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Transitional Kindergarten: The New Kid on the Early Learning Block

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In recent years, several states have expanded a new publicly funded learning option: Transitional Kindergarten (TK). TK programs bridge prekindergarten and kindergarten in their eligibility, requirements, and design. We use Michigan's TK program as a case study on the fit of this new entrant in the early learning landscape. Michigan's program is well suited for this purpose because it contains most of the program design elements of other large-scale TK programs across the country. Using statewide administrative data, we describe which districts offer TK when doing so is optional, the characteristics of children who enroll in TK at four and five years old, and substitution patterns between TK and alternative learning options. Broadly, we find TK in Michigan closes some socioeconomic gaps in early program enrollment while exacerbating others. Specifically, districts with more White students and fewer economically disadvantaged students are more likely to offer TK than other districts. Within districts that do not offer TK in every school, TK is more likely to be offered in schools with more economically disadvantaged students. Among preschool-age children, those from non-economically disadvantaged families are more likely to enroll in TK than their peers; among kindergarten-age children, there is little difference in take-up by family income. Finally, we find evidence of substitution, with some children enrolling in TK instead of state-funded prekindergarten or instead of enrolling in kindergarten early, though with no evidence that public slots decline overall. Our findings have implications for addressing the fragmented early education landscape when expanding programs.

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Transitional Kindergarten: The New Kid on the Early Learning Block

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Abstract

In recent years, several states have expanded a new publicly funded learning option: Transitional Kindergarten (TK). TK programs bridge prekindergarten and kindergarten in their eligibility, requirements, and design. We use Michigan's TK program as a case study on the fit of this new entrant in the early learning landscape. Michigan's program is well suited for this purpose because it contains most of the program design elements of other large-scale TK programs across the country. Using statewide administrative data, we describe which districts offer TK when doing so is optional, the characteristics of children who enroll in TK at four and five years old, and substitution patterns between TK and alternative learning options. Broadly, we find TK in Michigan closes some socioeconomic gaps in early program enrollment while exacerbating others. Specifically, districts with more White students and fewer economically disadvantaged students are more likely to offer TK than other districts. Within districts that do not offer TK in every school, TK is more likely to be offered in schools with more economically disadvantaged students. Among preschool-age children, those from non-economically disadvantaged families are more likely to enroll in TK than their peers; among kindergarten-age children, there is little difference in take-up by family income. Finally, we find evidence of substitution, with some children enrolling in TK instead of state-funded prekindergarten or instead of enrolling in kindergarten early, though with no evidence that public slots decline overall. Our findings have implications for addressing the fragmented early education landscape when expanding programs.

Transitional Kindergarten: The New Kid on the Early Learning Block

The landscape of publicly funded early learning options is a complicated patchwork. Most states have at least one public option for four-year-olds from families with low incomes, and several states have multiple. All federal funding sources for preschool, including Head Start and child care subsidies, are also income-targeted (Barnett & Hustedt, 2016). For families with higher incomes, most states offer no public options (Friedman-Krauss et al., 2022; Larin, 2019). At age five, 44 states are required by law to offer at least half-day kindergarten, with 17 of those states requiring all children to attend (Education Commission of the States, 2023).

Recently, several states have adopted a new program that further complicates the early learning landscape: Transitional Kindergarten (TK). As we describe in more detail below, TK is a novel public school-based option for four- and/or five-year olds. For four-year-olds, TK is an alternative to prekindergarten (Pre-K) and other child care. For five-year-olds, TK provides families with another option for delaying kindergarten (often called "redshirting"). Unlike most publicly funded Pre-K programs, TK is available to all age-eligible children regardless of family income. TK is becoming increasingly common across the United States but research on this program is scant.

