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Impact of States' Adoption of Response to Interventions (RTI) on the Identification and Placement of Students in Special Education

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This study investigates the impact of states' adoption of Response to Interventions (RTI) on the identification and placement of students in special education. RTI, adopted by the reauthorization of the Individuals with Disabilities Education Act in 2004, is designed to improve the identification and support of children with learning disabilities within inclusive educational settings. Using multiple national datasets, we employed a difference-in-differences method to assess state-level impacts from 2004 to 2018. Results show that states adopting RTI observed increased identification of students with specific learning disabilities, yet showed reductions in the placement of students with disabilities in separate school settings. Furthermore, our subgroup analyses suggest that RTI adoption disproportionately increased disability identification among non-White students relative to their White peers.

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Impact of States' Adoption of Response to Interventions (RTI) on the Identification and Placement of Students in Special Education

Students with special needs often face developmental, academic, and social challenges throughout their education trajectory (Petersen, 2012). Public policies play an important role in shaping and refining educational programs and services for these students by ensuring equitable opportunities for optimal growth and development. Policies like the Individuals with Disabilities Education Act (IDEA) determine the eligibility criteria for services and regulate the methods and locations of service delivery. In turn, the policy levers within IDEA can either bolster the provision of beneficial services to students with special needs, or conversely, obstruct their access to necessary services.

To better identify and serve public school students with specific learning disabilities (SLD) or with other special needs, the federal government included in the 2004 reauthorization of IDEA a policy mandate to scale up Response to Intervention (RTI) (IDEA 2004, Sec. 614.b.6.B). States then started requiring RTI in schools.[1] The RTI approach is a comprehensive evaluation criterion that is used for both the identification of students with SLD and intervention provision purposes. Specifically, RTI includes evidence-based instruction, screening and monitoring assessments, and targeted interventions across school years (Berkeley et al., 2009; Fletcher et al., 2019; L. S. Fuchs et al., 2007). In 2006, fifteen states adopted RTI, with more states gradually joining after 2006 (Zirkel & Thomas, 2010a).

States' adoption of RTI or Multi-Tiered System of Support (MTSS) has shaped the education of students with disabilities quite substantially, given that students might be identified differently for SLD or placed in regular classrooms for interventions. Yet, scientific evidence of

[1] Please note that the federal government introduced RTI in 2004, but states did not change their practices until 2006. Consequently, the RTI start year is considered 2006 moving forward.

the effects of statewide introduction on student outcomes remains limited (Gilmour et al., 2023; Hall-Mills, 2021). Two recent studies investigated the effect of Tennessee's and Florida's mandated RTI policies and found that specific learning disability prevalence significantly decreased after RTI implementation (Gilmour et al., 2023; Hall-Mills, 2021). However, these findings might be only applicable to these specific states and may not generalize to other states' responses to federal RTI policy.

Moreover, RTI may have differential impacts through the identification and intervention support of marginalized students who may have been previously underserved due to systemic barriers. On one hand, RTI could potentially worsen racial inequities in special education due to longstanding challenges with resource allocation, cultural competence, and assessment bias for children of color (Harry & Klingner, 2014). On the other hand, RTI could potentially improve equity in special education by reducing the over-identification of students of color (Hoover, 2010), for example, by providing timely evidence-based interventions in general education settings. We explore the extent to which RTI may reduce or exacerbate racial inequities in the identifications of disability and special education.

Our study is the first to casually examine how the national adoption of RTI across 46 states affected whether students in that state were identified with a disability, or were placed in a different education setting for special education services. We use a difference-in-difference (DID) framework with multiple state-level data sources to exploit the variation in the timing of states' RTI adoption to isolate the impacts of the policy change. We use data from 2004 to 2018 to capture the full span of state RTI implementation from the IDEA legislation onward. This is critical given that RTI is a progressive program that requires multiple years to be fully implemented and to start influencing student outcomes. We also incorporate the latest

developments in DID methodology with staggered treatment timing to address bias stemming from traditional two-way fixed effects specification (Goodman-Bacon, 2021) and to draw more reliable conclusions about the causal relationships between RTI adoption and student outcomes. We find that states' adoption of RTI resulted in higher proportions of students identified with SLD, but lower proportions of students with disabilities who were placed in a separate school setting. Our racial subgroup analyses indicate that RTI adoption was marginally associated with the likelihood of students of color being identified with a disability compared with White students.

Background

The goal of the Individuals with Disabilities Education Act (IDEA, 1990), previously known as the Education for All Handicapped Children Act (EHA; 1975-1990), was to provide access to a free, appropriate public education for the specific needs of children with disabilities (OSERS, 2016). IDEA thus required states to appropriately identify and serve children with disabilities. Traditionally, the identification process begins with a referral by either a child's parent or a teacher. A school's specialist (e.g., a psychologist or a physician) then conducts an evaluation to assess whether the child has a disability, after which school officials and parents determine eligibility for special education (Parks, 2011). School officials, along with the child's parents, then decide whether their child should receive needed treatment either in their regular classroom or a special educational setting.

Specifically, the criteria for disability identification and special education placement under IDEA changed for children with SLD after the revision and reauthorization in 2004. Before the reauthorization, schools usually used what is known as the IQ-achievement discrepancy model—a significant difference between a student's intelligence score and the

student's achievement score—to identify children with disabilities (Fletcher et al., 2005). For instance, a student might be identified with a disability under this model if the difference between their IQ and achievement is greater than two standard deviations. After the 2004 revision, the federal law encouraged states to use an "evidence-based" approach to identify and serve children with learning disabilities. RTI was a recommended approach under this definition (henceforth, RTI refers to both RTI and a multi-tiered system of support).[2]

Students identified with SLD would receive individualized services or targeted interventions aimed at ameliorating the challenges they are likely to face throughout schooling. Because of this individualization, services are provided by schools depending on students' needs. Students may receive instruction in a regular education classroom or in a separate educational setting for different lengths of time (i.e., part of the school day either in a regular classroom or in a separate school). The identification and placement of children with learning needs vary by state, even though criteria were set by the federal government. In 2006, 15 states first adopted RTI, 40 states had started RTI in 2014, and as of 2018, 45 states had adopted RTI (see Figure 1).

