						
First Penalty	-2.57**	-36.96***	-2.38	-1.99	-41.77***	-5.07
	(1.29)	(11.97)	(3.41)	(1.28)	(10.46)	(3.81)
Multiple Penalties	-2.05***	-16.21*	0.20	-1.91***	-17.05**	-0.31
	(0.67)	(8.85)	(1.02)	(0.60)	(8.33)	(1.24)
Post 2007 *	0.52	20.76**	2.58	0.07	24.72***	4.76*
Consecutive Penalties	(1.78)	(8.75)	(2.54)	(1.63)	(7.09)	(2.61)
Post 2007 * Penalty	-3.18*	-41.87***	-3.27	-2.60	-46.72***	-6.11
	(1.62)	(13.58)	(3.59)	(1.61)	(13.24)	(4.35)
Post 2007 * Threat	0.61	4.91	0.89	0.62	4.95	1.03
	(0.76)	(9.73)	(2.32)	(0.76)	(9.75)	(2.33)
Consecutive	-0.02	-31.51***	-6.03	-0.01	-31.55***	-6.16
Penalties	(1.15)	(10.14)	(4.13)	(1.15)	(10.18)	(4.15)
Penalty	2.65**	40.38***	3.92	2.65**	40.36***	3.90
	(1.32)	(10.01)	(3.47)	(1.32)	(10.02)	(3.49)
Threat	1.36***	23.38**	0.11	1.36***	23.29**	0.07
	(0.41)	(10.91)	(1.80)	(0.41)	(10.89)	(1.82)
Post 2007	-0.05	-1.15	-0.19	-0.06	-0.98	-0.10
	(0.05)	(0.72)	(0.16)	(0.05)	(0.67)	(0.24)
Charters Included	No	No	No	Yes	Yes	Yes
Observations	1249	1249	1249	1399	1399	1399
R^2	0.57	0.36	0.39	0.56	0.40	0.37

Note: Each specification contains controls including a cubic in years since 2000, percent of students eligible for free and reduced-price meals, and a quadratic of the White composition. Standard errors are reported in parentheses and clustered at the district level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.4: DD Effect of IDEA Sanctions on Other Outcomes

	Overall Risk	Total Enrollment	Black Composition	White Composition	FARM	Teacher Ratio
Total Effect	-2.12	489.23	1.29	0.62	1.04	2.52
	(3.16)	(1072.44)	(3.25)	(4.28)	(4.33)	(3.06)
Post 2007 * Penalty	-3.31	777.00	3.96	-2.98	-2.88	4.15
	(4.21)	(1085.37)	(6.10)	(8.01)	(9.05)	(6.04)
Post 2007 * Threat	1.19	-287.77	-2.67	3.61	3.92	-1.63
	(2.63)	(1359.06)	(3.99)	(4.95)	(6.14)	(5.84)
Penalty	1.07	1177.00	5.91	-10.25	-8.83	-2.70**
	(2.91)	(984.88)	(5.34)	(7.16)	(7.79)	(1.36)
Threat	0.56	-2779.20**	-7.87***	10.08***	0.57	-4.76***
	(1.98)	(1404.85)	(2.94)	(3.82)	(4.24)	(1.44)
Post 2007	-0.13	-249.45	0.75	-0.78	-1.31*	2.22
	(0.15)	(152.47)	(0.60)	(0.68)	(0.67)	(3.12)
Charters Included	No	No	No	No	No	No
Observations	1249	1249	1249	1249	1249	1249
R^2	0.17	0.11	0.45	0.53	0.56	0.01
F	8.41	2.36	17.77	33.64	105.53	20.78

Note: The specifications for overall risk, total enrollment, and teacher ratio contain controls including a cubic in years since 2000, percent of students eligible for free and reduced-price meals, and a quadratic of the White composition. The racial composition specifications contain controls including a cubic in years since 2000 and percent of students eligible for free and reduced-price meals. The FARM specification only includes controls for a cubic in years since 2000 and a quadratic of the White composition. Standard errors are reported in parentheses and clustered at the district level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.5: Disproportionality in Free and Reduced-Price Meal Eligibility

	(1) Pre 2007	(2) Post 2007	(3) Difference
Penalty = 0	1.34	1.21	-0.13
	(0.07)	(0.05)	(0.11)
	[145]	[488]	
Penalty = 1	5.00	4.13	-0.87
	(3.89)	(1.33)	(3.09)
	[2]	[7]	
Difference	3.66	2.92	-0.74
	(0.65)	(0.48)	(0.96)

Note: Standard errors are reported in parentheses, and observations are in brackets. This table presents a crude difference-in-differences analysis of the impact of financial penalties on disproportionality in free and reduced-price meal eligibility.

Table A.6: Characteristics of Ineligible Districts By Verified Ratio

	Pre 2007		Post 2007	
	(1)	(2)	(3)	(4)
	All	Disproportionate	All	Disproportionate
Black VR	1.40	3.85	1.65	4.21
	(0.90)	(0.66)	(1.15)	(1.53)
Black Risk	18.57	46.45	20.93	50.28
	(11.80)	(14.47)	(13.95)	(18.92)
White Risk	14.38	12.11	14.22	12.50
	(6.45)	(2.28)	(7.68)	(2.77)
Overall Risk	13.63	12.30	13.37	12.78
	(2.74)	(2.23)	(2.76)	(2.84)
Total Enrollment	2096.07	1588.78	1755.74	1386.51
	(1181.31)	(862.30)	(900.29)	(541.91)
Black Composition	3.63	0.68	3.32	0.92
	(14.43)	(0.25)	(13.10)	(0.41)
White Composition	89.94	93.88	89.64	91.68
	(15.30)	(4.75)	(14.66)	(8.64)
FARM	34.19	37.03	41.86	40.61
	(16.22)	(16.19)	(15.59)	(17.67)
Special Education	5349.15	5693.87	5251.23	5065.87
Costs	(1413.33)	(1800.74)	(1515.71)	(1679.44)
Federal Special	410.23	330.37	534.42	669.91
Education Revenue	(586.33)	(487.71)	(618.63)	(794.32)
Student-Teacher	21.88	24.59	25.29	24.85
Ratio	(7.11)	(10.25)	(20.04)	(7.69)
Observations	297	18	404	41
Threat Count		18		30
Penalty Count		6		9

Note: Standard deviations are reported in parentheses. A district is treated as disproportionate if its current Black verified ratio exceeds 3.

Table A.7: DDD Effect of IDEA Sanctions on Racial Disproportionality

	(1) Black VR	(2) Black Risk	(3) White Risk	(4) Black VR	(5) Black Risk	(6) White Risk
Total Effect	-2.17***	-35.11**	-3.73	-1.92***	-31.94**	-5.19
	(0.75)	(14.41)	(3.04)	(0.69)	(14.23)	(3.57)
Post 2007 * Eligible	-2.81**	-41.12**	-4.22	-2.16*	-37.30**	-8.89*
* Penalty	(1.24)	(17.69)	(3.83)	(1.18)	(17.65)	(5.00)
Post 2007 * Eligible	0.63	6.01	0.49	0.24	5.36	3.70
* Threat	(0.92)	(11.68)	(2.71)	(0.91)	(11.41)	(3.71)
Post 2007 * Penalty	0.02	8.97	1.82	-0.40	3.89	5.29*
	(0.82)	(7.21)	(1.16)	(0.67)	(7.09)	(2.72)
Post 2007 * Threat	-0.01	-1.00	0.47	0.39	-0.25	-2.49
	(0.52)	(6.49)	(1.18)	(0.51)	(5.86)	(2.79)
Eligible * Penalty	1.98**	26.53**	3.05	1.68**	25.01**	5.84
	(0.80)	(11.28)	(2.65)	(0.80)	(11.23)	(3.63)
Eligible * Threat	-0.19	4.10	1.73	0.24	6.24	-0.94
	(0.48)	(11.77)	(2.18)	(0.52)	(11.65)	(3.21)
Penalty	0.44	-3.32	-1.71**	0.75**	-1.58	-4.80*
	(0.30)	(4.37)	(0.86)	(0.31)	(4.14)	(2.49)
Threat	1.56***	19.39***	-1.31	1.16***	17.60***	1.50
	(0.25)	(3.77)	(0.90)	(0.30)	(3.44)	(2.59)
Post 2007 * Eligible	-0.18**	-1.65*	0.02	0.00	-1.67*	-0.53
	(0.07)	(0.98)	(0.41)	(0.16)	(0.86)	(0.44)
Eligible	0.21***	3.68***	-0.01	0.01	2.68***	-0.37
	(0.08)	(1.12)	(0.94)	(0.18)	(0.97)	(0.92)
Post 2007	0.12	0.58	0.10	0.00	0.86	0.25
	(0.08)	(1.12)	(0.33)	(0.11)	(0.99)	(0.49)
Charters Included	No	No	No	Yes	Yes	Yes
Observations	1789	1789	1789	2152	2152	2151
R^2	0.37	0.25	0.34	0.14	0.25	0.29

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Table A.7 (cont'd)

	(1) Black VR	(2) Black Risk	(3) White Risk	(4) Black VR	(5) Black Risk	(6) White Risk
F	31.17	11.61	11.28	26.48	12.66	10.57

Note: Each specification contains controls including a cubic in years since 2000, percent of students eligible for free and reduced-price meals, and a quadratic of the White composition. Standard errors are reported in parentheses and clustered at the district level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.8: Potential Causes of Disproportionality

	(1) Black Risk	(2) Black Risk	(3) Black Risk	(4) White Risk	(5) White Risk	(6) White Risk
White Composition	0.10***	0.09***	0.11**	-0.11***	-0.09***	-0.04**
	(0.02)	(0.03)	(0.05)	(0.02)	(0.02)	(0.02)
White Income		4.72	8.37		-2.80	4.96*
		(3.45)	(6.19)		(1.70)	(2.98)
Black Income		-2.25	-2.20		-0.59	-0.48
		(2.15)	(2.12)		(0.77)	(0.77)
FARM			0.07			0.15***
			(0.08)			(0.04)
Constant	11.69***	-14.65	-59.94	23.59***	58.80***	-37.41
	(1.34)	(30.31)	(54.74)	(1.66)	(14.47)	(29.39)
Observations	168	168	168	168	168	168
R^2	0.09	0.11	0.11	0.30	0.33	0.42
F	20.94	8.37	6.36	30.90	15.75	18.55

Note: Income measures (in 2009 inflation-adjusted dollars) come from the 2009 5-year American Community Survey (ACS) and represent the median income, in logs, within a district by race. For comparability, risk, White composition, and free and reduced-price meal measures are restricted to the same time period as the ACS data, i.e., 2004-2009, and the median by district values are used. I additionally restrict the sample to the DD baseline sample without charter schools. Due to the availability of district-level income data from the ACS and the time restriction, I lose 15 districts used in the DD sample. Standard errors are reported in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix B Tables for "Disparities in Special Education Identification: Evidence from Michigan"

Table B.1: Summary Statistics

	Mean	SD	N
Special Education Participation (Headcount)	.136	.032	4198
Special Education Participation (FTE)	.036	.019	4198
Special Education Intensity	.261	.092	4198
In General Education 80% of Day	63.71	14.41	505
Homestead Taxable Values Per Pupil	130042	50839	4198
Median Household Income	49685	13049	505
Percent FARM	38.14	18.20	4198
Budget	.058	3.14	4198
White Composition of Students	85.83	18.10	4198
City	.069	.254	4198
Suburb	.256	.437	4198
Town	.182	.385	4198
Rural	.493	.500	4198
Met/Exceeded 8th Grade Math Standards	68.43	14.97	4198
White Risk of Special Education	14.22	5.14	4194
Black Risk of Special Education	19.35	11.40	3016
Hispanic Risk of Special Education	13.74	8.65	3133

Note: Statistics drawn from a sample of 523 traditional public school districts from the 2002-03 through the 2010-11 academic years. The taxable value and median household income measures are per the total number of pupils in the district. All dollar terms have been converted to 2010 U.S. dollars. Censored special education by race data lead to the lower number of observations in the risk of special education variables.

Table B.2: Disparities in Special Education Identification

	(1) HC	(2) FTE	(3) Intensity	(4) White Risk	(5) Black Risk	(6) Hispanic Risk
Log Homestead	0.813*	-0.393	-3.743****	0.921*	2.827**	0.425
Taxable Values Per Pupil	(0.414)	(0.245)	(0.969)	(0.496)	(1.315)	(1.072)
Percent FARM	0.052****	0.016**	0.020	0.026	0.035	-0.030
	(0.014)	(0.008)	(0.031)	(0.038)	(0.036)	(0.034)
White Composition of	0.009	-0.009	-0.053*	-0.101**	0.076***	0.014
Students	(0.010)	(0.008)	(0.031)	(0.050)	(0.024)	(0.030)
Budget	-0.011	0.002	0.025	0.006	-0.098	-0.042
	(0.020)	(0.012)	(0.053)	(0.027)	(0.083)	(0.057)
Met/Exceeded 8th	-0.063****	-0.035****	-0.096****	-0.089****	-0.031	-0.019
Grade Math Standards	(0.009)	(0.006)	(0.023)	(0.022)	(0.033)	(0.026)
Log Median Income	-0.035	-0.045	-0.256	-1.746	2.206	-4.577**
	(0.932)	(0.481)	(2.118)	(2.060)	(2.288)	(2.131)
City	0.668	1.263***	7.298****	-1.442	-0.725	-1.496
	(0.547)	(0.419)	(1.790)	(1.950)	(1.133)	(1.226)
Suburb	0.698**	0.767****	4.269****	-0.403	-2.002**	0.197
	(0.328)	(0.216)	(0.968)	(0.911)	(0.991)	(0.833)
Town	0.490	0.610****	3.624****	0.067	-0.804	-1.121
	(0.302)	(0.159)	(0.796)	(0.533)	(1.138)	(0.893)
Observations	4198	4198	4198	4194	3016	3133
R^2	0.19	0.29	0.28	0.29	0.05	0.03

Note: Estimates from a linear probability model with year fixed effects. Taxable values and median income values have been converted to 2010 U.S. dollars. Again, censored special education by race data lead to the lower number of observations in the risk of special education variables. Standard errors clustered at the district level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$.

Appendix C Tables for "Class Size and Special Education Placement: Revisiting Tennessee's Project STAR"

Table C.1: Means of Selected Characteristics

	(1) All	(2) Small	(3) Aide	(4) Regular
Special Education	0.11	0.11	0.13	0.11
	(0.32)	(0.31)	(0.33)	(0.31)
Female	0.50	0.52	0.46	0.52
	(0.50)	(0.50)	(0.50)	(0.50)
Black	0.23	0.25	0.21	0.23
	(0.42)	(0.43)	(0.41)	(0.42)
Free Lunch	0.41	0.43	0.39	0.40
	(0.49)	(0.50)	(0.49)	(0.49)
Class Size	20.00	15.08	22.60	22.20
	(4.02)	(1.56)	(2.28)	(2.26)
Initial Z-Score	0.31	0.50	0.21	0.20
	(0.87)	(0.90)	(0.82)	(0.85)
4^{th} Grade Z-Score	0.18	0.33	0.08	0.13
	(0.90)	(0.90)	(0.89)	(0.90)
Observations	2025	665	688	672

Note: Means with standard deviations in parentheses. Small, aide, and regular refer to the three classroom types of Project STAR. Free lunch and initial z-score are determined using data from a student's first year in the experiment.