We use Michigan's Transitional Kindergarten program as a case study on the fit of this new entrant in the early learning landscape. In recent years, significant shares of Michigan children enrolled in public programs (e.g., 28% of four-year-olds were in the state's income-targeted Pre-K program in SY 2021-22 and 7% were in Head Start), allowing us to examine substitution patterns across options commonly found in states with and without TK. Importantly too, while TK programs vary in the states that offer them, Michigan TK has the same key characteristics as other large-scale TK programs—many of which are associated with positive child outcomes (e.g., based in public schools and taught by teachers who meet the same educational requirements and receive the same compensation as K-12 teachers) (Chaudry et al., 2021).

Using statewide administrative data, we describe which districts offer TK when doing so is optional, the characteristics of children who enroll, and the substitution patterns TK induces between early learning options. We make two main contributions to the literature. We are the first to document how a TK program that serves both Pre-K- and kindergarten-eligible children fits into and alters the existing early learning landscape. Second, and more generally, we estimate how enrollment patterns in alternate learning options change when no-cost alternatives are introduced. Our findings show that a district-led roll out of an early learning program with universal eligibility closed some socioeconomic gaps in early learning program enrollment while exacerbating others.

1. The Early Learning Landscape

Before investigating Transitional Kindergarten's impact on the early learning landscape, it is important to understand the options that typically exist in the absence of TK. Public Pre-K enrollment among four-year-olds is the highest it has ever been in the U.S. (McElrath, 2021; U.S. Census, 2020). Much of this growth can be attributed to the expansion of state-funded Pre-K programs since the 1980s (Cascio, 2021). State programs operate alongside district-funded Pre-K programs, federal programs like Head Start and Early Childhood Special Education, and a vast network of tuition-based providers that accept public dollars to subsidize the cost of care for eligible families. Twenty states also allow children who are not quite old enough for kindergarten to enroll early through waiver processes, though the criteria for early entrance vary considerably by state (Education Commission of the States, 2023). These early entrance waivers offer an additional opportunity to access public schooling for children younger than five years old.

Other families, however, choose to delay kindergarten—a practice known as "redshirting" (Education Commission of the States, 2020). Research on the academic and socioemotional benefits of redshirting is mixed, but parents may consider it because they believe it conveys academic, social, and/or physical advantages or because they are concerned about their child's preparedness for school at a young age (Deming & Dynarski, 2009; Huang, 2015). In such cases, families may opt to keep their child at home, enroll in preschool, or, as we explain below, enroll in TK.

Importantly, there are clear sociodemographic differences in Pre-K enrollment and kindergarten redshirting for four- and five-year-olds that are likely a result of variation in parent preference, unequal access to public programs, and the cost of redshirting. At ages three and four, Hispanic children are nearly 10 percentage points less likely to enroll in center-based care than White, Black, and Asian children. Children living in households with low incomes or whose parents have lower educational attainment are also less likely to enroll in center-based care (NCES, 2021). Even in contexts where no-cost Pre-K options are available to all families, these inequities persist (Cavalluzzo et al., 2009; McCormick et al., 2023; Shapiro et al., 2019).

For redshirting, rates are highest among White families with higher incomes (Bassok & Reardon, 2013; Cosden et al., 1993; Dougan & Pijanowski, 2011; Frey, 2005; Winsler et al., 2012). As with Pre-K enrollment, demographic variation in kindergarten redshirting is likely driven partly by parent preferences. However, because redshirting usually imposes an additional cost on families whose children are eligible for kindergarten, some posit that higher rates of redshirting among White families with high incomes also reflect the financial burden of forgoing employment or paying for an additional year of child care that may be infeasible for families with lower incomes (Greenburg & Winsler, 2020). TK provides families of five-year-olds with a no-cost option for redshirting that is not means tested. The rollout of TK

provides an opportunity to explore how demographic differences in redshirting change when families have access to a no-cost alternative to kindergarten.

Prior research has found that the introduction of new public Pre-K programs results in some substitution away from pre-existing programs that serve similar populations, which can cause some pre-existing programs to close or reduce their capacity (Bassok, 2012; Brown, 2019). However, little is known about how the introduction of TK impacts enrollment in other early learning options, or how enrollment in TK may differ across demographic groups. The only evidence on differential participation in TK comes from a study that examines 75 districts in the first year of California's TK expansion (limited to four-year-olds born between September 2 and December 2). That research finds no evidence of differential take-up by race/ethnicity, free- or reduced-price lunch status, or English learner status (Cadigan, Quick, & Manship, 2015).