Compared to the traditional approach, RTI is believed to be a better method of identifying and serving students (Fletcher et al., 2019; Grosche & Volpe, 2013). As Figure 2 indicates, RTI usually has three tiers: at Tier 1, all children are screened and provided with high-quality and core instruction in regular classrooms; at Tier 2, if students experience learning difficulties responding to instruction, they will receive small targeted group instruction by classroom teachers or special educators; at Tier 3, if students with difficulties make little or no

[2] There are several versions of RTI implemented across states, and the main one is a multi-tiered system of support (MTSS). While most of the features between RTI and MTSS are the same, MTSS also reflects "tiers" in the name and incorporates students' social-emotional functioning under the category of Emotional Disturbance addressed by Positive Behavior Interventions and Supports also referred to as Positive Behavioral Interventions and Supports (PBIS) (Jimerson et al., 2016).

progress in response to specialized instruction over time, they will receive intensive interventions either in a school setting or another location (e.g., tutoring and other services outside of school) (Berkeley et al., 2009; D. Fuchs et al., 2003). Tier 3 is often the step at which children would be more likely to be identified with SLD despite variations across states. Students can return to the general classroom for part-time or full-time instruction if their difficulties are remedied by interventions in RTI treatments (Fuchs & Fuchs, 2006). With the criteria and implementation processes of RTI, the approach aims to prevent children from the "wait to fail model" by intervening early with targeted assistance regardless of their disability status, assisting schools and districts in broadening the range of interventions available to children in regular classrooms, and ensuring that the curriculum truly meets the needs of all students nationwide. Although RTI's standards may vary across states, its use often means that schools will operate these tiered practices to teach and assist students with different needs (Zirkel & Thomas, 2010a, 2010b). We also acknowledge that most states adopted RTI gradually, and in this study, we consider the time when states first adopted the RTI model or provided some support for schools to implement RTI.

The Impact of Response to Intervention on Disability Outcomes

Correlational studies examining the association between RTI and SLD identification have found mixed results (Parks, 2011; VanDerHeyden et al., 2007; Wanzek & Vaughn, 2011). Some studies find a negative correlation between RTI implementation and disability identification. For instance, VanDerHeyden et al. (2007) observed a drop in special education (SPED) identification from 6% to 3.5% following a year of RTI implementation in five elementary schools. They also noted an initial increase in the percentage of children qualifying for special education services from 41% to 71% with the introduction of RTI, which then declined back to 40% when RTI was discontinued in the subsequent year. In contrast, a study by Wanzek and Vaughn (2011), which

looked at elementary student cohorts did not find a significant relationship between RTI and SPED identification. These correlational studies also explored changes in SLD identification among different student groups, aiming to address concerns of disproportionality in SLD identification (e.g., racial groups).

It is important to note that contradictory evidence from evaluations of RTI has emerged in the literature. Studies finding a decrease in disability identifications from RTI might suggest that identification procedures within RTI have been streamlined, assisting students earlier without them being identified with a disability (Fuchs et al, 2005; VanDerHeyden et al., 2007). In contrast, research finding an increase in disability rates might suggest that RTI has an improved assessment method for identifying students with learning needs and a broader definition of learning disability that considers contextual factors (Grigorenko et al., 2020). Within the current literature, we cannot draw a complete picture RTI's effects, particularly when implemented at scale. In this policy area, more research is clearly needed to make informed policy and practice decisions for children with SLD.

Further, RTI can also influence education placements for students with SLD. Similarly, research has also shown mixed results regarding the effect of RTI on educational placements. Without directly testing the relation, some evidence suggested that RTI could lead to more inclusive general education settings for students with disabilities by reducing the number of students receiving instruction in special education environments, often accompanied by fewer diagnoses of SLD and improved academic performance among students (Fuchs, D. & Fuchs, L. S., 2006; Vaughn, S. & Fuchs, L. S., 2003). However, the results are varied across studies. For example, some researchers suggest decreases in special education placements because of SLD identifications following the implementation of RTI (e.g., Burns et al., 2005). In contrast, other

research indicates that RTI serves as a universal support framework for all students, rather than a connection to special education, and RTI may not change special education placements (Berkeley et al., 2020; Torgesen, 2009). Thus, while RTI has the potential to influence special education placements by altering the processes of disability identification and support, evidence of its impact is limited and suggests variability in outcomes across different contexts and over time (Fletcher et al., 2007).

Research has also indicated that RTI methods may promote better educational opportunities for students of color. Some studies suggest that students of color are more likely to be misidentified with a disability and placed in a non-inclusive environment (Ciolfi and Ryan, 2011; Ford, 2004). However, only a handful of studies have tested the association of RTI with different racial subgroups (Gilmour et al., 2023; Marston et al., 2003; Parks, 2011; VanDerHeyden et al, 2007). Most of the studies found no evidence of disproportionate identification of children of color for special education (Marston et al., 2003; Parks, 2011; VanDerHeyden et al, 2007), and only one study found that RTI was linked to a deeper reduction in SLD by third grade for Black students. Black students experienced a bigger decrease in SLD after RTI implementation, using the data from the state of Tennessee (Gilmour et al., 2023).

Overall, while studies suggest RTI may be associated with a decrease in SLD identifications, these studies are often correlational, include a small sample size, and are conducted in one state or a research-oriented site. As a result, there is limited causal evidence regarding RTI's impact on SLD rates, special education placements, and potential disparities in identification across different student racial groups, especially at the national level.

Current Study

Leveraging the 2004 federal mandate, we investigate whether states' adoption of RTI affected the proportion of students identified with SLD or with any disability, and the proportion of those students who were placed in different special education settings (i.e., in a regular classroom or a separate educational environment) — the key aims of RTI — across the country. In so doing, we contribute to this policy literature by conducting the first causally informative analysis that leverages the variation in the timing of RTI adoption across different states. Utilizing a quasi-experimental design, specifically the DID approach, we can effectively isolate the impact of state-introduced RTI on student disability identification across states. Our study timeframe, 2004 - 2018, allows us to fully capture changes in state RTI policy before and after IDEA (2004) reauthorization, considerably boosting the study's generalizability and validity. Finally, this study is one of the first to examine heterogeneity in the effects of RTI on disability by student's racial groups, adding evidence about RTI's effect on students from different backgrounds to potentially reduce the disproportionality of students of color being identified with a disability.

Our analysis is conducted in two phases. The first set of analyses estimates the effects of state RTI adoption on the proportion of students with disabilities from the aggregated American Community Survey (ACS) data, which provides detailed information on individual students' disability status. Next, we leverage state-level IDEA data from the Office of Special Education Programs (OSEP) to examine the impacts of RTI on the proportions of students identified with disabilities, students identified with SLD, and those placed in different special educational settings. We ask three research questions:

Q 1: Does state RTI adoption lead to changes in the proportion of students being identified with disabilities [3] and the proportion of students with SLD?

Q 2: Does state RTI adoption lead to changes in the proportion of students placed in different special education settings (i.e., in a regular classroom or a separate educational environment)?