Table C.2: Effect of Small Class Size on Fourth Grade Special Education Placement

	(1)	(2)	(3)	(4)
Small	0.018	0.018	0.019	0.028*
	(0.015)	(0.016)	(0.016)	(0.016)
Aide		0.001	0.000	-0.001
		(0.017)	(0.017)	(0.017)
Female			-0.041***	-0.040***
			(0.015)	(0.015)
Black			0.029	0.020
			(0.041)	(0.039)
Free Lunch			0.087***	0.077***
			(0.018)	(0.018)
Initial Z-Score				-0.035**
				(0.015)
Constant	0.109***	0.108***	0.086***	0.100***
	(0.005)	(0.009)	(0.016)	(0.016)
Observations	2025	2025	2025	2025
R^2	0.00	0.00	0.02	0.03

Note: Estimates from a linear probability model with school-by-entry-wave fixed effects. Free lunch and initial z-score are determined using data from a student's first year in the experiment. Standard errors clustered at the school-by-entry-wave level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C.3: Test Score Means by Class Size and Special Education Status

	(1) Regular	(2) Small	(3) Difference
Panel A - Initial Z-Score			
General Education	0.24	0.52	0.28
	(0.02)	(0.04)	(0.04)
Special Education	-0.01	0.40	0.41
	(0.08)	(0.12)	(0.14)
Difference	-0.24	-0.11	0.13
	(0.07)	(0.11)	(0.13)
Panel B - 4^{th} Grade Z-Score			
General Education	0.18	0.40	0.22
	(0.02)	(0.03)	(0.04)
Special Education	-0.43	-0.26	0.17
	(0.09)	(0.14)	(0.17)
Difference	-0.61	-0.66	-0.05
	(0.07)	(0.11)	(0.13)

Note: Means with standard errors in parentheses.

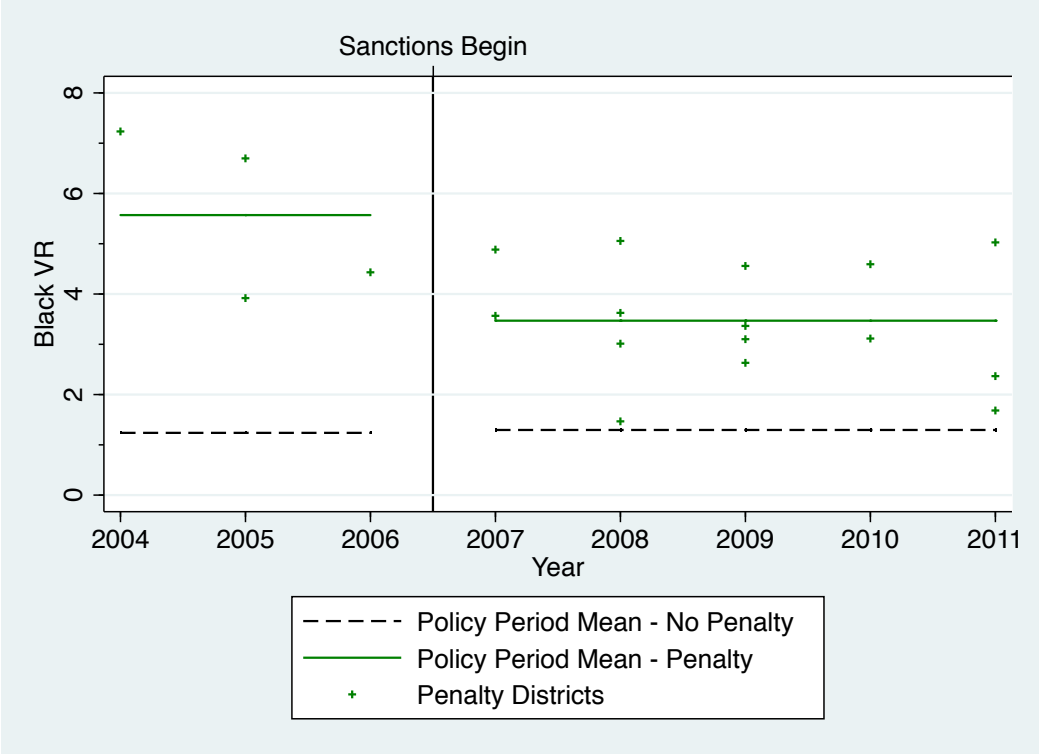
Table C.4: Effect of Small Class Size and Special Education Status on Academic Performance

Independent Var.	Kindergarten (1)	First Grade (2)	Second Grade (3)	Third Grade (4)	Fourth Grade (5)
Panel A:					
Small	0.187***	0.189***	0.141***	0.152***	0.035
	(0.039)	(0.035)	(0.034)	(0.030)	(0.025)
Panel B:					
Small	0.183***	0.191***	0.131***	0.149***	
	(0.043)	(0.036)	(0.036)	(0.031)	
Panel C:					
Small	0.280***	0.231***	0.179***	0.234***	0.195***
	(0.056)	(0.052)	(0.057)	(0.046)	(0.045)
Panel D:					
Small	0.095**	0.105**	0.053	0.068*	
	(0.042)	(0.042)	(0.037)	(0.040)	
In FGSPQ	0.251***	0.269***	0.132***	0.034	
	(0.026)	(0.032)	(0.030)	(0.033)	
Small*In FGSPQ	0.197***	0.145***	0.140***	0.170***	
	(0.050)	(0.053)	(0.054)	(0.056)	
Panel E:					
Small	0.290***	0.228***	0.185***	0.255***	0.223***
	(0.059)	(0.054)	(0.057)	(0.050)	(0.049)
Sp Ed	-0.025	-0.350***	-0.478***	-0.408***	-0.512***
	(0.122)	(0.091)	(0.102)	(0.115)	(0.107)
Small*Sp Ed	-0.083	0.081	0.040	-0.106	-0.156
	(0.168)	(0.172)	(0.197)	(0.185)	(0.196)
Observations (B and D):	5855	6447	5829	5929	
Observations (C and E):	1542	1996	1903	1937	2025

Note: Estimates from a linear probability model with school-by-entry-wave fixed effects. FGSPQ refers to the analytic sample used in the paper. Sp Ed refers to fourth-grade special education status. Standard errors clustered at the school-by-entry-wave level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

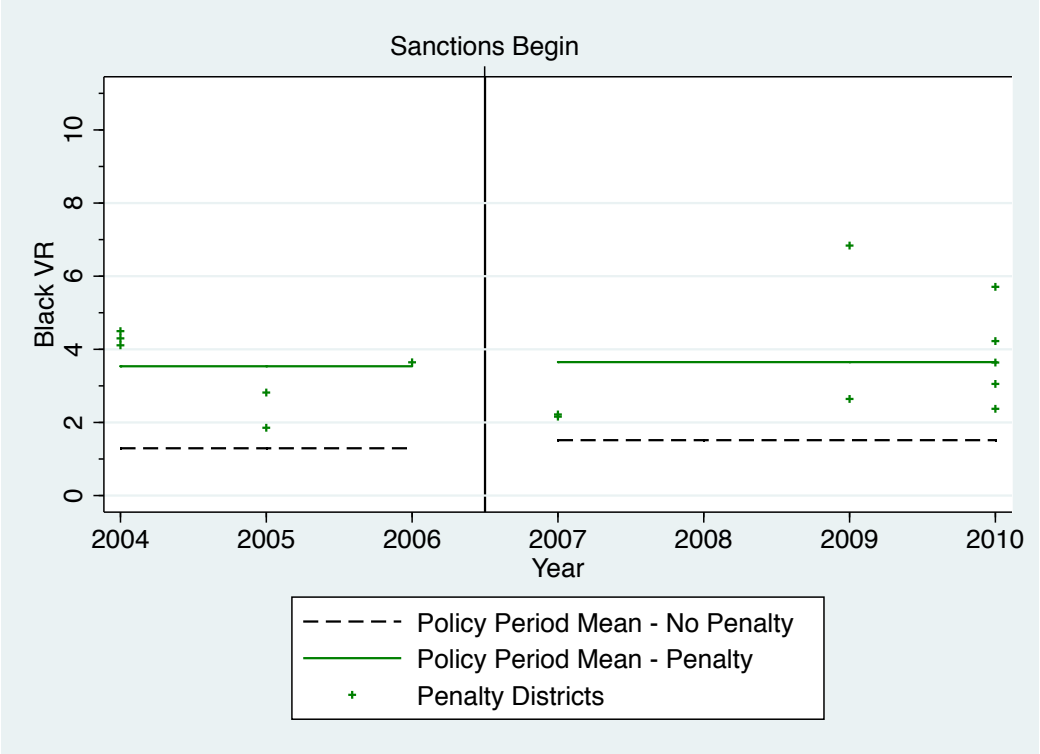
Appendix D Figures for "The Impact of Disproportionality Regulations on Identification into Special Education Programs"

Figure D.1: Impact of Penalties on the Black Verified Ratio



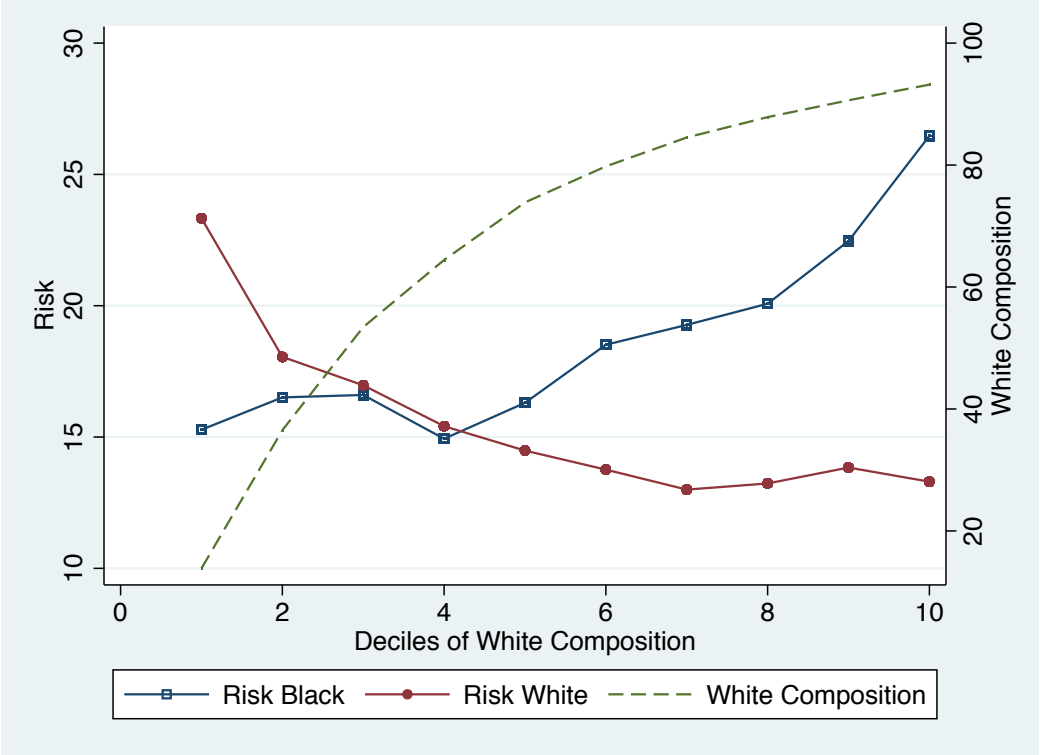
Note: This figure plots the policy period means of the Black verified ratio for districts in penalty phases and districts in neither threat nor penalty phases. Scatter points for districts in neither threat or penalty phases were excluded for illustrative purposes. The data have been restricted to the analytic sample used in the DD regressions, leaving only traditional public school districts eligible for disproportionality calculations. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

Figure D.2: Impact of Penalties on the Black Verified Ratio for Ineligible Districts



Note: This figure plots the policy period means of the Black verified ratio for districts in penalty phases and districts in neither threat nor penalty phases. Scatter points for districts in neither threat or penalty phases were excluded for illustrative purposes. The data have been restricted to the analytic sample used in the DDD regressions, leaving only traditional public school districts ineligible for disproportionality calculations.

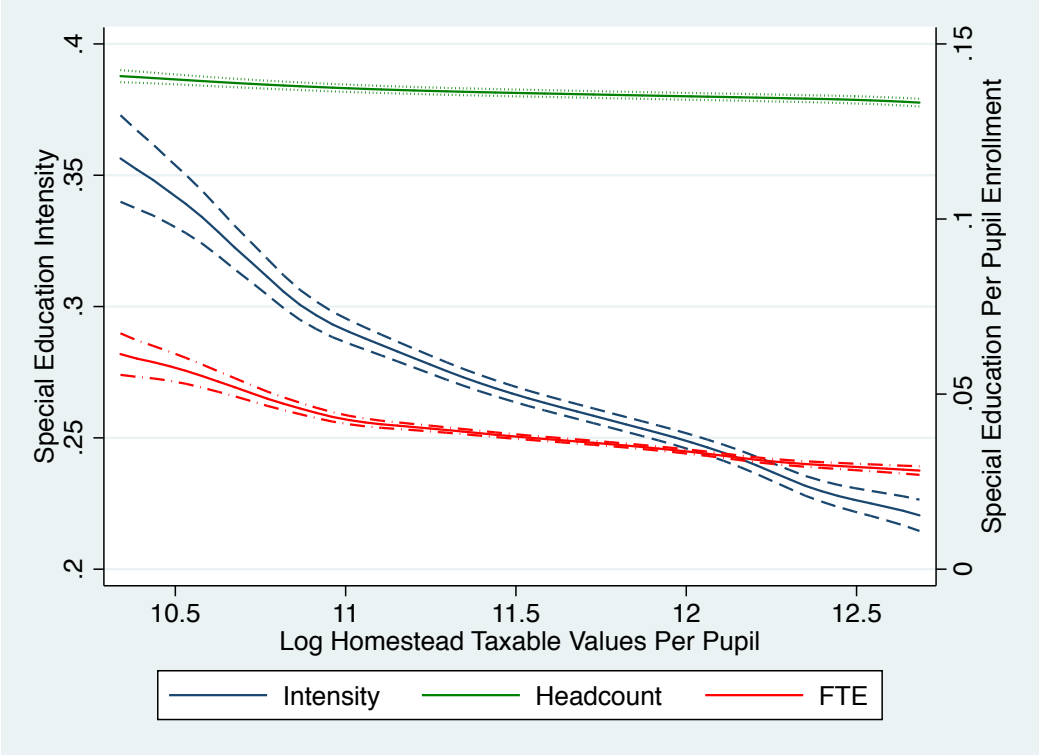
Figure D.3: Risk by Race Over White Composition



Note: This graphic shows the relationship between the risk of special education placement for Black and White students separately over the distribution of total White composition. The sample has been restricted to the DD analytic sample without charter schools.