2. What is Transitional Kindergarten?

Recently, Transitional Kindergarten (TK) has emerged as a new public program available to families with young children. Broadly speaking, TK programs are school-based early learning programs that enroll children in the year before kindergarten. California, Iowa, Michigan, and Washington have substantial TK program offerings (Friedman-Krauss et al., 2022), with some additional states home to district-initiated TK programs that are not systematically tracked. Importantly, TK exists alongside other early learning options in these states. All four states have income-targeted state-funded Pre-K. Michigan and Washington allow early kindergarten entrance and kindergarten redshirting (ECS, 2023).[1] California and Iowa allow redshirting but not early kindergarten entrance.

Although TK programs are relatively new and understudied, two studies have found promising impacts. A recent impact study of California's TK program showed substantial positive impacts on literacy, math, and social emotional skills at kindergarten entry, with impacts persisting through the end of kindergarten for literacy skills (Manship et al., 2017). These findings are noteworthy because about 80% of the control group attended other Pre-K programs, representing a particularly strong counterfactual compared to most other early learning programs that have been rigorously evaluated (Feller et al., 2016). And, in a concurrent impact study, we find attending TK in Michigan improves children's third grade math scores by around 0.29 standard deviations (Berne et al., 2024a). Most evaluations of early education programs, in contrast, find much smaller or null effects on third grade tests (Phillips et al., 2017).

[1] Note that "having kindergarten redshirting" means the practice is allowed, not that it is publicly funded—which it typically is not.

Like kindergarten, TK programs are "universal" in the sense that families are not required to meet income or other needs-based eligibility criteria.[2] However, all TK programs have age-eligibility criteria that vary across context (in part due to variation in kindergarten entrance laws). California's program, the largest in the country, currently only enrolls four-year-olds who are one to eight months too young for kindergarten (CA DOE, 2024). It is expanding to all four-year-olds by SY 2025-26 (CA DOE, 2023). In this way, California's TK program will become the state's universal Pre-K program (Fuller & Slovik, 2022; Melnick et al., 2022). In contrast, many districts in Iowa offer TK, but these programs can only enroll children who are age-eligible to enroll in kindergarten (Iowa Department of Education, 2018). In this way, Iowa's program functions solely as a publicly funded redshirting option.

The programs in Michigan and Washington sit in the middle, as both a public Pre-K alternative for four-year-olds and a public redshirting option for five-year-olds. Washington has TK programs in an estimated 44% of districts serving 4,700 children (Goodvin et al., 2023). In Michigan, our focal state, over 300 school districts (50% of all districts) offered a TK program in SY 2021-22 with estimated enrollment of well over 10,000 children (Shapiro et al., 2023). In Washington and Michigan, TK provides an additional option before kindergarten for families with low incomes, the only no-cost option before kindergarten for families with higher incomes, and a no-cost redshirting option for all families.

In Michigan, Washington, and Iowa, school districts have wide autonomy over TK, including the choice of whether to offer it and considerable flexibility in how programs are designed. Districts may choose to not offer TK because of administrative hurdles, space limitations, or a perceived lack of demand, for example. This differs from California, which requires that all districts offer TK (CA DOE, 2023). California TK programs are also more programmatically uniform because they are required to align with California's Preschool Learning Foundations (CA DOE, 2023).

Turning our attention to Michigan specifically, TK funding is available for all children who turn five by the state's kindergarten birthday cutoff (September 1) or within three months after (September 2-December 1). Therefore, funding is available for all five-year-olds, but only the oldest four-year-olds. Nearly all TK districts offer the program to children who turn five in the six-month window around the kindergarten cutoff (June 1-December 1). In contrast, only 60 percent of TK districts enroll five-year-olds born in March, April, and May (Shapiro et al., 2023). For a visual explanation of age-eligibility for TK and other early learning options in Michigan in SY 2021-22, see Figure 1.