Q 3: Does the adoption of state RTI differentially affect disability identifications for White students and students of color?

Method

Data

Our analysis data is integrated from multiple sources and is aggregated at the state and year levels. We used the Federal Information Processing Standard (FIPS) for states and years to merge the datasets. The sources include states' Department of Education websites and the papers of Berkeley et al. (2009) and Zirkel & Thomas (2010), the American Community Survey (ACS), the Digest of Education Statistics (DES), and the Office of Special Education Programs (OSEP) under Individuals with Disabilities Education Act (IDEA).

Measures

Table 1 presents the summary statistics for all variables by RTI status in 2006, the first year in which states adopted RTI.

Treatment Variable

State RTI adoption. RTI status is an indicator variable that equals 1 in the years a state adopted RTI (i.e., a state adopted RTI in a specific year) and 0 otherwise. For example, Colorado

[3] To ease the comparison of outcomes between analyses, the proportion of students with disabilities from the ACS was aggregated at the state level. The proportion of students with disabilities is also collected from IDEA at the state level. For robustness, we use the outcome from both datasets, although the measures are different (see details in Measures section).

adopted RTI in 2005. Colorado thus has a value of 1 for the RTI indicator variable from 2006 to 2018 and 0 for the years before 2006. The variable information is primarily drawn from sources on each state's Department of Education website and the papers (Berkeley et al., 2009; Zirkel & Thomas, 2010).

Appendix Table 1 lists the RTI start year for each state by their switching status: those that had RTI early between 2006 and 2008 ("early switched states"), those that had RTI later than 2009 ("later-switched states"), and those that never had RTI ("never-on states") as of 2018. Figure 1 shows the adoption of RTI across states by year. The number of states that adopted RTI increased gradually from 2006 to 2015. The first state adopted RTI in 2006 and the last state began in 2017. Fifteen states adopted RTI in 2006, and forty-five states required RTI by 2017, providing sufficient variation to support the analysis.

Outcome Measures

The proportion of students identified with a disability. There are two measures for the proportion of students with disabilities used in this study. The first measure is from the ACS questionnaire. The key item asked the household head, primarily parents, to indicate whether the student had a physical, mental, or emotional problem, and having difficulty remembering, concentrating, or making decisions as a result, "Because of a physical, mental, or emotional condition, does this person have serious difficulty concentrating, remembering, or making decisions?" The disability outcome is coded as a dummy indicator that equals 1 if a person had a disability in the relevant year and 0 otherwise. We aggregated the individual data at the state and year levels for consistency across the available data.

The second measure is calculated by using the aggregated count of all types of disabilities present in public schools derived from OSEP records (e.g., specific learning disability, autism

spectrum disorder, emotional disturbance, and speech or language impairment). We calculated the proportion of students with disabilities by dividing the total number of students between 6 and 21 with disabilities in a state and year by the total number of the 6 to 21-year-old students enrolled in schools in that state and year. The count of students with disabilities comes from the OSEP data and the total number of students enrolled in schools are from DES.

Proportion of students identified with SLD. Similarly, we calculated the proportion of students with SLD by dividing the total number of students between 6 and 21 with SLD in a state and year by the total number of the 6-21-year-old students enrolled in schools in that state and year, derived from the OSEP and DES records.

Educational setting. Using the same calculation scheme, we computed the proportions of students identified with disabilities or those identified with SLD that were placed in a regular classroom (i.e., the number of students with SLD placed in regular class 80% or more of the day) or a separate school setting by dividing the total number of students with disabilities or students with SLD enrolled in schools. Specifically, we calculated the proportion of students identified with disabilities placed in regular classrooms for 80% or more of the day; proportion of students identified with disabilities in a separate school; proportion of students identified with SLD in regular classrooms for 80% or more of the day; and proportion of students identified with SLD in a separate school. We use the term "educational setting" throughout the rest of the paper. Note that the education setting data is not available until 2012, so we did not use this outcome in the event study analyses due to limited years.

Covariates

All covariates are presented in Table 1. Some are derived from the ACS and then aggregated to the state level. The ACS covariates include students' demographics (e.g., race,

gender), school status (e.g., whether enrolled in public school), and socioeconomic information (e.g., whether received Food Stamps/SNAP). We used racial and ethnic information to conduct subgroup analyses by grouping students of color into a single "Students of color" subgroup, and all others into a "White" subgroup, due to power. State covariates come from the University of Kentucky Center for Poverty Research (UKCPR) National Welfare Data (2022).

Empirical Framework

The primary challenge to securing a causal estimation of the RTI effects is that states that adopt RTI early versus later are not randomly determined. States may implement RTI programs due to numerous observed and unobserved factors. We use a differences-in-differences (DID) framework to exploit policy changes during the period in which individuals were exposed to RTI during their school years. This method enables two comparisons: first, we compare the changes in disability outcomes in states that adopted RTI to changes in these outcomes in states that did not; second, we compare the changes in outcomes before states introduced RTI to the changes in outcomes after states adopted RTI.

Specifically, we estimated the following equation:

$$D_{st} = \alpha + \beta\ RTI_{st} + \theta_s + \lambda_t + S_{st} + e_{st} \quad (1)$$

D_{st} is the outcome (e.g., percentage of students identified with disabilities; percentage of students with SLD) in a state s at year t. RTI_{st} is a dichotomous variable that indicates the RTI status in state s at year t, and therefore β is the coefficient of interest. θ_s are state-fixed effects, and λ_t are year-fixed effects. e_{st} is the residual, and α is a constant term. Standard errors are clustered at the state level. All outcome measures are aggregated at the state level.

We used DID using Callaway and Sant'Anna's (CS) (2021) estimation method with staggered treatment timing and doubly robust estimators (Baker et al., 2022). The CS model

allows the use of not-yet-treated units as control groups, which is more applicable than other methods (e.g., Sun & Abraham, 2021) [4] in this study's context because there are few states that remain untreated by the end of the study period due to the IDEA reauthorization. Specifically, the CS method addresses the negative weighting problem in the traditional two-way fixed effects (TWFE) models by estimating group-time average treatment effects (Callaway & Sant'Anna, 2021).[5] The group is defined by the time point when the units are first treated (i.e., states that adopted RTI in the same year are in the same group). The group-time average treatment effect is estimated for group *g* at time *t*, compared to the groups that have never been treated or not yet been treated at the same time point. We use the *doubly robust* estimators, calculating at the group-time level and then aggregating to present a simple, easy-to-interpret coefficient for the average treatment effects. We present the dynamic aggregated effects of all the group-time average treatment effects, which are the aggregated effects derived from the event study models. We implemented these analyses using the STATA package *csdid* developed by Rios-Avila (2021). Because the role of covariates in these emerging DID estimations is unclear, we did not include state covariates in the CS model.