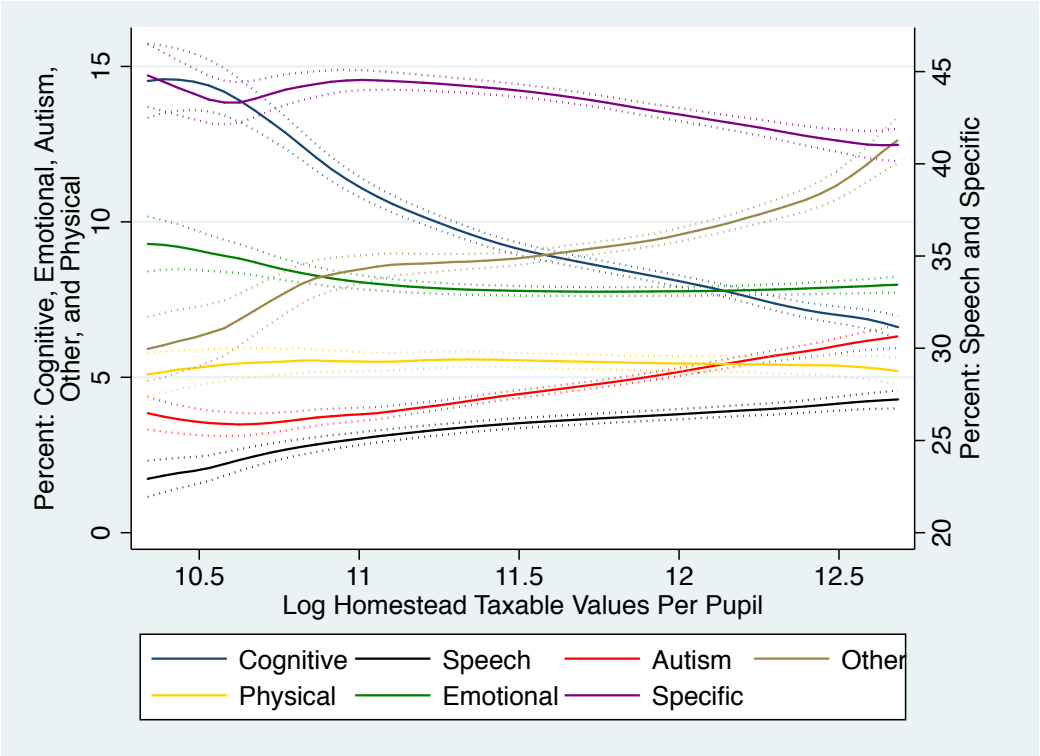
Appendix E Figures for "Disparities in Special Education Identification: Evidence from Michigan"

Figure E.1: Special Education Participation Over Homestead Taxable Values



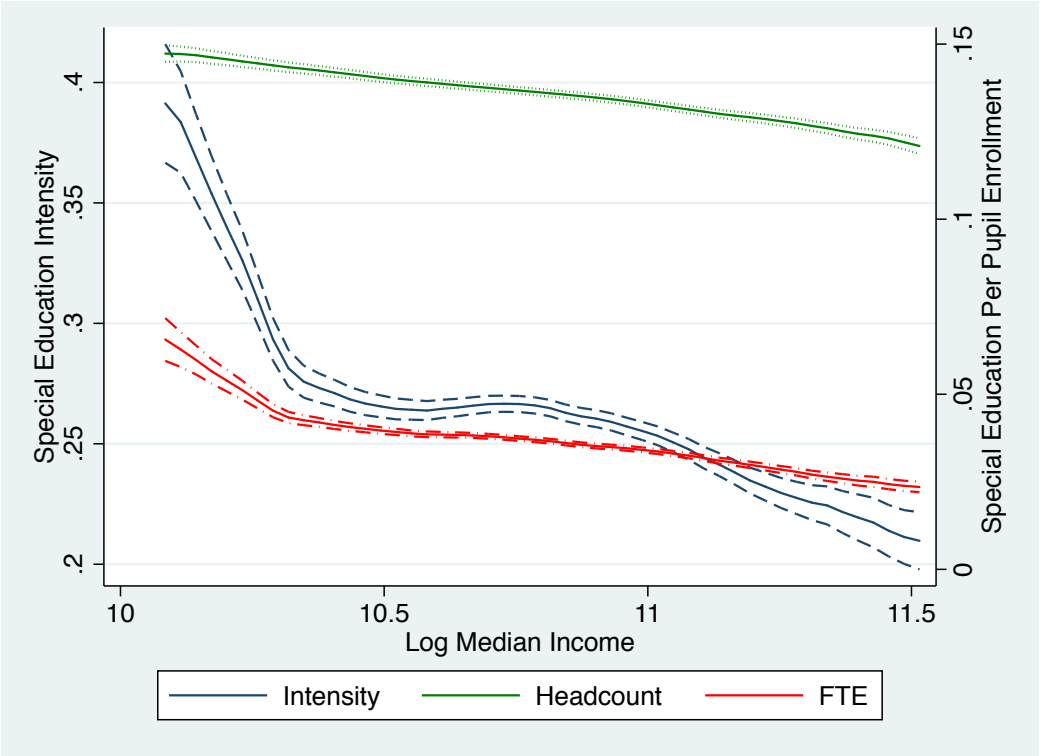
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure E.2: Disability Categories Over Homestead Taxable Values



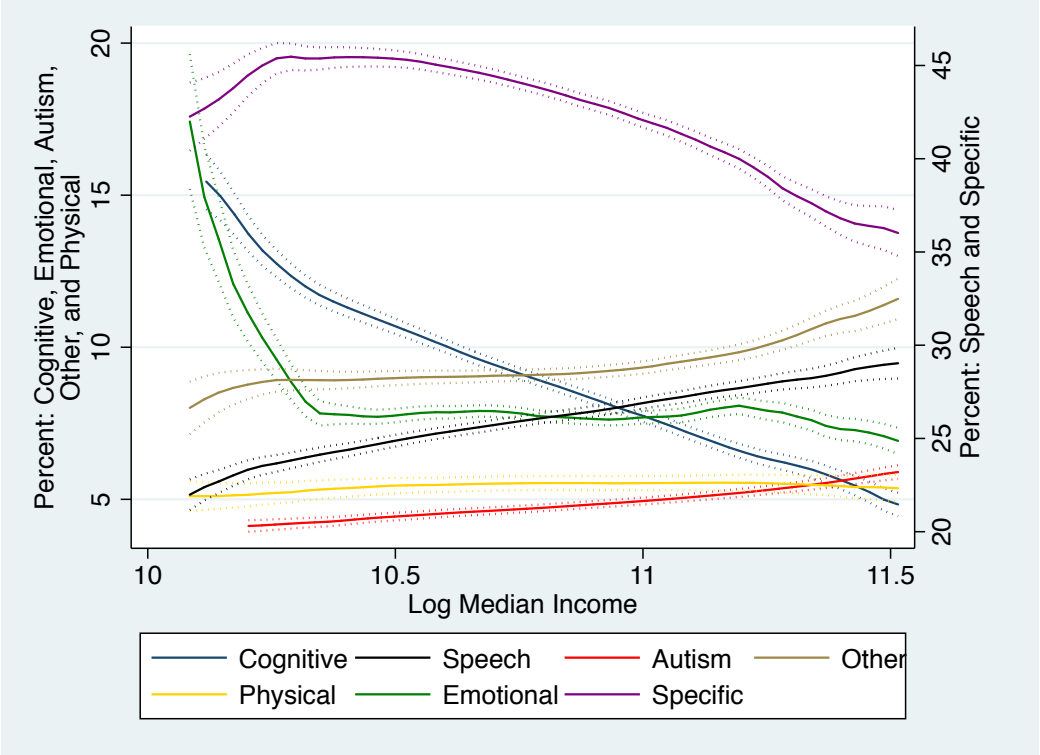
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure E.3: Special Education Participation Over Median Household Income



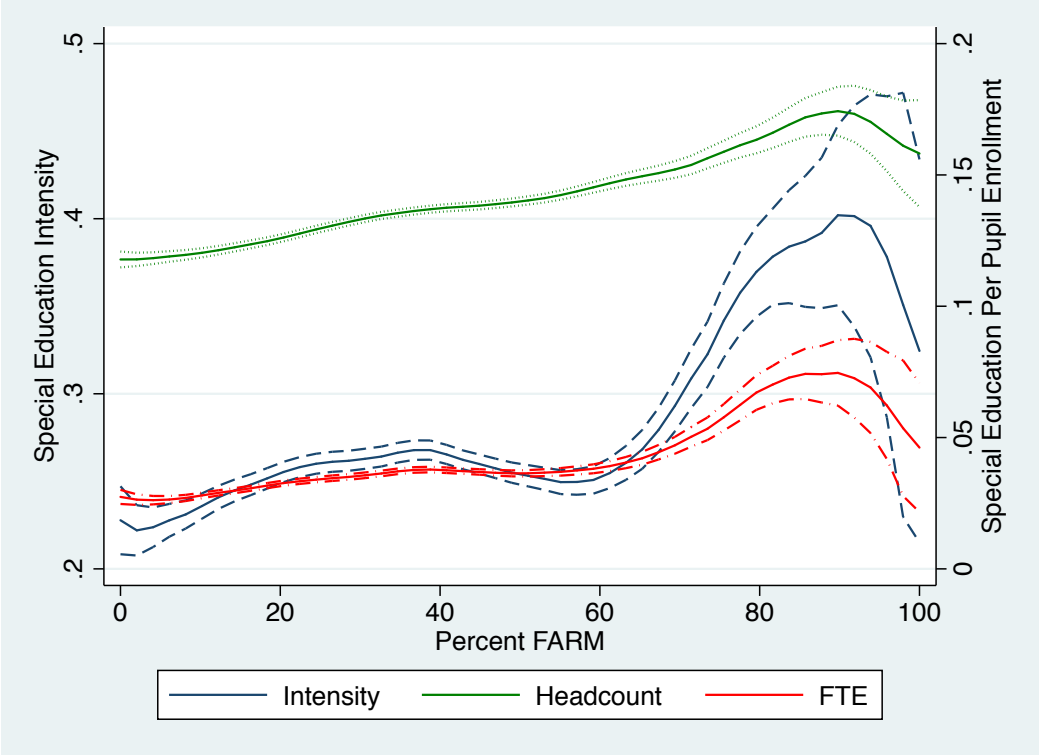
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure E.4: Disability Categories Over Median Household Income



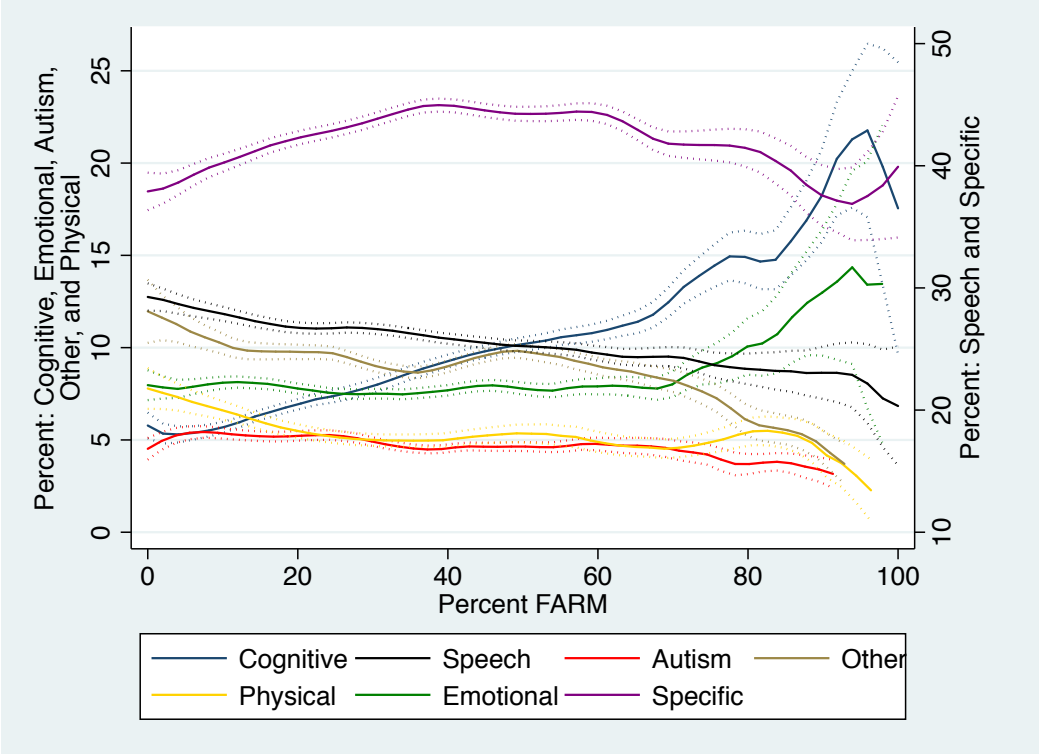
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure E.5: Special Education Participation Over the Percent of Students Eligible Free and Reduced-Price Meals



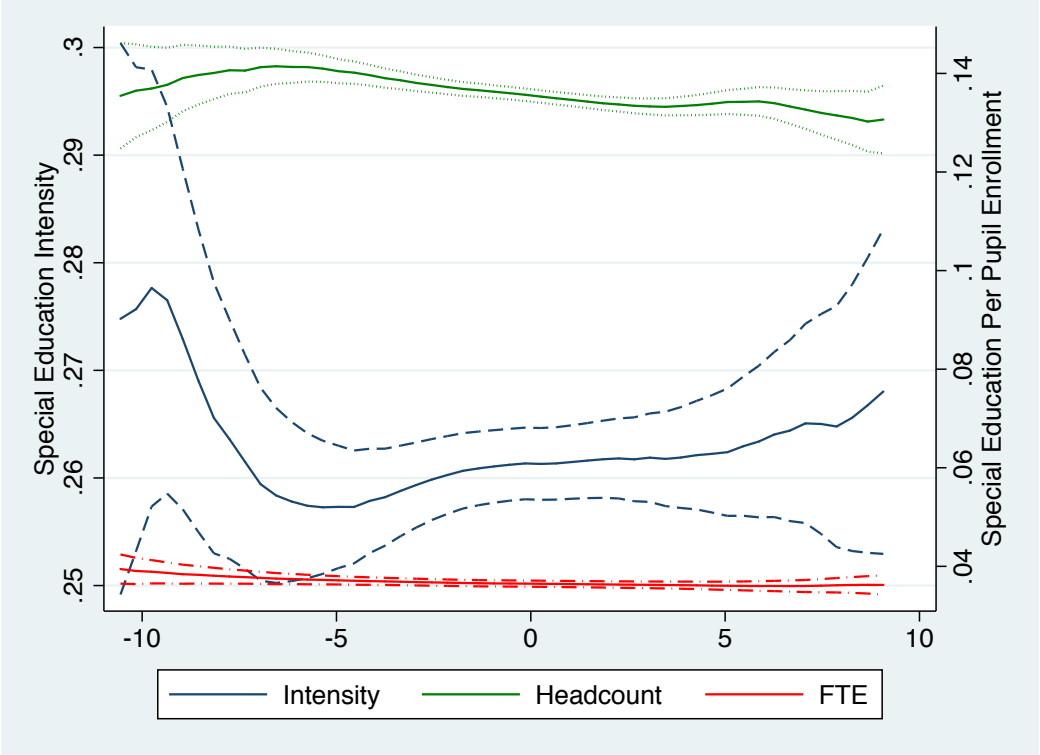
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure E.6: Disability Categories Over the Percent of Students Eligible Free and Reduced-Price Meals