The origin of TK in Michigan is not documented and is difficult to determine. Though some districts had TK programs prior to SY 2012-13, the number of districts offering programs has grown substantially since then in response to a statewide shift in the kindergarten birthday cutoff from December

[2] TK programs are not necessarily universal in the sense of having space for every child who wants to enroll.

to September. Essentially, TK programs filled the gap year for children with fall birthdays created by this shift. The state refers to TK as the first year of a two-year kindergarten program but otherwise has not specified the purpose of TK or its intended fit in the early learning landscape.

Until recently, the characteristics of Michigan's TK program had not been systematically tracked. Using survey data from over 170 school districts, our team found that TK has several research-aligned features (Shapiro et al., 2023). First, TK teachers are compensated at parity with K-12 teachers, making TK teachers the highest paid early learning workforce in the state. Second, TK programs are located in public schools; co-location of Pre-K and kindergarten is associated with stronger kindergarten readiness and higher end-of-kindergarten grades (Ansari & Winsler, 2016). Third, TK offers a full school day, with the same number of days and weeks as K-12. Longer program hours are beneficial to working parents and can improve children's learning outcomes via additional instructional time (Atteberry et al., 2019).

These characteristics make TK more like kindergarten than the state's public Pre-K program—called the Great Start Readiness Program (or GSRP)—which is offered in virtually every district and targets economically disadvantaged children. TK is funded at the same level as kindergarten, $14,347/child in 2021, as part of the state's K-12 funding formula. GSRP lags behind considerably at $8,700/child (Berne et al., 2024b), per separate legislation in the state. The higher funding allows TK programs to compensate teachers at the same rate as K-12 teachers, while GSRP programs pay teachers about a third less than K-12 teachers and do not offer comparable benefits. GSRP teachers must have a BA degree, but not the same certification as K-12 teachers. GSRP programs serve about a third of participants in community-based centers and until recently provided care only four days a week and fewer weeks per year than K-12 (Wu et al., 2023). Finally, over 90% of Michigan's GSRP programs use curricula that have been repeatedly outperformed by other options (Shapiro et al., 2023). Few TK programs use those curricula, instead using more math- and language/literacy-focused curricula—a model more typically found in kindergarten nationally than in preschool. In Michigan (and in other states that offer it), TK is a potential substitute for other early learning options but also plays a unique role.

3. Current Study

We use Michigan TK to explore how TK both fits into and changes the early learning program landscape. Our research questions are:

1. How do districts and charter schools that offer Transitional Kindergarten programs differ geographically and demographically from those that do not?
2. Which children enroll in TK programs when they are offered?
3. How does the availability of TK impact participation in other early learning options?

Data

We primarily rely on state administrative files—including longitudinal student records as well as school- and district-level information—to address our research questions. When reporting to the state, Michigan districts are encouraged to use an indicator that distinguishes children enrolled in TK from children enrolled in traditional kindergarten. Unfortunately, preliminary investigations of the data and conversations with district officials revealed that some districts do not use the TK indicator, but instead simply record these children as kindergarteners. This led us to undertake an extensive data triangulation process to verify which districts and charters had TK programs in SY 2021-22 by reviewing district websites and communicating with district staff via email and phone calls.

We categorize a district/charter as having TK in SY 2021-22 if they reported at least 10 TK students in the administrative data that year or if we confirmed the existence of a program via outreach. Unfortunately, we can only measure TK enrollment at the individual level in districts that report TK students in the data. We elaborate on the implications of our data limitations in the discussion section.

Sample

The sample for our district-level analysis includes all traditional public school districts and charter schools that enrolled kindergarten students in the 2021-22 school year. The sample includes 534 districts (305 of which offered TK) and 233 charter schools (57 of which offered TK).[3] For our student-level analysis, we focus on districts in which we determined there is reliable reporting of individual TK enrollment information.[4] This restricted sample includes 209 of the 305 school districts that offered TK.[5] As shown in Appendix Table B1, TK districts we include in the restricted sample are similar to those we exclude in terms of racial composition, but the districts we exclude have a higher proportion of economically disadvantaged students and are more likely to be located in towns or rural areas instead of suburbs. The in-sample districts may have more resources that support better data reporting. We return to this limitation in the discussion section.