Event Study

The main identifying assumption of a DID design is the existence of parallel trends in outcomes between treatment and control groups before the start of treatment. In this study, parallel trends mean that the proportion of students identified with disabilities, or the proportion of students identified with SLD would be parallel between states with and without RTI in the

[4] The method only allows for never-treated or last-treated comparison units, which is less applicable in the study context because there are few untreated states.

[5] The validity of TWFE DID models has been criticized by recent studies indicating that the TWFE estimators are often biased when treatment is staggered (i.e., turns on at different times for different units) or when effects vary over time (Borusyak et al., 2022; Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021; Sun & Abraham, 2021).

absence of RTI adoption. Specifically, we tested the plausibility of the parallel trends' assumption and assessed the dynamic treatment effects over time in the outcome variables using an event-study model as follows (Granger, 1969):

$$D_{st}=c+\Sigma_{r=-8}^{r=-2}\ \alpha_r T_r * RTI_s+\Sigma_{r=0}^{r=8}\ \alpha_r T_r * RTI_s+\theta X_{st}+\lambda_t+C_{it}+S_{ist}+e_{ist} \quad (2)$$

r represents the event time, and *r* = 0 corresponds to the year in which states adopted their RTI. T_r is thus the relative event time to the year of RTI introduction, interacted with RTI_s, which is an indicator of whether the state switched to RTI. The year before states adopted RTI (*r* = -1) is omitted as the reference year. The coefficient of interest, α_r, indicates the change in the outcome in each year before RTI adoption. If there are no pre-trends, we would see that all coefficients are not significantly different from zero before the RTI introduction. Because the same concerns in the DID method also apply to regression-based event studies, we show CS event study estimates for outcome measures in Figure 3-5. Although the magnitudes of the pre-treatment coefficients vary in the three models, the coefficients from all models are close to zero in all years before the states introduced RTI and statistically insignificant in three different models, suggesting there are no systematic pre-existing trends.

Robustness Checks

To ensure the validity of our results, we conducted robustness checks using traditional TWFE and Sun and Abraham (SA) models. Although the traditional TWFE model could be biased, it allows the inclusion of the covariates. Sun and Abraham (SA) (2021), also provide unbiased estimates of the DID treatment effects. However, SA only allows for never-treated or last-treated comparison units, which is not suitable for our study.[6] These checks were conducted to assess the robustness and reliability of our findings.

[6] SA is like the CS method. Both CS and SA provide solutions for aggregating the group-time average treatment effects. SA's interaction-weighted three-step estimator also solves the problem of negative weighing in the TWFE

Results

We present CS estimates in Table 2. Panel A presents the effects of state RTI adoption on the proportion of students identified with all types of disabilities and students identified with SLD. The results suggest that the adoption of state RTI was not associated with the proportion of students identified with disabilities. For the proportion of students identified with SLD, we find a significant positive effect, indicating that the introduction of RTI in a state increased the proportion of students identified with SLD by .7 percentage points (pp) ($p < .05$), corresponding to a 14 percent change in the proportion of students with SLD.

Panel B shows the results of state RTI adoption in the special education setting for students identified with disabilities and those identified with SLD. These estimates are all negative in direction, and most are insignificant, except for the estimate of the proportion of students with disabilities placed in a separate setting. This finding suggests that the adoption of RTI decreased the proportion of students identified with disabilities being served in a separate setting by .8 pp ($p = .05$), corresponding to a 40 percent change in the proportion of students with disabilities placed in a separate setting. Additionally, the estimate for the proportion of students with disabilities using ACS is lower than the estimate from IDEA due to different definitions of disabilities in each source (details provided in the Measures section). Consequently, the ACS sample includes 6% of students with disabilities, compared to 13% in the IDEA sample (see Table 1).

Heterogeneity Analysis

Table 3 presents the same CS model results when estimated separately for the White and

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model and focuses on the event study type aggregation (Sun and Abraham, 2021). The analysis was implemented using the interaction-weighted three-step estimator and Stata package "eventstudyinteract" developed by the authors (Sun and Abraham, 2021) "Eventstudyinteract" is a Stata module developed by the authors that implements the interaction weighted estimator for an event study.

students of color subgroups drawn from the ACS sample. The estimate shows that the proportion of students of color identified with disabilities increased by .49 pp ($p < .1$), corresponding to a .89 percent change in the proportion of students of color identified with disabilities after RTI adoption. This is an increase on top of a higher disability identification rate for non-White students (*Mean* = .058, *SD* = .020), compared to White students (*Mean* = .050, *SD* = .011) without RTI adoption. The results for the proportion of White students are not statistically significant ($b = .0004$, $p > .1$).

Event Study Estimates

While the aggregated results provide overall estimates of the impacts of state RTI adoption on student outcomes, the event study models offer the evolution of treatment effects over time and an important assessment of pre-trends. All event study figures present results from the CS models: the *y*-axis shows the coefficients, the *x*-axis indicates the years relative to state RTI adoption, and the middle dot-line separates the years before and after states adopted RTI.[7]

Importantly, from Figures 3-5, all pre-event coefficients (leads) are insignificant, indicating no pre-trends across all outcomes. Figures 3 and 4 present the estimates predicting two measures of the state-level proportion of students identified with disabilities and those with SLD. As the results shown in Table 2 suggest, RTI did not affect the state-level proportion of students identified with disabilities. Figure 4 shows the event study results for the proportion of students identified with SLD, indicating a .1 pp increase in the proportion of students identified with SLD after 4-5 years of RTI implementation.

For the subgroup analysis, Figure 5 presents the estimates predicting students identified with disabilities for White and students of color subgroups using ACS data. The results show that

[7] The data for special education placement is only available starting at 2012, so the event study estimates could be only performed for few years.

all estimates are insignificant across the two subgroups. There are inconsistent results between the CS event study and CS aggregated dynamic effects (Table 3). In Table 3, we find that the proportion of students of color identified with disabilities increased by .5 pp, which is marginally significant ($p < .1$) that might not be detected in the event study.

Estimates of Robustness Checks

Results for robustness checks are shown in Online Supplemental Tables S1-S3 and Figures S1-S4. Comparing the CS and SA event study estimates reveal highly similar pre- and post-treatment trends. However, they are in the opposite direction of the traditional TWFE estimates in both the proportion of students identified with disabilities and the proportion of students identified with SLD outcomes. For example, for the outcome of the proportion of students with SLD specifically, the coefficient switched its sign from negative in TWFE (b = -.3 pp, p = .1) to positive in CS estimate (b = .7 pp, p = .05) (See Online Supplemental Table S1). This is likely because the CS method corrects the negative weighting problem in TWFE from differences in treatment timing, which usually biases the estimates downward or can even flip their signs (Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021).