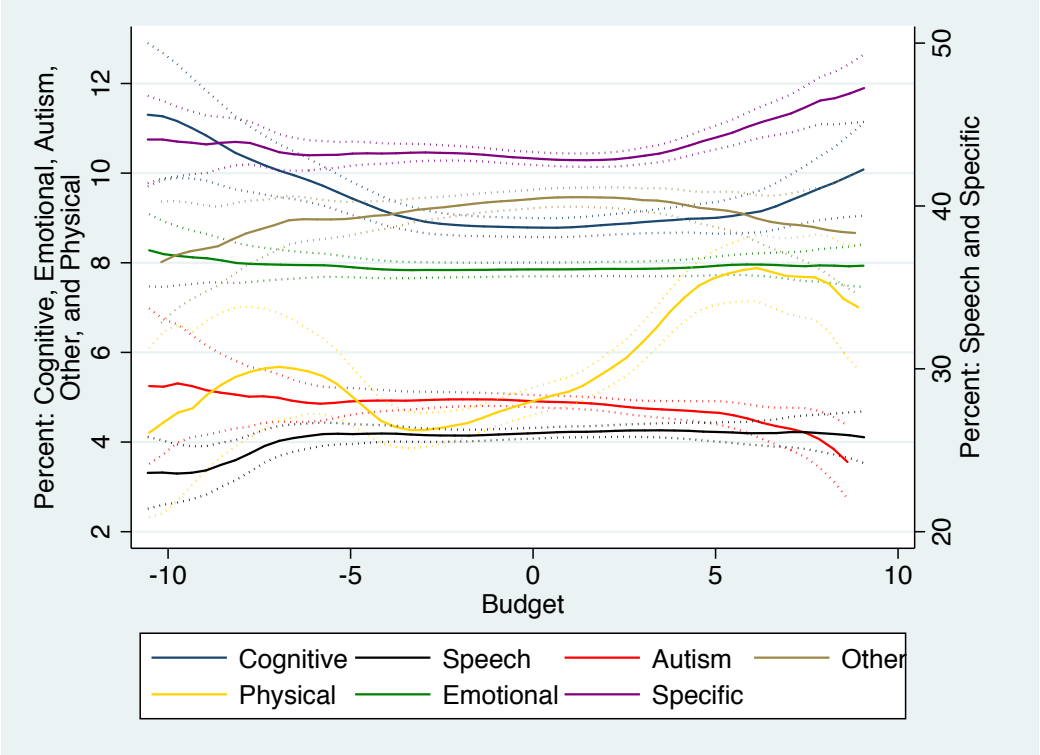
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure E.7: Special Education Participation Over District Budget



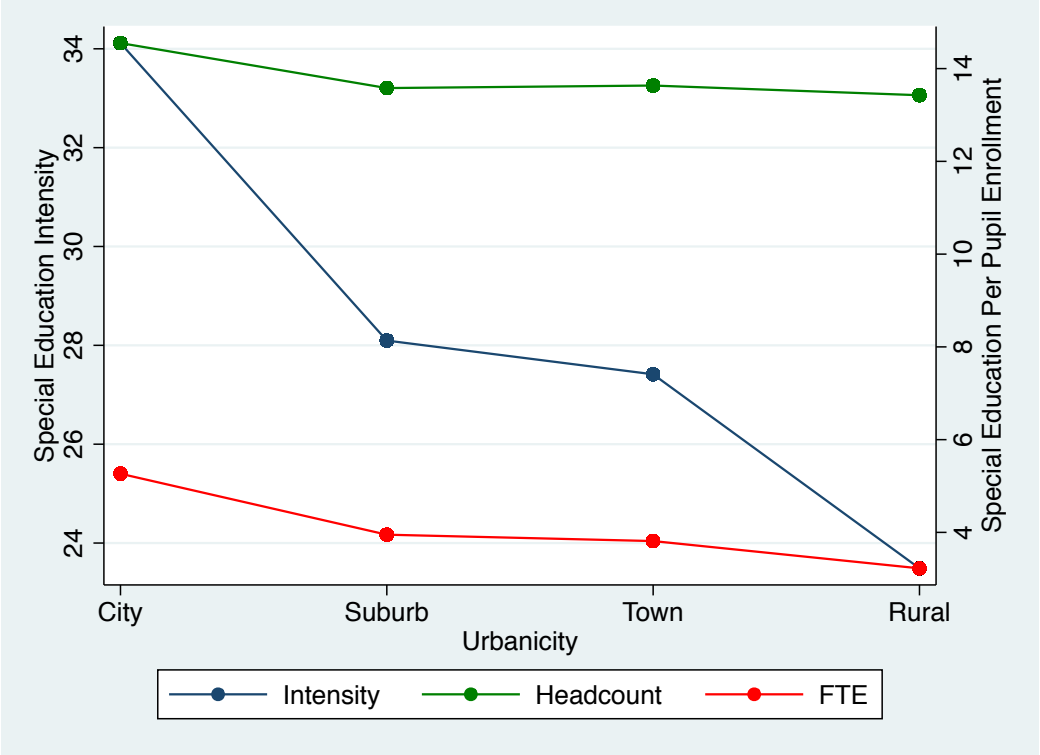
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure E.8: Disability Categories Over District Budget



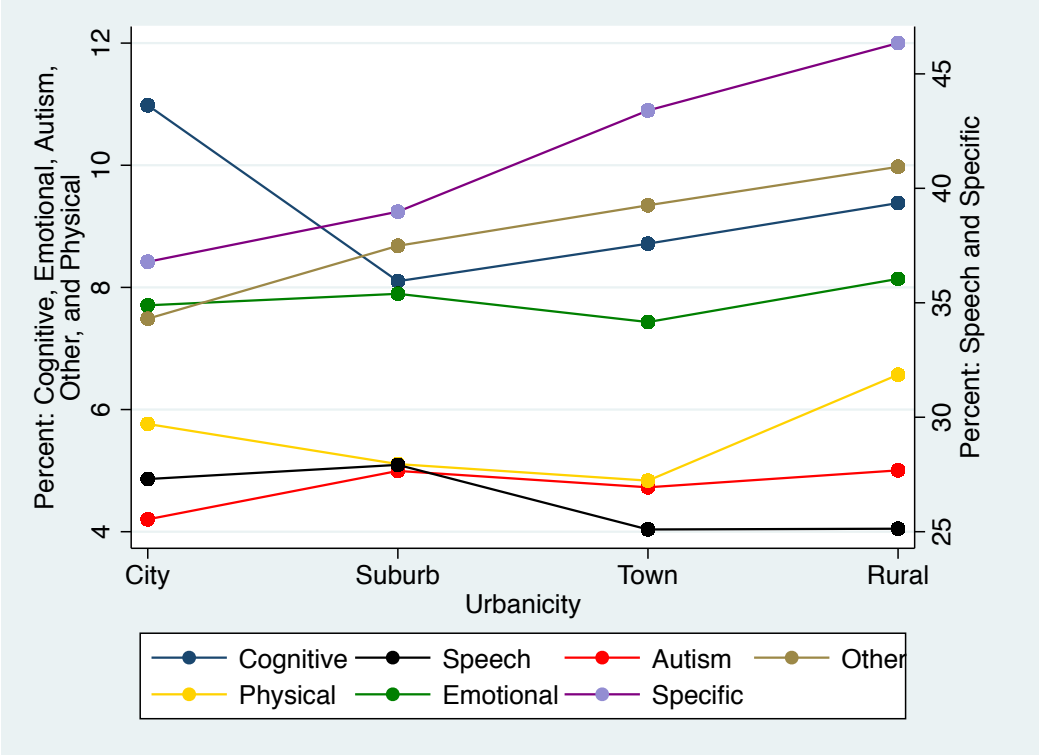
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure E.9: Special Education Participation Over District Urbanicity



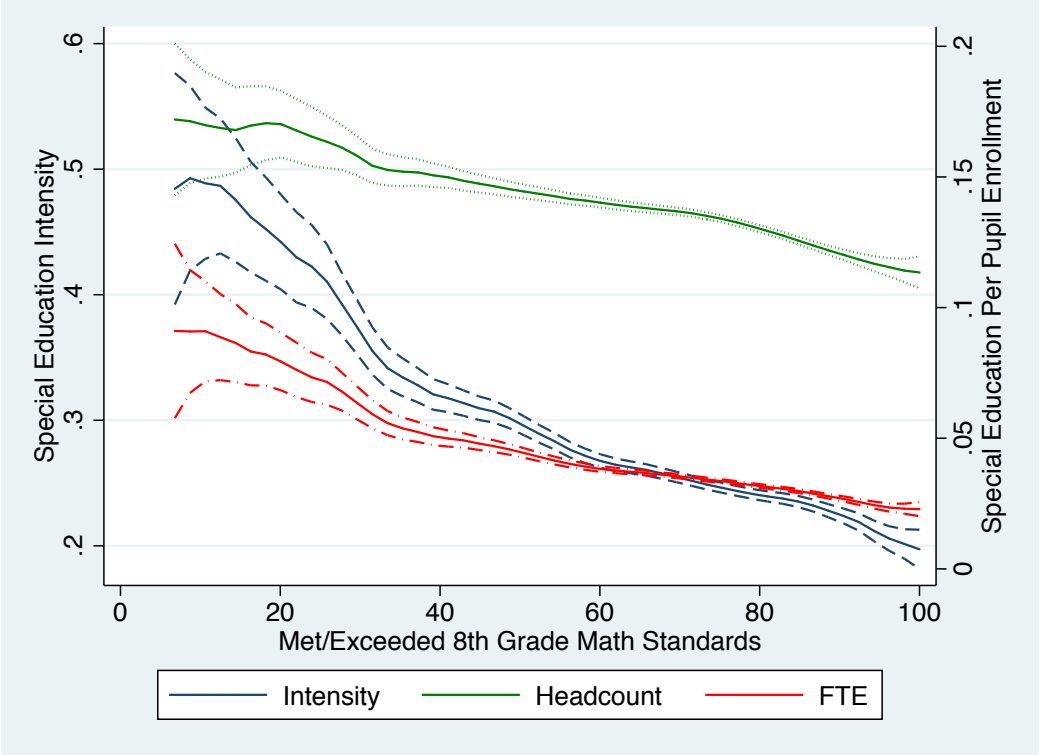
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure E.10: Disability Categories Over District Urbanicity



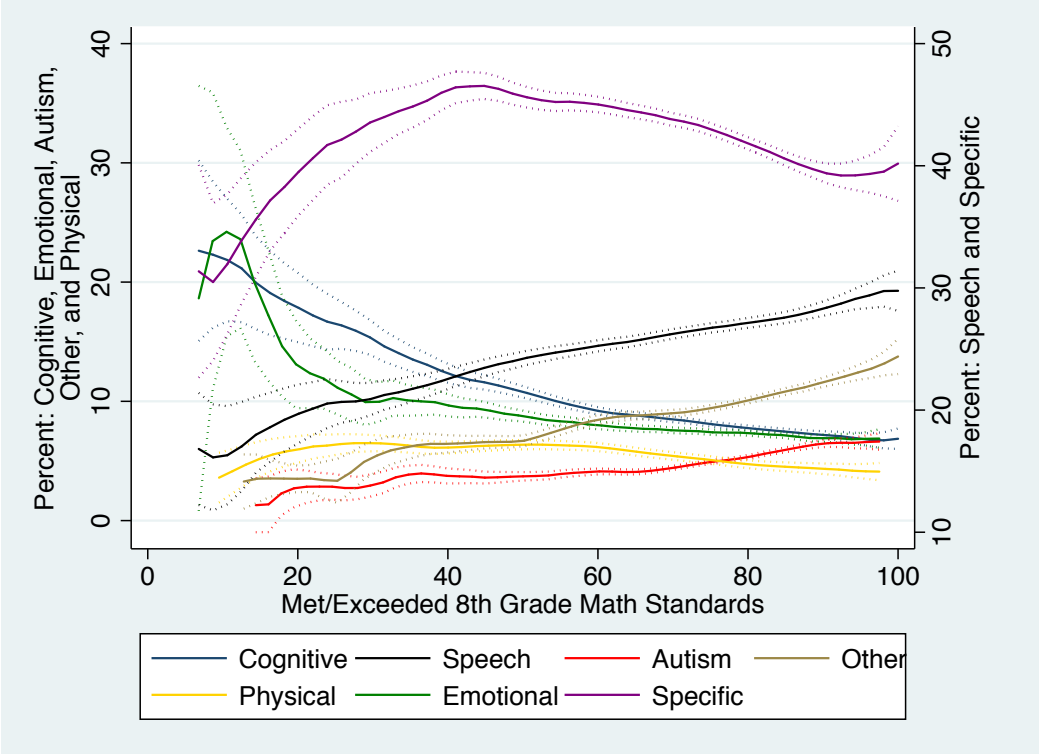
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure E.11: Special Education Participation Over the Share of Eighth Graders That Met or Exceeded Math Standards



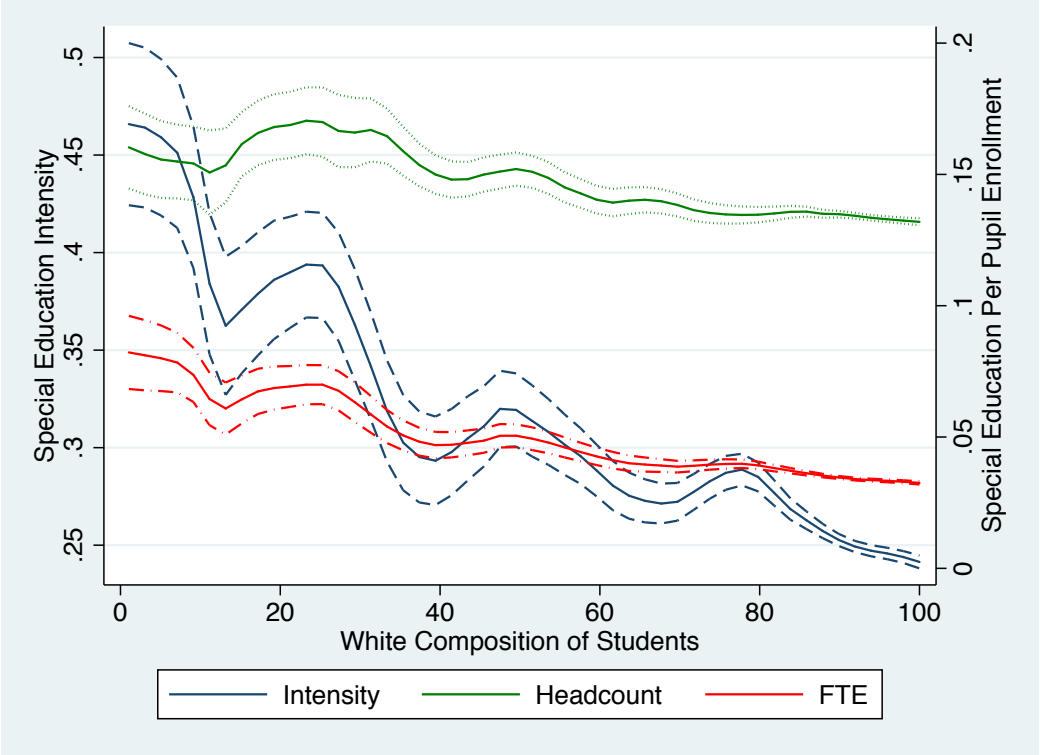
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure E.12: Disability Categories Over the Share of Eighth Graders That Met or Exceeded Math Standards