4. Analysis and Results

RQ 1: Which districts offer TK?

[3] Shapiro et al. (2023) report 307 districts with TK in SY 2021-22 and 274 districts without. Those numbers count intermediate school districts that directly enroll children who receive special education services as unique districts. In this paper, we limit our attention to regular school districts.

[4] We consider a district's reporting reliable if the district reports 10 or more TK students. It seems unlikely a district would code 10 or more children as enrolled in TK by accident, and districts probably rarely offer TK classrooms for fewer than 10 children. Also, in districts that meet this threshold, children coded as TK and early kindergarten students have grade progression patterns that are consistent with their coding.

[5] Only 8 of the 57 charters with TK programs met our threshold for reliable student-level reporting. For this reason, we exclude charter schools from our student-level analysis.

In Table 1, we compare the characteristics of districts and charter schools with and without TK in the 2021-22 school year, based on students in grades 1-5.[6] As Table 1 shows, on average, TK districts serve a higher share of White students (72% vs. 52%, *p*-value of the difference=0.000) and a smaller share of Black students (10% vs. 27%; *p*=0.000) than non-TK districts. TK districts also have a substantially smaller share of economically disadvantaged students (50% vs. 68%; *p*=0.000) and a smaller share of students who participated in state-funded Pre-K (29% vs. 37%; *p*=0.000). TK districts on average enroll a much larger kindergarten class (and more students overall) and are more likely to be in suburban localities (37% v. 14%, *p*=0.000). These patterns generally hold when we control for district characteristics simultaneously in a regression framework (see Appendix Table B2).[7]

These findings suggest that larger and more advantaged districts are more likely to offer a TK program than smaller and less advantaged districts. Within the 209 districts that offer TK and have student-level TK enrollment information, we examined which schools were more likely to house a TK program. In 109 of these districts, every building that enrolls kindergarten students also has a TK program.[8] Districts that do not offer TK in every school are more likely to place TK programs in schools that serve younger and more economically disadvantaged children (Appendix Figure B1). For example, a 10-percentage point increase in the share of students who are economically disadvantaged raises the likelihood of a school having TK by 4.1 percentage points (7.3 percent relative to baseline), relative to other schools in the same district. Schools with publicly funded Pre-K programs (including GSRP and locally-funded Pre-K programs) were 15.8 percentage points (28.3 percent) more likely to have TK programs.

RQ 2: Which children enroll?

Table 2 shows the proportion of SY 2022-23 kindergarten students that enrolled in TK in SY 2021-22, overall and separately by student and district characteristic. As above, the sample is limited to the 209 districts with reliable TK enrollment information. Column 1 shows TK enrollment rates for all children who turned five in the spring, summer, or fall of 2021; columns 2-4 report rates separately by season.[9] Importantly, these estimates are unconditional, but we find similar results when using a

[6] The one exception is that we do not use students in grades 1 through 5 to calculate mean kindergarten enrollment because, by definition, these older grades cannot provide information on that district characteristic in the focal school year.
[7] We also find similar demographic and geographic differences in the characteristics of TK charters and non-TK charters, with one exception. Charter schools with and without TK are more similar in terms of the share of students they serve who attended state-funded Pre-K prior to kindergarten.
[8] In one district, 16 students are marked as being enrolled in TK, but it's unclear which buildings house TK programs since none record more than 10 TK students.
[9] An alternative (related) way to answer RQ 2 is to compare the demographics of TK students and kindergarten students in the same districts. If certain types of children are more likely to enroll in TK, then the demographic composition of TK students will skew in their direction. Appendix Table B8 takes this approach using the same set of districts as in Table 2. As expected, both tables point to the same conclusions.

multivariate regression model that controls for other student characteristics. We show results separately by birth season because children's age influences how they utilize TK. Children born in the fall can use TK as an alternative to home care, formal Pre-K, or early kindergarten entry. Children born in the spring and summer are old enough to attend kindergarten in SY 2021-22. Therefore, if parents enroll the latter in TK, it is to "redshirt"—that is, to delay kindergarten by a year. (See Appendix Table B3 for conditional estimates).