Discussion

This study is the first to provide comprehensive evidence on the effects of the adoption of a universal intervention policy, state RTI, on students' disability outcomes. We leverage multiple large national datasets to evaluate the central aims of RTI—to *identify* and *serve* students with disabilities. We exploit variation in the timing of states' RTI adoption and use a DID design with the latest methodological techniques to provide causal estimates of the effects of RTI on state-level outcomes. By using 20 years of data to examine the impact of RTI, we can capture dynamic

effects across the entire era of state RTI implementation since its start. This is important because RTI is an iterative program that needs several years to implement and affect student outcomes.

We find that the state adoption of RTI in public schools increased the proportion of students identified with SLD. Distinct from some of the prior correlational and recent findings that RTI reduced the incidence of disability after implementation (Gilmour et al., 2023; VanDerHeyden et al., 2007; Wanzek and Vaughn, 2011), we find that the introduction of state RTI was associated with a .7 pp increase in the proportion of students identified with SLD ($p < .05$). This suggests that RTI, as a framework or intervention, may be effective in identifying students with SLD, potentially leading to more students receiving the support they need when identification is precedent of any treatments (Kovaleski et al., 2022).

This finding may also reflect the purpose of RTI, aiming to specifically support students with SLD. In other words, the RTI framework could assist students' learning needs more effectively and timely (Catts et al., 2015; Milburn et al., 2017), by possibly taking valuable information collected through RTI into consideration for the process of SLD identifications (Artiles, 2015; Voulgarides et al., 2017). This finding further suggests that RTI is not used as a means to reduce the rate of SLD identifications in the short term, but rather to better identify students with SLD (Vaughn et al., 2003).

For special education placement, we observe a statistically significant 0.8 pp, with an 8 percent decrease in the proportion of students identified with disabilities being placed in a separate school. The finding suggests that RTI could potentially support the inclusion of students with disabilities in regular classrooms. This could be a reflection of increasing support within regular classrooms, making them more accommodating and inclusive for students with disabilities, aligning with the principles of inclusion (e.g., Artiles et al., 2006) with the broader

aim of the integration of students with disabilities into regular classrooms. Inclusive education should not require a transformation of regular classroom spaces but rather should provide adaptations to accommodate all students. This trend implies that regular classrooms may be becoming better equipped with specialized staff and resources to support students with disabilities. Such an environment enables children to stay in the least restrictive settings, which is often seen as beneficial for their educational and social development (Bender & Shores, 2007; Vaughn et al., 2003; WestEd, 2004).

Researchers have suggested that RTI could be a policy lever to decrease the achievement gap between White students and students of color (Mckinney et al., 2010; Farkas, 2020). To test this possibility, we examined the heterogeneous effects of state RTI on the proportion of students with disabilities for different racial subgroups. Although the event study results do not show clear evidence, we observed a relative increase of .5 pp in the identification of students with disabilities among students of color compared to White students in states adopting RTI. This finding may have contradictory meanings in the context of prior literature. On one hand, researchers might argue that the disparity in disability identification still exists even with RTI implemented when instructions do not include culturally and linguistically diverse components (Artiles, 2015; Voulgarides et al., 2017). This is consistent with some research on disability overidentification for students of color (Aron & Loprest, 2012; Coutinho & Oswald, 2000; Sullivan, 2011), even though the evidence is not related to RTI. On the other hand, the increased identification for students of color under RTI might mean that by helping remove culturally biased features in the identification process, students of color could benefit from special education services (Hughes & Dexter, 2022; Ford, 2004; Reynolds & Shaywitz, 2009), given that disability identification is usually the first step to receive special education services (Fletcher

& Vaughn, 2009). As the existing RTI qualitative research found that RTI reduced the incidence of disabilities of color (Parks, 2011), this finding further suggests that the RTI approach might have improved the identification process.

Taken together, the effects of state RTI on students' disability outcomes suggest that state RTI adoption has significantly affected students' SLD identifications, setting for students identified with disabilities in a separate school, and students of color identified with disabilities. We validated the findings with all the estimates from the event study in CS, SA, and TWFE, excluding special education placement due to missing data. The event study reveals that RTI's impact will become significant 6 years after introduction. It is interesting to learn that the introduction of state RTI significantly increased the proportion of students identified with SLD and the proportion of students identified with disabilities for students of color, suggesting that state RTI efficiently identifies students with learning difficulties. Nevertheless, RTI is a suggested approach to identifying and serving students with disabilities, more culturally inclusive, and likely to reduce inequality in the process of disability identification and special education services (Hughes & Dexter, 2022; Ford, 2004; Reynolds & Shaywitz, 2009). Furthermore, RTI should not be used as a tool to reduce the identification of students with disabilities, as some special education policies have unintentionally caused (Ballis & Heath, 2019; Cullen, 2003; Dhuey & Lipscomb, 2011). The findings extend our understanding of the relationship between state RTI adoption and services related to students' disability identification, shedding light on whether state RTI policies can promote equity in special education.

Moving forward, future studies should seek to understand which components of states' RTI policies and implementation processes increased the proportion of students identified with SLD and reduced the proportion of students identified with disabilities placed in a separate

school. Future research should also look at how state RTI could work to help students of color with disability identification and services to promote equity in this area. One promising direction is to study and develop RTI with the same instruction across states in combination with collaborative resources from different professionals (e.g., paraprofessional, reading specialist, or speech pathologist). One of the many encouraging examples is that RTI improves children's skills. For instance, Buysse et al. (2016) conducted two studies to evaluate an RTI program, which included formative assessment, foundational instruction, and targeted small-group lessons designed for pre-kindergarteners who needed assistance and found positive effects on targeted language and literacy skills in both studies.

Limitations

This study is not without its limitations. First, this study is conducted as the field is still learning about the latest DID methods. Although CS models address the negative weighting programs of traditional two-way fixed effects, the results from this study should only be interpreted as suggestive and not explicitly causal. Second, because RTI is still evolving in most states, the adoption of RTI differs substantially in its scope, process, and location. The insignificant results from this study may indicate that RTI has not been adopted fully across states or at least not include all components suggested by research (Hoover et al., 2008). For example, some states first adopted RTI with some districts and then rolled it out to the entire states, while others might be implemented fully across states. Our study does not account for these differences. Studies using administrative data within one state may help reveal more nuanced dynamics between RTI and student disability outcomes. Finally, the outcome measure from ACS might not be optimal to capture the identification of students' disabilities. Our heterogeneity results about RTI effects should be interpreted with caution.