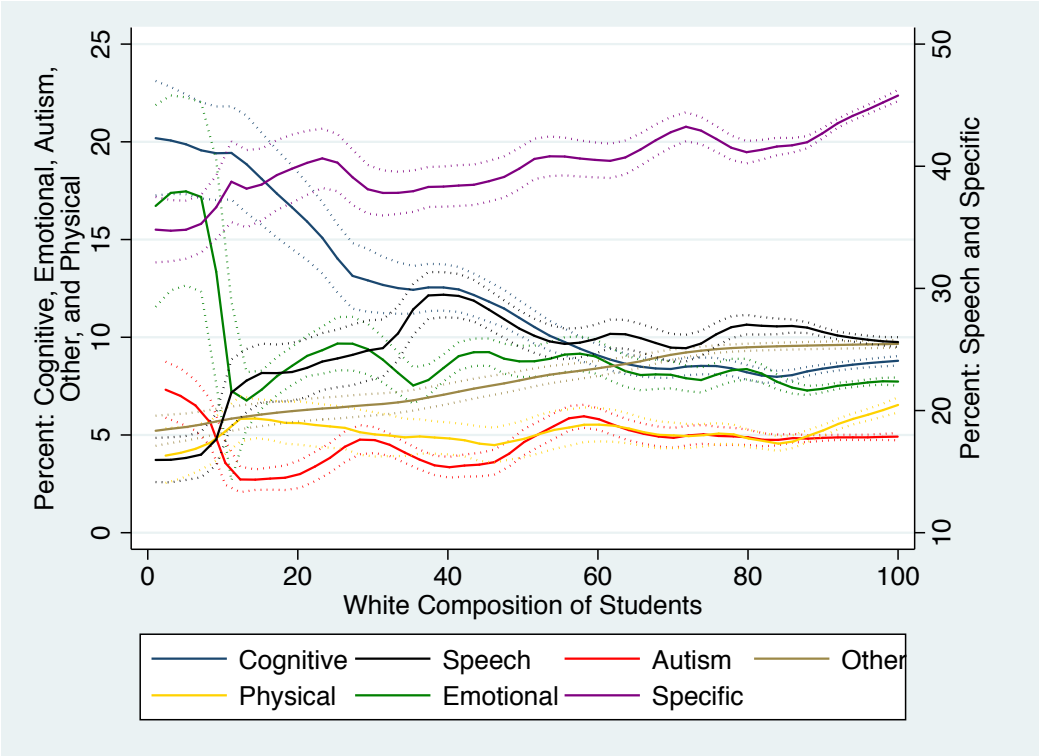
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure E.13: Special Education Participation Over White Composition



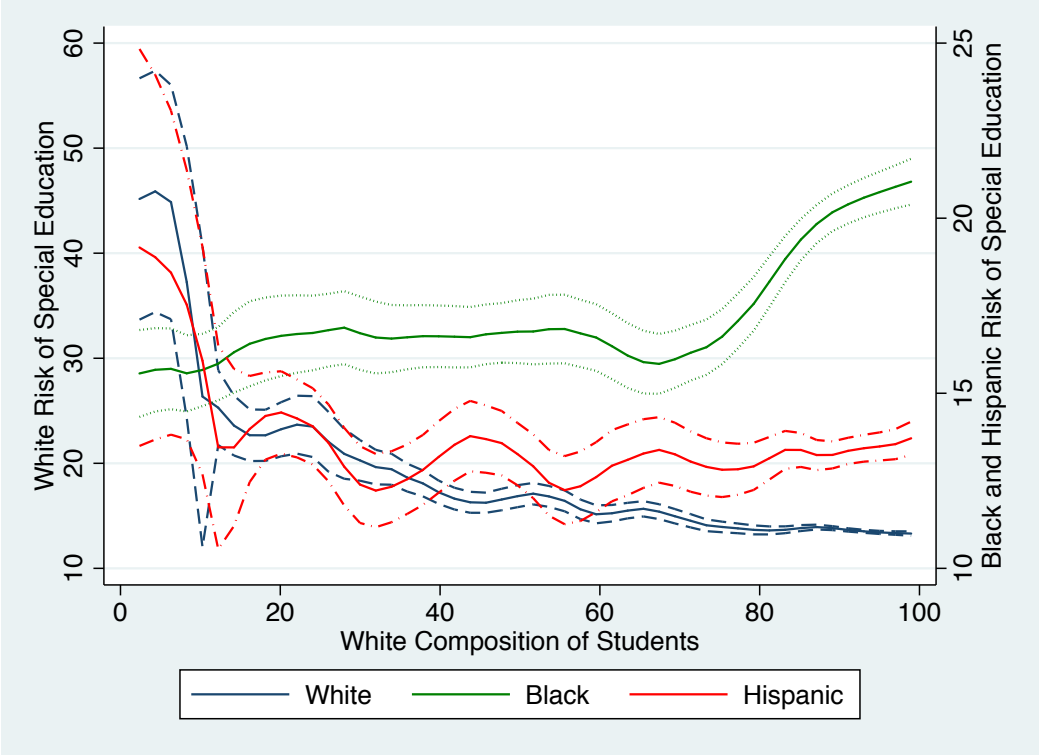
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure E.14: Disability Categories Over White Composition



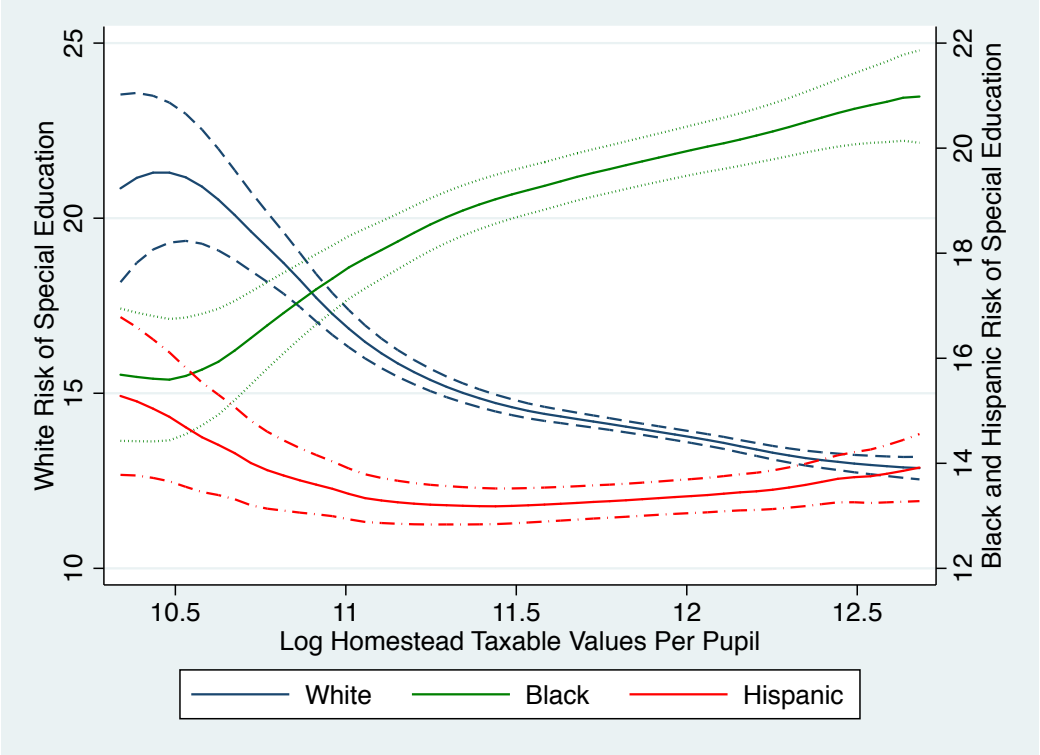
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure E.15: Risk of Special Education Over White Composition



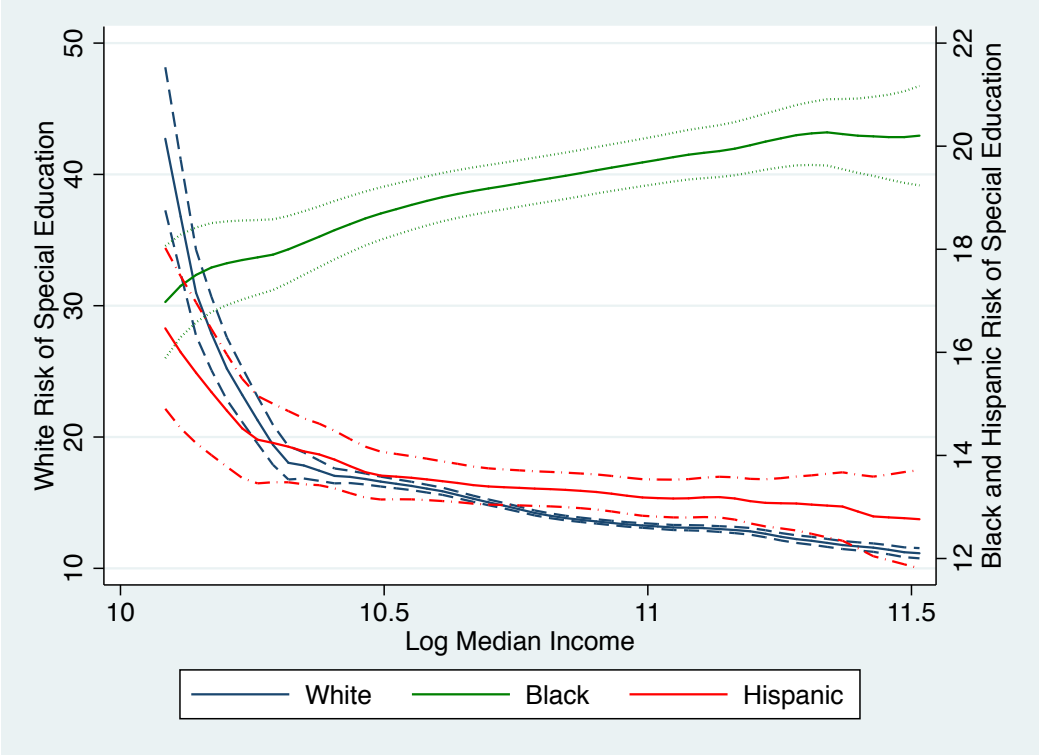
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

Figure E.16: Risk of Special Education Over Homestead Taxable Values



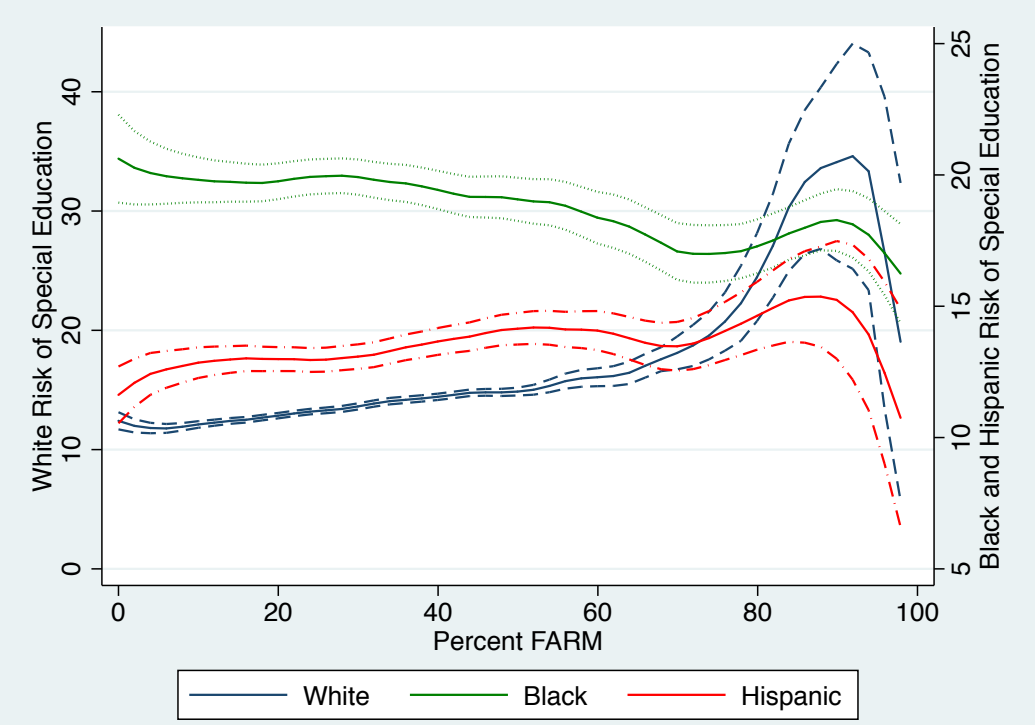
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

Figure E.17: Risk of Special Education Over Median Household Income



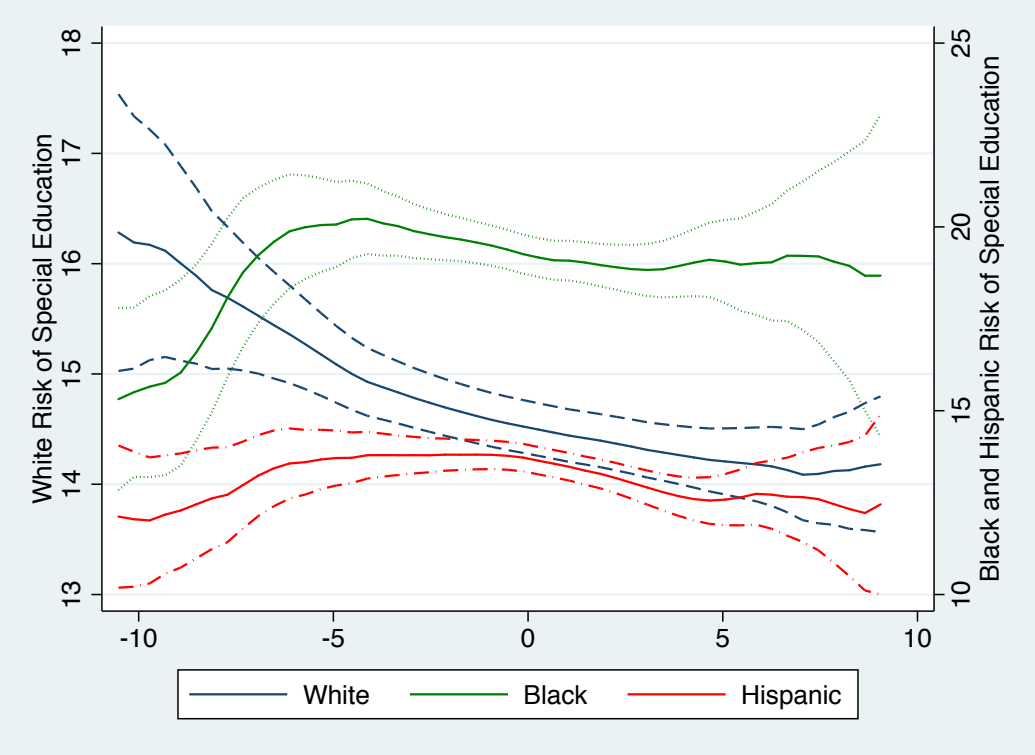
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