Overall, families are more likely to enroll boys in TK than girls (24% vs. 19%, p=0.000). This difference is driven by children with summer birthdays (27% vs. 17%, p=0.000), indicating that families are more likely to use TK for redshirting boys than girls. For preschool-age children, i.e., those born in the fall, the gender gap is much smaller (38% vs. 35%, p=0.000). We also find that children with IEPs at any time during their first year of public school (i.e., TK or kindergarten) are more likely to enroll in TK than those without IEPs. Importantly, this difference is small for children with fall birthdays (41% vs. 36%, p<0.010) but pronounced for those with spring (16% vs. 5%, p=0.000) and summer (38% vs. 20%, p=0.000) birthdays, suggesting that children who have IEPs are more likely than children without IEPs to enroll in TK when the program serves as a "redshirting" option.

Overall, White children, Hispanic children, and children of another race/ethnicity are roughly twice as likely to enroll in TK than Black and Asian children. This pattern holds when disaggregated by season of birth. Relatedly, families that are not economically disadvantaged enroll children in TK at slightly greater rates than their counterparts (24% v. 20%, p=0.000). However, among children with a fall birthday, this difference is substantially larger, with 42% of fall-born children from families who are not economically disadvantaged enrolling in TK compared with only 31% from economically disadvantaged families. In contrast, the TK enrollment gap is much smaller for children with summer birthdays: 20% for children from families that are economically disadvantaged versus 24% for their counterparts. As we discuss below, the differential enrollment by race/ethnicity and socioeconomic status likely reflects the differential availability of alternative learning options, as well as parent preferences.

RQ 3: How does the availability of TK impact participation in other early learning options?

Next, we examine how TK enrollment, state-funded Pre-K enrollment, early kindergarten entrance, and kindergarten redshirting change after a district adopts TK. To do so, we conduct event study analyses that compare how enrollment changes after a district adopts TK (the treated group) with changes over the same time period in districts that never adopted TK (the untreated group). Note that TK likely affects enrollment in non-public programs too, but we cannot observe those changes in our data.

Unlike our previous analyses, this method requires data from years prior to SY 2021-22 when we have less knowledge about which districts offered TK. Therefore, we restrict our treated group to 14

districts in which we have a high level of confidence about the timing of TK adoption (and which have reliable student-level enrollment information). The data allow us to look four years prior to and three years following the introduction of TK in each district. The comparison group is all districts that never adopted TK. When examining outcomes that occur during the Pre-K year, we limit the sample to children born from September 1 to November 30 since children born later aren't eligible for TK in their Pre-K year in Michigan (see Figure 1). When analyzing redshirting, we include all children from the relevant cohort regardless of birthdate because redshirting is an option for all children. See Appendix A for a complete description of the underlying statistical models.

Figure 2 shows how the availability of TK affected enrollment patterns in children's Pre-K year. Among economically disadvantaged (ED) children, the introduction of TK led to a substantial decline in the likelihood of waiving into kindergarten and a more modest decline in GSRP enrollment (the state's means-tested public Pre-K program). In the third year following the introduction of TK, the likelihood of entering kindergarten early fell by 25 percentage points (57 percent relative to baseline). In the same year the likelihood of enrolling in GSRP fell by 6 percentage points (21%), but this estimate is imprecise and not significantly different than zero. For non-ED children, the likelihood of waiving into kindergarten early fell by 9 p.p. (23%) but there was no significant change in GSRP enrollment, consistent with the fact that most of these children were not eligible for the means-tested program.