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Tables

Table 1
Baseline Descriptive Statistics in 2006

	RTI sample		Non-RTI sample		
	Mean	SD	Mean	SD	Mean *Diff*
Outcome Measures					
% of students with disabilities in ACS	0.06	0.01	0.06	0.01	0.00
% of students with disabilities in IDEA	0.13	0.02	0.13	0.02	0.00
% of students with SLD	0.06	0.01	0.05	0.01	0.01
% of SLD students placed in a regular classroom	0.34	0.06	0.34	0.06	0.00
% of SLD students placed at a separate school	0.00	0.00	0.01	0.01	0.07
% of all students with a disability placed in a regular classroom	0.31	0.04	0.31	0.04	0.00
% of all disability students placed at a separate school	0.01	0.01	0.02	0.02	-0.01*
Covariates					
% White	0.78	0.11	0.74	0.17	0.04
% Hispanic	0.11	0.09	0.11	0.12	0.00
% Black	0.11	0.10	0.11	0.13	0.00
% Other	0.11	0.06	0.16	0.15	-0.04
% In school	0.83	0.01	0.83	0.02	0.00
% Female	0.49	0.01	0.49	0.01	0.00
% Enrolled in public school	0.70	0.03	0.70	0.04	0.00
% Enrolled in pre-K and K-12	0.87	0.02	0.87	0.03	0.00
% High-school dropout	0.01	0.00	0.01	0.00	0.00
Personal income (2018 dollars)	6413.35	680.24	6551.94	920.00	-138.59
Family income (2018 dollars)	84122.37	8372.84	89963.47	18677.43	-5841.10
% Received Food stamp	0.14	0.06	0.13	0.05	0.01

% of students in poverty	0.12	0.03	0.12	0.03	-0.01
% Rural	0.23	0.18	0.22	0.20	0.01
Total enrollment	996944.53	742447.46	954490.94	1288960.69	42453.59
Pupil-teacher ratio	16.02	2.82	14.76	2.10	1.26*
Per pupil expenditure (2018 dollars)	13177.14	1962.92	14655.28	3659.34	-1478.14
% of students received free- or reduced-price lunch	0.40	0.09	0.39	0.11	0.01
% ELL students	0.07	0.04	0.07	0.05	0.00
State population	6222432.80	4928055.34	5695650.56	7212950.48	526782.24
% AFDC recipients	0.01	0.00	0.01	0.01	0.00
% SNAP recipients	0.10	0.04	0.09	0.03	0.01
Per capita personal income (2018 dollars in thousands)	43.98	4.01	35.57	51.12	-3.41
Gross state product	0.04	0.01	0.05	0.02	0.00
Unemployment rate	4.29	0.79	4.52	1.07	-0.24
Poverty Rate	11.98	2.44	11.80	3.48	0.18
State Observations	15		36		

Note. The data for educational setting is only available starting at 2012. Therefore, the baseline data for the educational setting is in 2012.

Table 2

CS Estimates for Effect of State RTI Adoption on State-Level Rates of Students' Disability & Specific Learning Disabilities (SLD) Identifications & Students' Special Education Placements

Panel A. Disability & SLD Identifications

	(1) Proportion of Students with Disabilities (ACS)	(2) Proportion of Students with Disabilities (IDEA)	(3) Proportion of Students with SLD (IDEA)
Response to Intervention	.002	.006	.007**
	(.002)	(.006)	(.003)
Observations	918	644	644

Panel B. Special Education Placements

	(1) Proportion of Students with Disabilities in Regular Classroom 80% or more of the day	(2) Proportion of Students with Disabilities Placed in A Separate School	(3) Proportion of Students with SLD in Regular Classroom 80% or more of the day	(4) Proportion of Students with SLD in A Separate School
Response to Intervention	-.005	-.008**	-.019	-.001
	(.012)	(.005)	(.016)	(.001)
Observations	714	714	714	714

Note. All the outcome measure were at the state level collected from Individual with Disability Education Act housed by OSEP, except for the first measure of proportion of students with disabilities from American Community Survey (ACS). The presented results from the estimates used the method proposed by Callaway and Sant'Anna (2021) (CS). The CS estimates are based on aggregated dynamic effects using the not-yet-treated states as the comparison group. Robust standard errors are clustered at the state level and presented in parentheses. *** $p < .01$, ** $p < .05$, * $p < 0.1$.

Table 3

Heterogeneous Effects of RTI on Disability by White and Students of Color

	Proportion of Students with Disabilities	
	White Students	Students of Color
	CS Estimates	
Response to Intervention	.0004	.0049*
	(.0011)	(.0028)
Observations	918	918

Note. The analysis sample includes children between 6 and 21 years old. The analysis is conducted at the state level by each racial subgroup. State and year-fixed effects were included in all models. *** $p < .01$, ** $p < .05$, * $p < .1$.