Figure E.18: Risk of Special Education Over the Percent of Students Eligible Free and Reduced-Price Meals



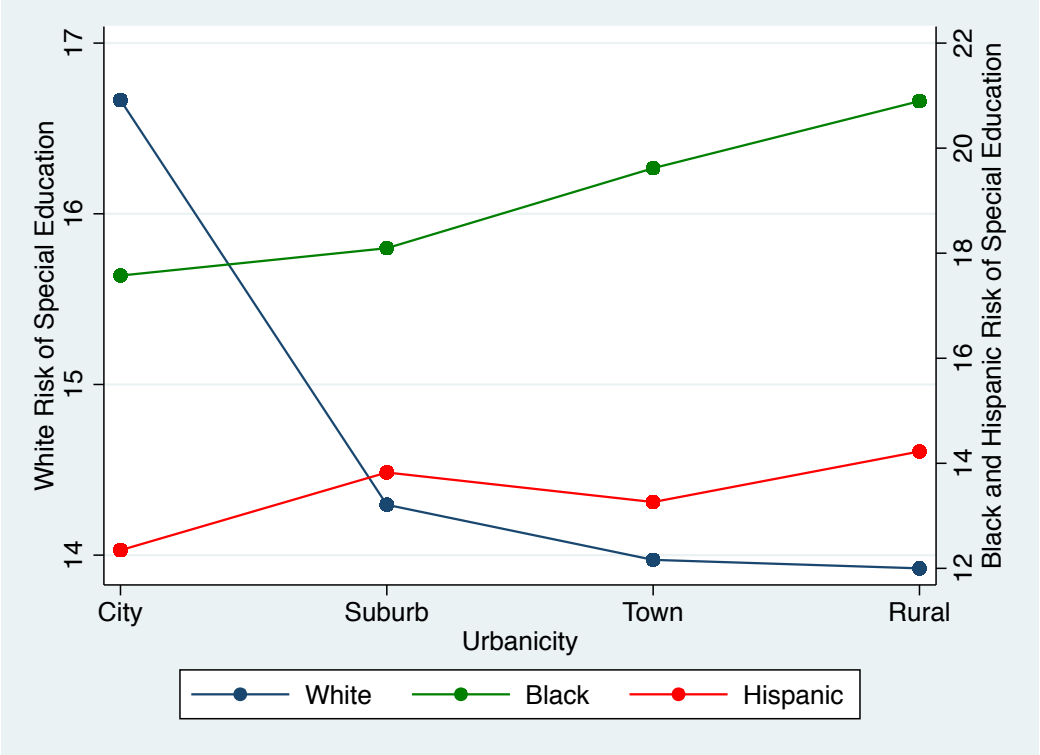
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

Figure E.19: Risk of Special Education Over District Budget



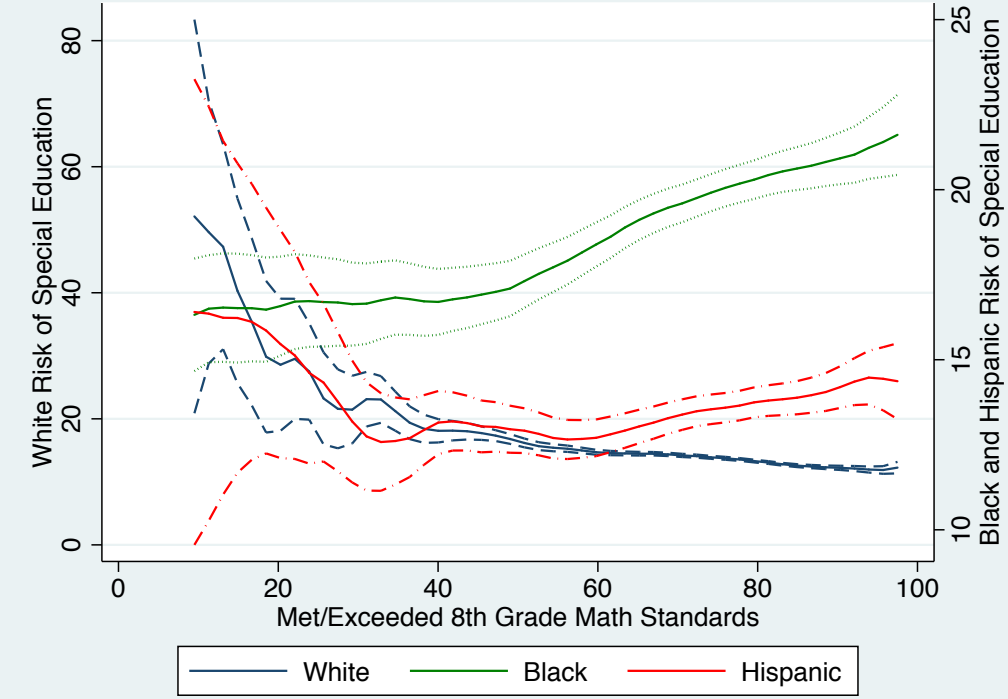
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

Figure E.20: Risk of Special Education Over District Urbanicity



Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

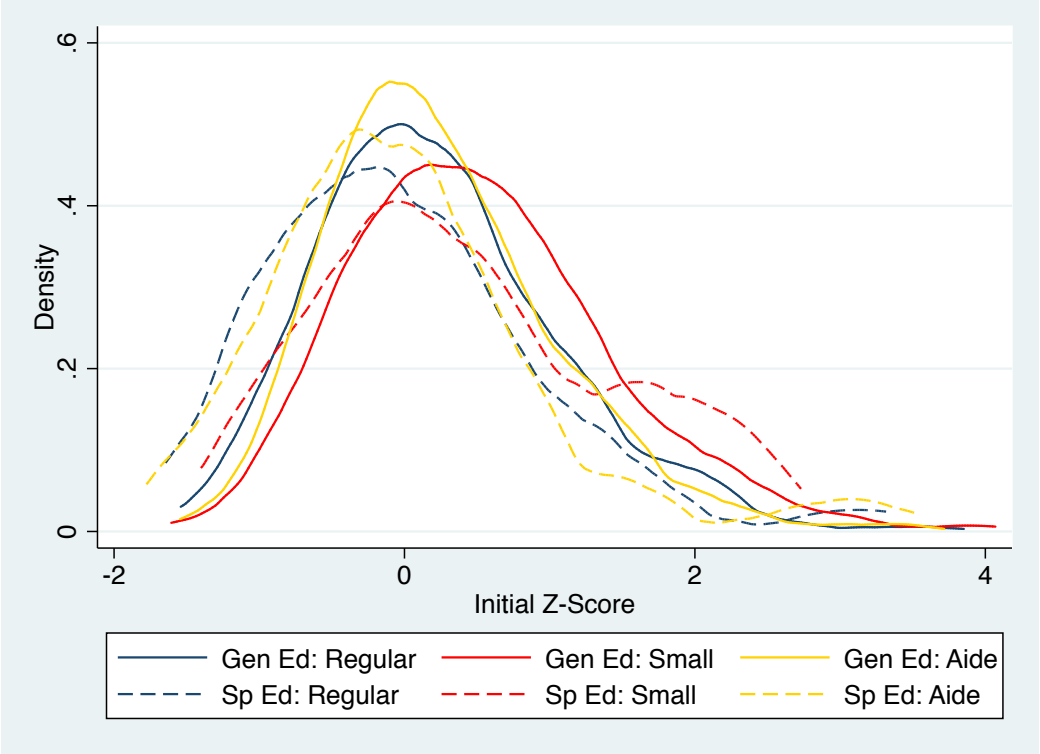
Figure E.21: Risk of Special Education Over the Share of Eighth Graders That Met or Exceeded Math Standards



Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

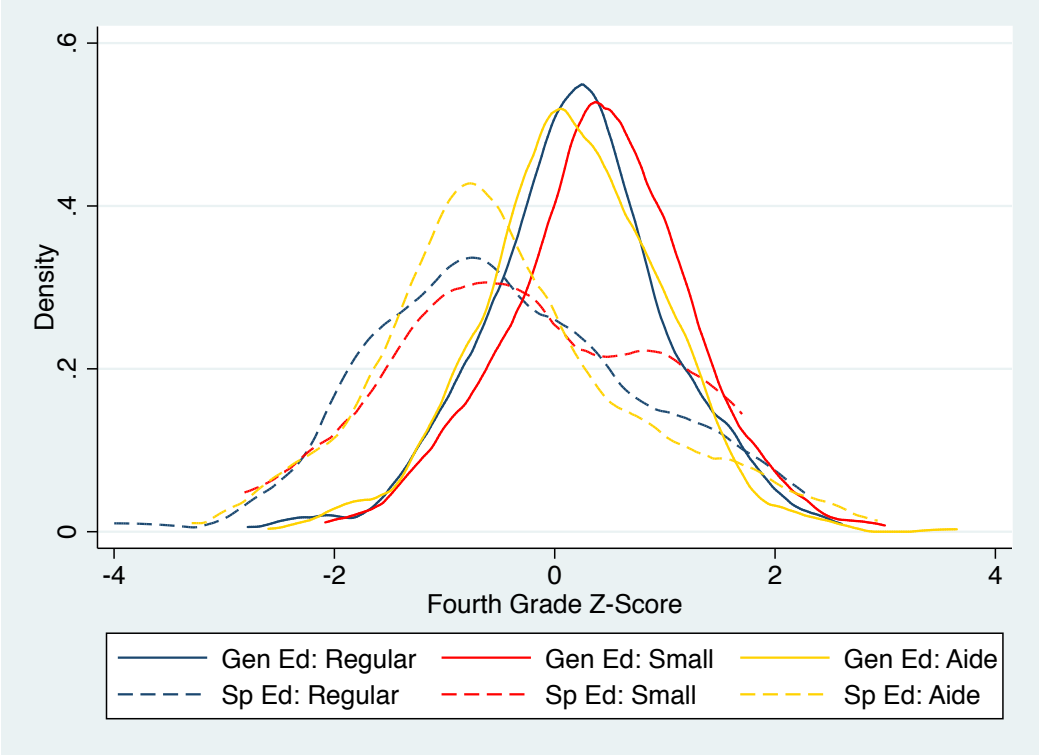
Appendix F Figures for "Class Size and Special Education Placement: Revisiting Tennessee's Project STAR"

Figure F.1: Distributions of Initial Z-Scores



Note: Kernel densities of initial z-scores by Project STAR class type and special education status.

Figure F.2: Distributions of Fourth Grade Z-Scores



Note: Kernel densities of fourth-grade z-scores by Project STAR class type and special education status.

Appendix G Appendices for "The Impact of Disproportionality Regulations on Identification into Special Education Programs"

Disproportionate Representation and Significant Disproportionality

Disproportionality addresses the relative representation of students of a particular race receiving special education services, which the literature calls risk. Policy makers and educators have long been concerned with this type of risk because it is believed that a child inappropriately assigned into special education bears the cost of the label without the high marginal benefit of the services.[14] The Office of Special Education and Westat provide states technical assistance in the calculation of various risk measures. There exist multiple methods to calculate racial risk. The most basic measure attempts to identify the probability a student from a given ethnic group will receive special education services. Risk, R_{id}, is calculated as the number of students in a given race i receiving special education services divided by the total number of students in that race enrolled in the school district d times one hundred.

$$R_{id} = \frac{\text{District } d \text{ Sp Ed Enrl for race } i}{\text{District } d \text{ Total Enrl for race } i} * 100$$

Using the district-level risk, as defined above, states calculate three relative risk measures: risk ratio, weighted risk ratio, and alternative risk ratio. Each of these measures has different strengths and weaknesses, like comparability across districts and interpretation with small student groups. The risk ratio, weighted risk ratio, and alternative risk ratio are defined,

[14] It is worth noting that the risk concept used in this body of literature as well as the legislation only controls for race. Recent papers, such as Coutinho and Oswald (2005), consider risk over gender.

respectively, as

$$RR_{id} = \frac{R_{id}}{R_{-id}}$$

$$WRR_{id} = \frac{(1 - p_i)R_{id}}{\sum_{j \neq i} p_j R_{jd}}$$

$$ARR_{id} = \frac{R_{id}}{R_{-i}}$$

where $-i$ means races not i, p_i is the proportion of students in racial group i in the state, and R_{-i} refers to the statewide risk of the comparison group $-i$. For example, a WRR comparing Black students to all other students of 2.7 means that a Black student is 2.7 times more likely to receive special education services than all other student groups when weighted by state level demographics, a case of overrepresentation.