Figures

Figure 1

Number of States with RTI between 2000 and 2018

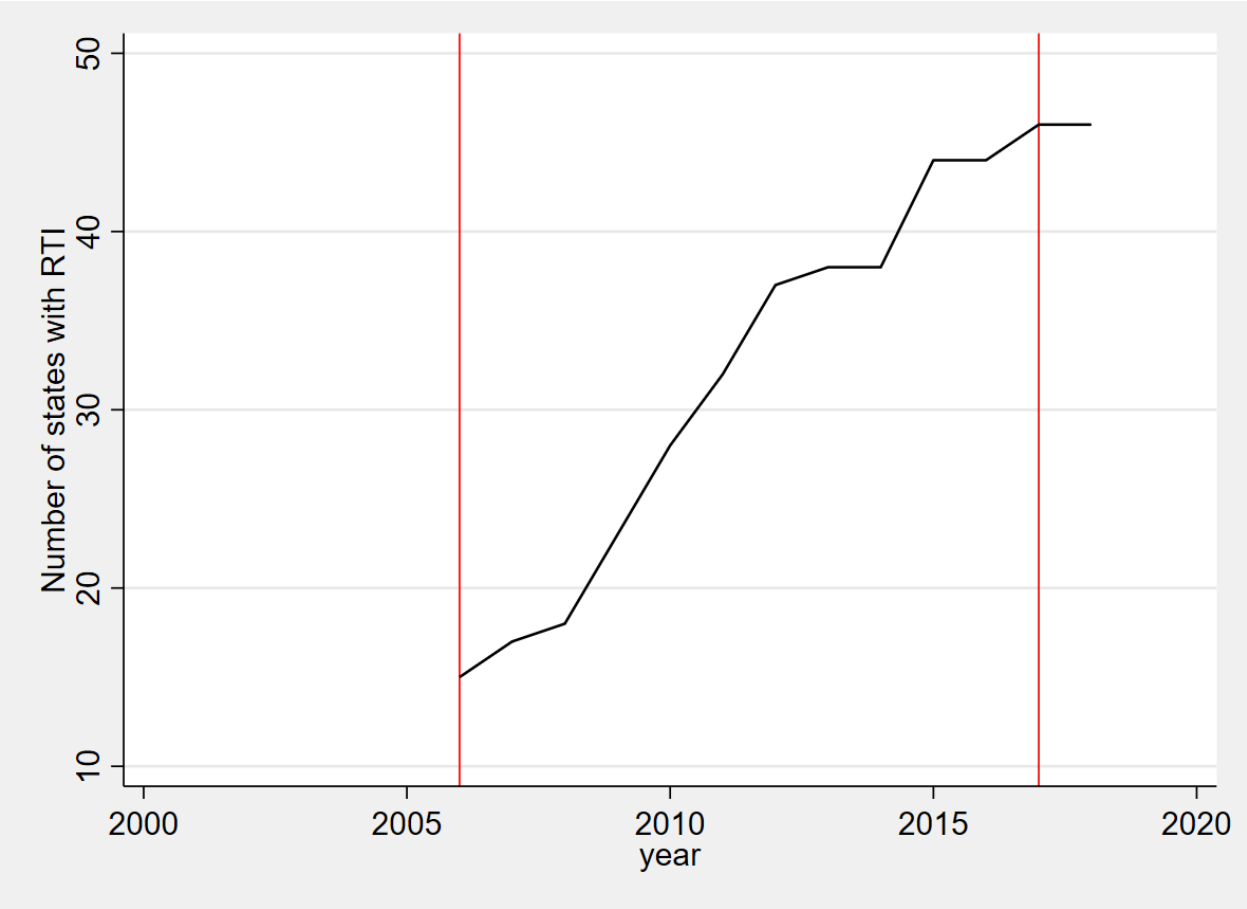


Figure 2

Response to Intervention in Three Tiers

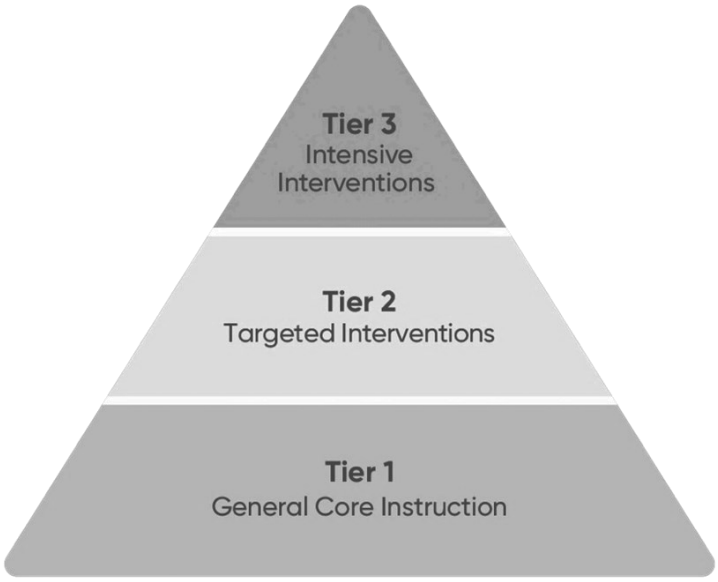


Figure 3

Event Study Estimates of State RTI on the Proportion of Students Identified with Disabilities

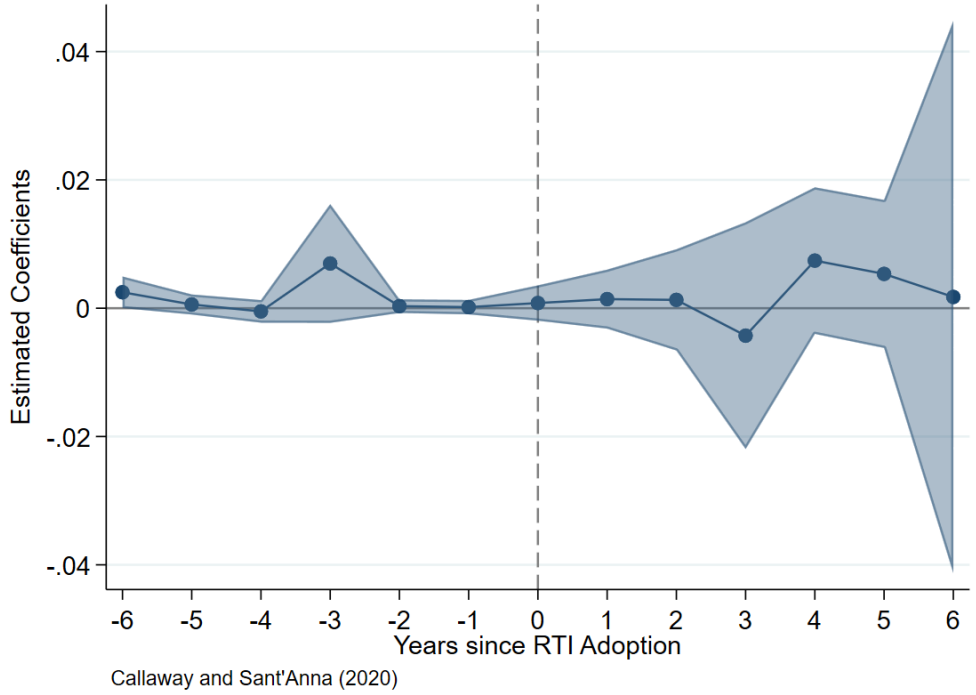


Figure 4

Event Study Estimates of State RTI on the Proportion of Students Identified with SLD