With the above measures, the MDE calculates the district's verified ratio, which is a measure designed to both reduce the complications caused by low enrollment of a comparison race and also allow for greater comparability across districts.[15] The MDE calculates two sets of the three ratios (WRR_{id}, ARR_{id}, and RR_{id}) using both the operating and resident district data. The lower of the district's relevant operating or resident district ratio is used

[15]The MDE will only calculate the verified ratio when both of the following conditions hold. First, there are 30 or more students in the LEA's special education program. Second, the LEA's total enrollment for all other racial groups exceeds 100.

to calculate the verified ratio.

$$VR_{id} = \begin{cases} WRR_{id}, & \text{if District } d \text{ Sum of Sp Ed Enrl for all races not } i \geq 10 \\ ARR_{id}, & \text{if District } d \text{ Sum of Sp Ed Enrl for all races not } i < 10 \\ RR_{id}, & \text{if (there are 0 Black or White Sp Ed students) or} \\ & \text{(there are less than 3 Black or White Sp Ed students and} \\ & WRR_{id} - RR_{id} \geq 1) \end{cases}$$

Supplementary Tables for "The Impact of Disproportionality Regulations on Identification into Special Education Programs"

Table G.1: Role of Control Variable Set on DD Impact of Penalties

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post 2007 * Penalty	-2.92***	-2.86***	-2.91***	-2.92***	-2.95***	-2.92***	-2.90***	-2.90***	-2.81***
	(0.96)	(0.97)	(0.96)	(0.96)	(0.92)	(0.95)	(0.99)	(0.94)	(1.02)
Post 2007 * Threat	0.61	0.56	0.61	0.61	0.64	0.62	0.59	0.63	0.62
	(0.76)	(0.76)	(0.76)	(0.76)	(0.75)	(0.76)	(0.77)	(0.75)	(0.76)
Penalty	2.40***	2.41***	2.40***	2.40***	2.28***	2.35***	2.45***	2.35***	2.64***
	(0.77)	(0.77)	(0.77)	(0.77)	(0.72)	(0.76)	(0.80)	(0.75)	(0.78)
Threat	1.36***	1.36***	1.36***	1.36***	1.51***	1.43***	1.36***	1.35***	1.36***
	(0.41)	(0.41)	(0.41)	(0.41)	(0.42)	(0.41)	(0.40)	(0.41)	(0.41)
Post 2007	-0.05	0.11***	-0.02	-0.07	-0.06	-0.05	-0.05	-0.05	-0.06
	(0.04)	(0.03)	(0.05)	(0.06)	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)
Years	-0.31*		-0.05	-0.65	-0.52***	-0.34*	-0.16	-0.30*	-0.32*
	(0.17)		(0.05)	(1.03)	(0.18)	(0.17)	(0.17)	(0.17)	(0.17)
$Years^2$	0.04*		0.01**	0.12	0.07***	0.05**	0.02	0.04*	0.05*
	(0.02)		(0.00)	(0.22)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$Years^3$	-0.00			-0.01	-0.00***	-0.00*	-0.00	-0.00	-0.00*
	(0.00)			(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Years^4$				0.00					
				(0.00)					
FARM	-0.01***	-0.00***	-0.01***	-0.01***	-0.01***	-0.01***		-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)
$FARM^2$								0.00	
								(0.00)	
White Composition	-0.01	-0.01	-0.01	-0.01		0.01***	-0.01	-0.00	-0.01

Continued on next page

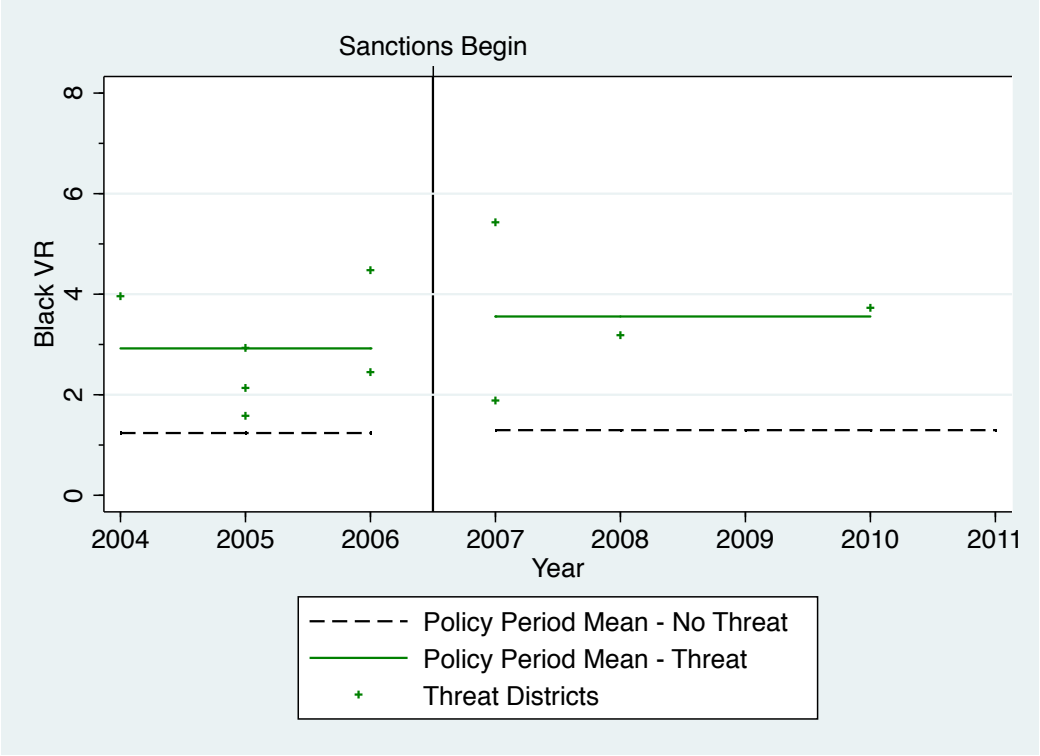
Table G.1 (cont'd)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	(0.00)	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.01)	(0.00)
White Composition^2	0.00***	0.00***	0.00***	0.00***			0.00***	0.00**	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)
Multi Penalty	0.49	0.49	0.49	0.49	0.48	0.50	0.54	0.46	
	(0.39)	(0.36)	(0.38)	(0.39)	(0.37)	(0.38)	(0.39)	(0.38)	
Observations	1249	1249	1249	1249	1249	1249	1249	1249	1249
R^2	0.57	0.56	0.57	0.57	0.52	0.55	0.55	0.57	0.57
F	49.62	55.27	53.64	47.81	56.08	58.40	50.07	49.80	31.28

Note: Each specification contains controls including a cubic in years since 2000, percent of students eligible for free and reduced-price meals, and a quadratic of the White composition. Standard errors are reported in parentheses and clustered at the district level. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

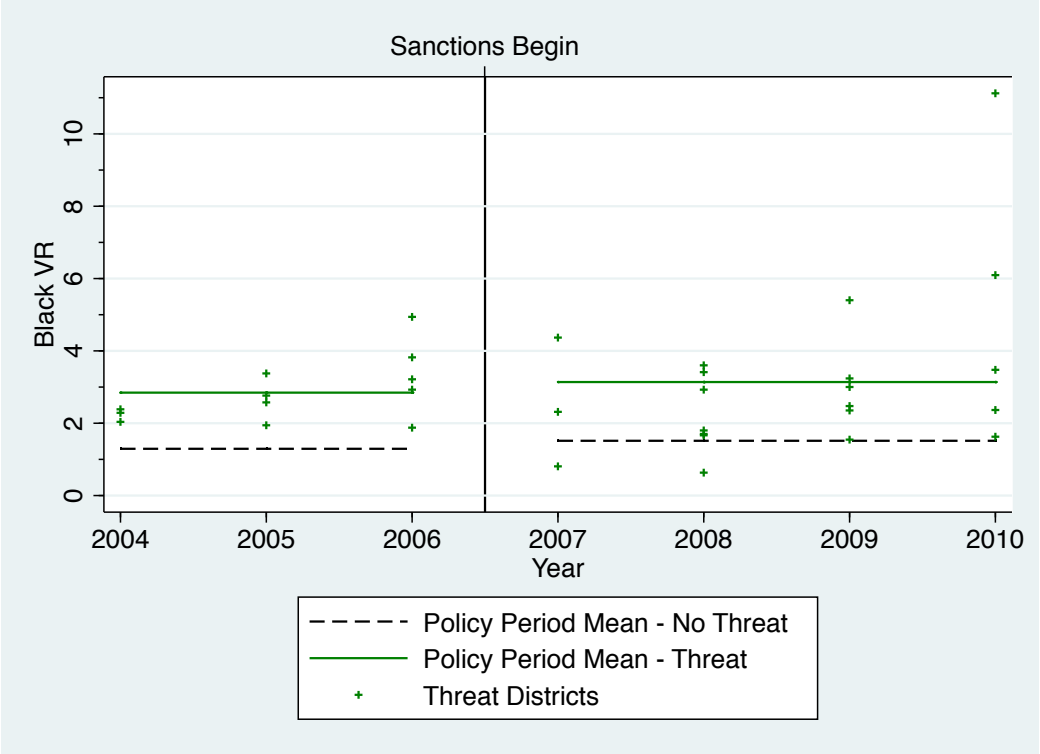
Supplementary Figures for "The Impact of Disproportionality Regulations on Identification into Special Education Programs"

Figure G.1: Impact of Threat on the Black Verified Ratio



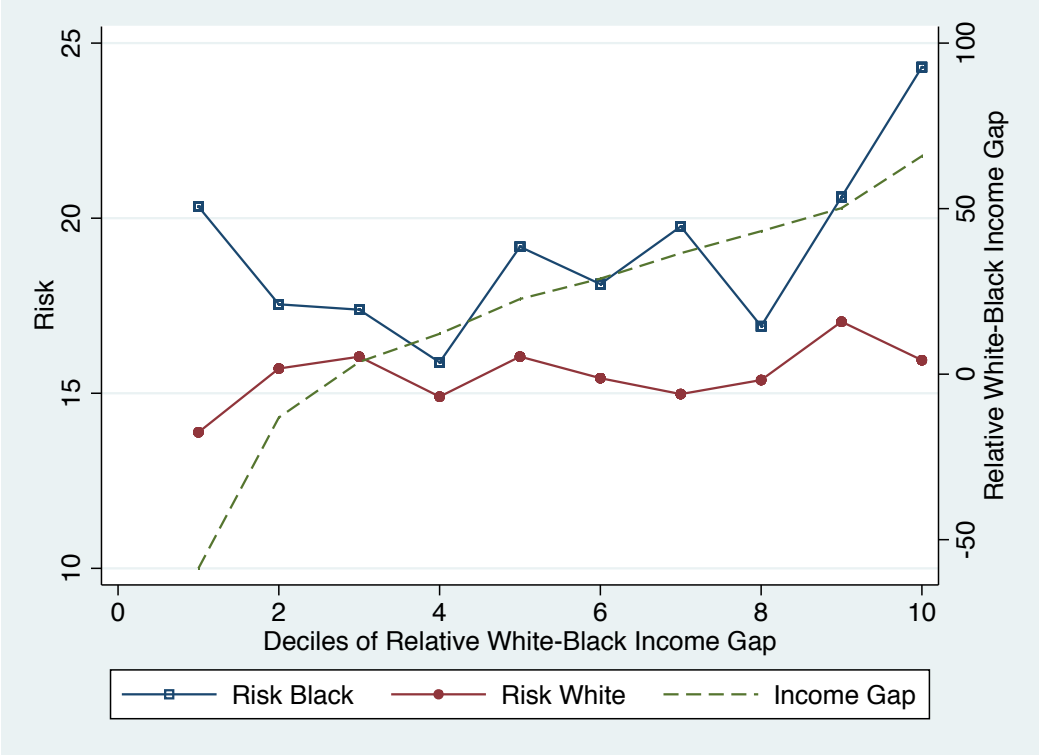
Note: This figure plots the policy period means of the Black verified ratio for districts in threat but not penalty phases and districts in neither threat nor penalty phases. Scatter points for districts in neither threat or penalty phases were excluded for illustrative purposes. The data have been restricted to the analytic sample used in the DD regressions, leaving only traditional public school districts eligible for disproportionality calculations.

Figure G.2: Impact of Threat on the Black Verified Ratio for Ineligible Districts



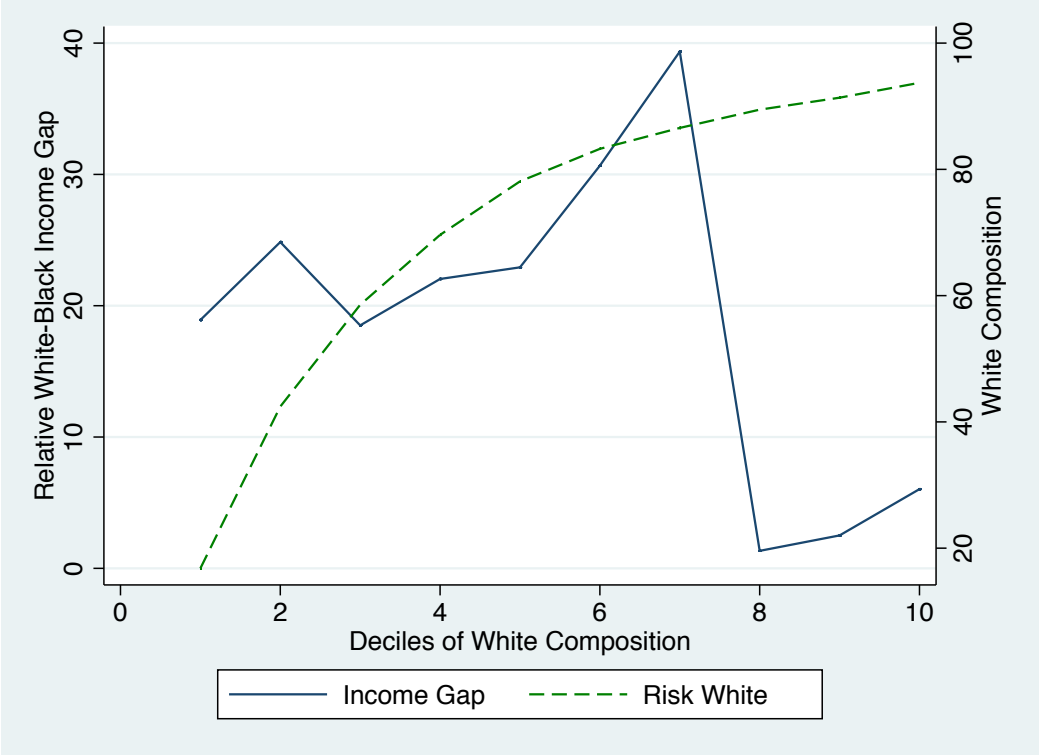
Note: This figure plots the policy period means of the Black verified ratio for districts in threat but not penalty phases and districts in neither threat nor penalty phases. Scatter points for districts in neither threat or penalty phases were excluded for illustrative purposes. The data have been restricted to the analytic sample used in the DDD regressions, leaving only traditional public school districts ineligible for disproportionality calculations.

Figure G.3: Risk by Race Over Relative Income Gap



Note: This graphic shows the relationship between the risk of special education placement for Black and White students separately over the distribution of the relative income gap. The sample has been restricted to the DD analytic sample without charter schools.

Figure G.4: Relative Income Gap Over White Composition

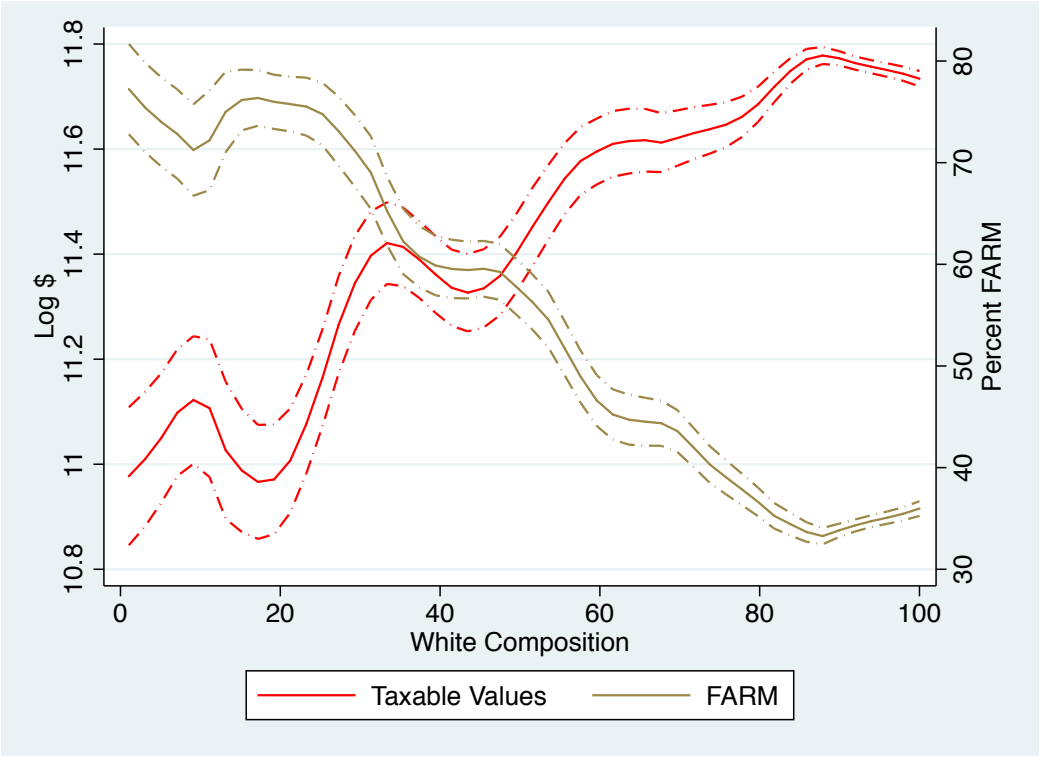


Note: This graphic shows the relationship between the relative income gap over the distribution of total White composition. The sample has been restricted to the DD analytic sample without charter schools.

Appendix H Appendices for "Disparities in Special Education Identification: Evidence from Michigan"

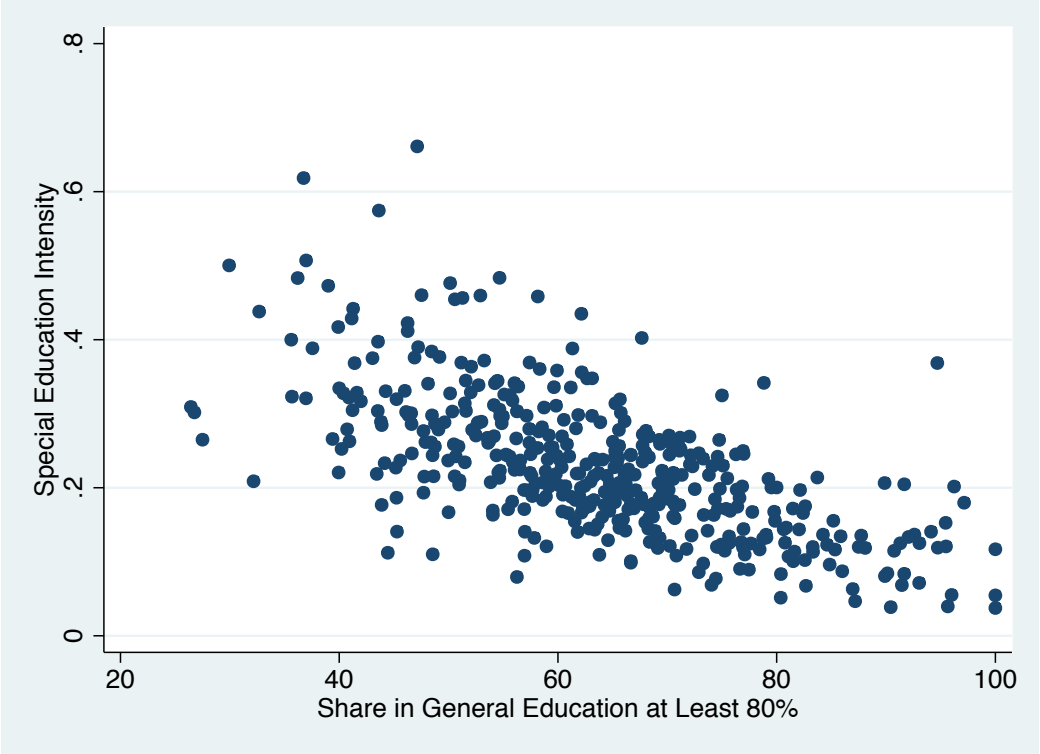
Supplementary Figures for "Disparities in Special Education Identification: Evidence from Michigan"

Figure H.1: Comparison Relationships With White Composition



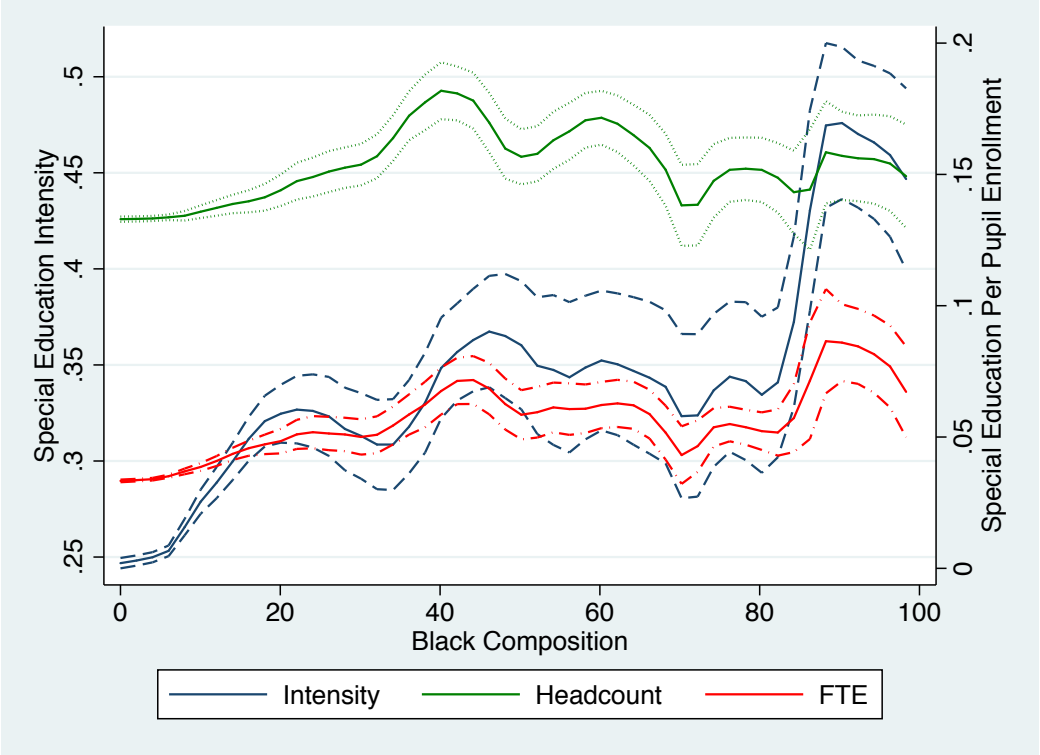
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Taxable values are plotted over logged dollars.

Figure H.2: Scatter Plot of Special Education Intensity and General Education Participation



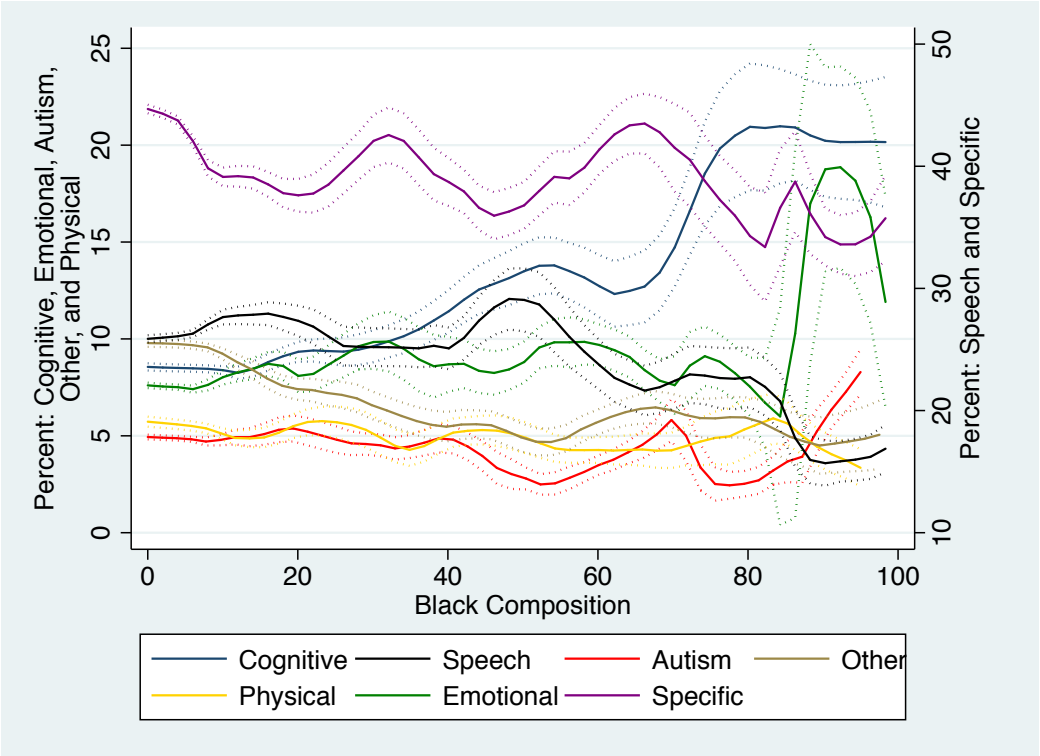
Note: Special education intensities are based on 2010 data while the share in general education for at least 80 percent of the day are based on 2011 data.

Figure H.3: Special Education Participation Over Black Composition



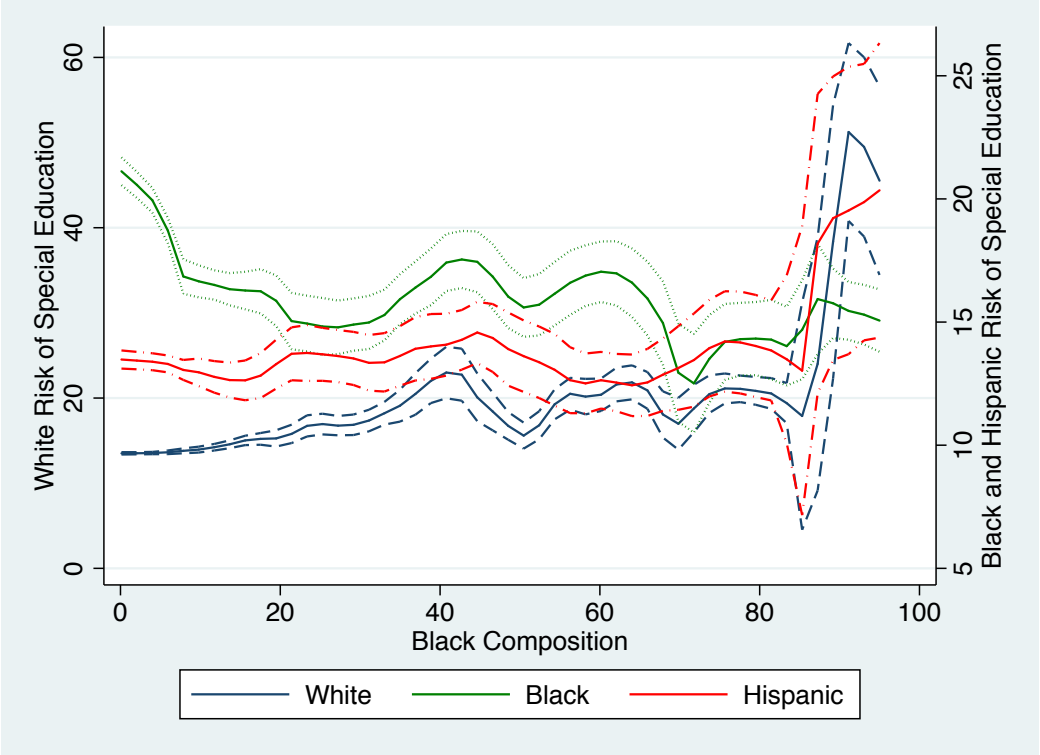
Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. Special education per pupil enrollment measures participation rates by headcount and FTE.

Figure H.4: Disability Categories Over Black Composition



Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color. The Physical group refers to the aggregation of the following disability categories: hearing impairment, visual impairment, physical impairment, severe multiple impairment, traumatic brain injury, and deaf-blindness.

Figure H.5: Risk of Special Education Over Black Composition



Note: Broken lines represent the 95 percent confidence interval around the solid line of the same color.

Appendix I Appendices for "Class Size and Special Education Placement: Revisiting Tennessee's Project STAR"

Supplementary Tables for "Class Size and Special Education Placement: Revisiting Tennessee's Project STAR"

Table I.1: Transition Matrix of Special Education Status by Grade

			1^{st} Grade			4^{th} Grade		
			No	Yes	Missing	No	Yes	Missing
K	Grade	No	4363	28	1731	1459	153	4510
		Yes	113	8	81	29	12	161
		Missing	2266	48	2963	421	99	4757
1^{st}	Grade	No	.	.	.	1903	256	4583
		Yes	.	.	.	6	8	70
		Missing	.	.	.	0	0	4775

Note: Cross tabulations of the counts of students by special education status. Yes (No) refers to a student participating (not participating) in special education programs in a specific grade. Missing means that the cell containing special education status information had missing data in for grade.

Table I.2: Characteristics of Students by Grade-Specific Special Education Status

	Kindergarten		First Grade		Fourth Grade	
	(1)	(2)	(3)	(4)	(5)	(6)
	Sp Ed	Gen Ed	Sp Ed	Gen Ed	Sp Ed	Gen Ed
Small	0.36	0.30	0.12	0.26	0.30	0.34
	(0.48)	(0.46)	(0.33)	(0.44)	(0.46)	(0.47)
Aide	0.31	0.35	0.49	0.36	0.36	0.33
	(0.46)	(0.48)	(0.50)	(0.48)	(0.48)	(0.47)
Female	0.38	0.49	0.31	0.48	0.41	0.51
	(0.49)	(0.50)	(0.47)	(0.50)	(0.49)	(0.50)
Black	0.17	0.33	0.19	0.33	0.16	0.24
	(0.38)	(0.47)	(0.40)	(0.47)	(0.37)	(0.43)
Free Lunch	0.57	0.48	0.70	0.50	0.50	0.40
	(0.50)	(0.50)	(0.46)	(0.50)	(0.50)	(0.49)
Z-Score						
Kindergarten	-0.42	0.07	-0.27	0.17	0.35	0.34
	(1.06)	(0.94)	(1.37)	(0.91)	(1.00)	(0.87)
First Grade	-0.21	0.17	-0.52	0.06	0.08	0.43
	(1.01)	(0.97)	(1.19)	(0.95)	(1.02)	(0.83)
Fourth Grade	-0.01	0.21	-0.68	0.10	-0.37	0.25
	(1.30)	(0.89)	(1.18)	(0.94)	(1.16)	(0.83)
Missing Special Education						
Kindergarten	0.00	0.00	0.57	0.34	0.38	0.22
	(0.00)	(0.00)	(0.50)	(0.47)	(0.49)	(0.41)
First Grade	0.40	0.28	0.00	0.00	0.00	0.00
	(0.49)	(0.45)	(0.00)	(0.00)	(0.00)	(0.00)
Fourth Grade	0.80	0.74	0.83	0.68	0.00	0.00
	(0.40)	(0.44)	(0.37)	(0.47)	(0.00)	(0.00)
Observations	202	6122	84	6742	264	1909

Note: Means with standard deviations in parentheses. Sp Ed (Gen Ed) refers to special education (general education) status in a given grade.

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