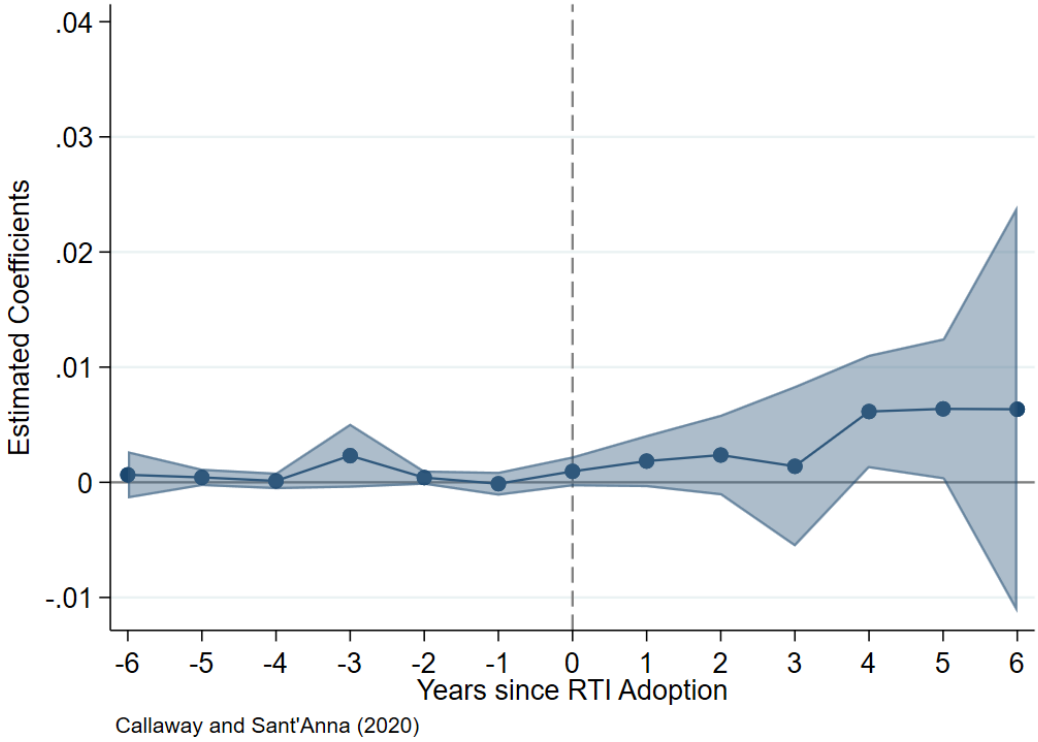
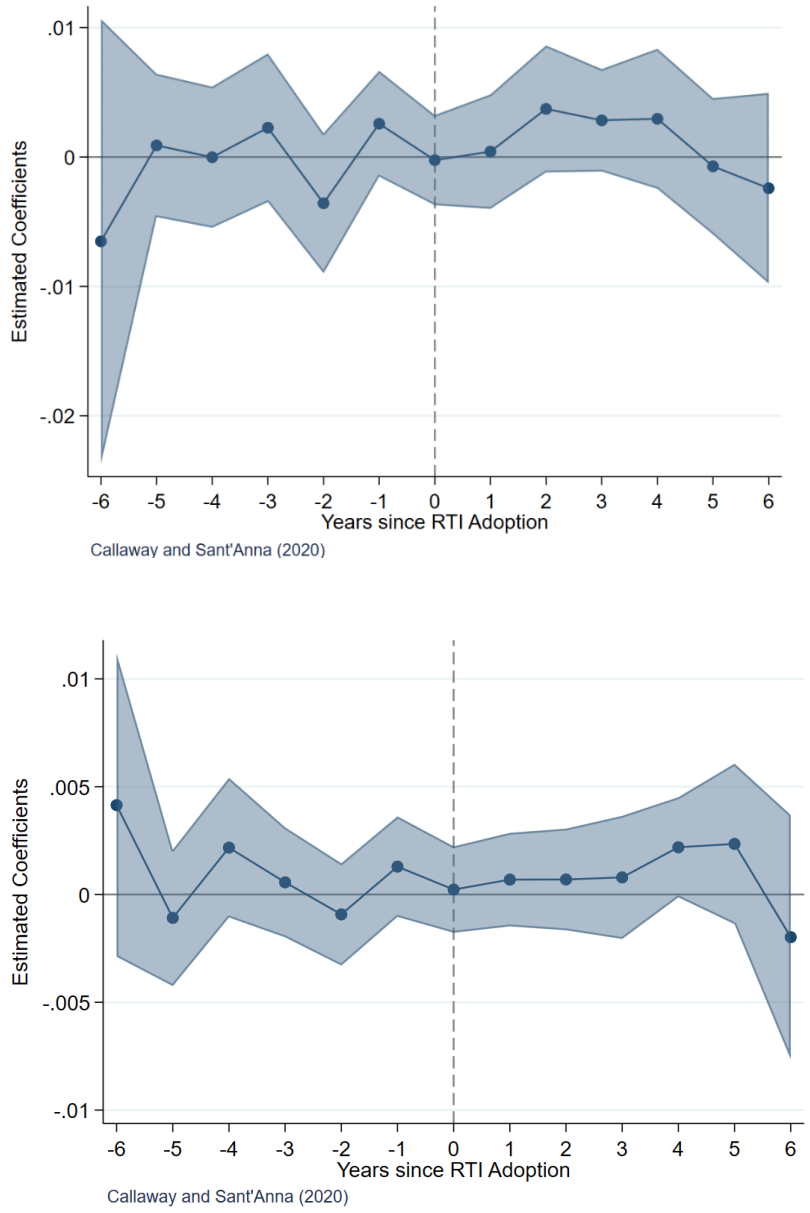


Figure 5

Event Study Estimates of State RTI on the Proportion of White Students (top graph) and students of color (bottom graph) Identified with Disabilities (ACS Data)



Appendix Table 1

RTI Start Year by State and Switching Status between 2006 and 2017

Early switched States		Later switched States		Never-on States	
Arizona	2006	Hawaii	2010	Alaska	no
Delaware	2006	Maine	2010	Kentucky	no
Florida	2006	South Carolina	2010	DC	no
Georgia	2006	Wisconsin	2010	Maryland	no
Iowa	2006	Idaho	2010	Vermont	no
Kansas	2006	Alabama	2011		
Nebraska	2006	Rhode Island	2011		
North Carolina	2006	Oklahoma	2011		
Ohio	2006	Wyoming	2011		
Pennsylvania	2006	Minnesota	2012		
Louisiana	2006	Nevada	2012		
Oregon	2006	North Dakota	2012		
Washington	2006	New York	2012		
West Virginia	2006	New Hampshire	2012		
Utah	2006	Mississippi	2013		
Montana	2007	Arkansas	2015		
Virginia	2007	New Jersey	2015		
Connecticut	2009	Tennessee	2015		
Missouri	2009	California	2015		
New Mexico	2009	Massachusetts	2015		
Colorado	2009	South Dakota	2015		
Illinois	2009	Michigan	2017		
Indiana	2009	Texas	2017		
Total	23		23		5

Note. Most information for RTI adoption is from papers of Berkeley et al. (2009) and Zirkel & Thomas (2010). Since these two papers only had RTI information during the study year, we checked each state's website of the Department of Education for details and double-checked the information with the two papers.