Figure 3 shows that TK increased redshirting among all (ED and non-ED) children. By the third cohort following adoption, TK increased redshirting by 5 p.p. (102%) for non-ED children and 9 p.p. (251%) for ED children. As expected, the increases were driven almost entirely by children using TK to redshirt.

Finally, note that differential impacts between ED and non-ED children are all sizeable and statistically significant. We discuss the implications of these differences in the next section. (See Appendix Figures B2 and B3 for subgroup analyses by sex.)

One limitation of our event study analysis is that it reflects the experiences of only 14 TK districts.[10] Accordingly, we conduct a second analysis that compares program enrollment rates in SY 2021-22 between the 229 districts that didn't offer TK that year and the 209 districts that did offer TK and that have reliable student-level data that year. This analysis requires additional assumptions but has the benefit of utilizing a much broader set of TK districts. Ultimately, the two approaches produce very similar results. We thus defer our discussion of the second approach to Appendix A.

Despite some evidence that GSRP enrollment fell among economically disadvantaged children, we find no evidence that GSRP enrollment fell in the aggregate. To examine this question, we conduct the

[10] See Appendix Table B4 for a comparison of the 14 districts included in Figure 2 with the broader sample of TK districts.

same event study analysis as before but using the entire Pre-K cohort rather than the subset of children who were old enough for TK. Using the full cohort allows us to capture the net effects of inflows and outflows from GSRP across different subgroups. Appendix Figure B4 shows that aggregate GSRP enrollment remained steady after districts introduced TK. Given the reduction in enrollment among those old enough for TK, the lack of an overall effect suggests that younger children filled the freed-up GSRP spots. Combined with our findings on TK and early kindergarten entrance, this suggests that TK increased the number of slots in publicly funded programs for children in their Pre-K year.

5. Discussion

Our study adds to extensive research on the fragmented early education landscape and its implications for demographic inequities in access and enrollment (Chaudry & Datta, 2017). Using Michigan as a case study on Transitional Kindergarten, our findings demonstrate how the introduction of a novel early childhood program can interact with extant options to exacerbate some inequities and mitigate others. Below, we discuss our findings through the lens of their implications for other states considering adding or expanding TK programs.

First, our district take-up findings illustrate how inequities in access can emerge when *districts* are charged with deciding whether to offer an early learning program. In Michigan, districts serving more traditionally advantaged populations are more likely to offer TK programs. Consequently, children from less traditionally advantaged families may have less access to the highest-funded early learning program in the state. This is the case even though districts that offer TK in at least one but not every elementary school do locate TK programs in schools that serve more economically disadvantaged students.

Theoretically, all districts in Michigan could take advantage of funding for TK students; why some districts offer TK and others don't is unclear. In a small survey we conducted with district administrators, the most common reasons for *not offering* TK were lack of space and funding issues. In contrast, the most common reasons for *offering* TK were to improve kindergarten readiness, provide more structured learning experiences before kindergarten, meet parent demand, and meet the needs of students with disabilities (Shapiro et al., 2023). Nationally, early learning programs vary in their coverage across districts. Some states give considerable latitude to districts on whether to offer a program, while others require programs in all districts (Friedman-Krauss et al., 2023). Our findings underscore the need for careful policy and research attention to the question of local autonomy.

Second, enrollment patterns *within* TK-offering districts are nuanced but suggest a role for policy in promoting equity. We found that boys and children with special needs—groups that tend to lag their peers in their early development (Weiland, 2016)—are more likely to enroll in TK. We also found that TK increases the likelihood of redshirting among all children, but the effects are substantially larger for

economically disadvantaged children. This finding is consistent with financial barriers preventing some families from delaying kindergarten entry (Bassok & Reardon, 2013).

However, economically disadvantaged families are *less* likely to enroll in TK as a form of preschool. This finding echoes some previous work showing that historically marginalized groups apply at lower rates to universal early learning programs (Shapiro et al., 2019). Notably, Michigan does not provide any guidance to districts on TK enrollment strategies. Other research has highlighted how specific supports and policies can increase enrollment rates for marginalized groups (Weixler et al., 2020). At the same time, our TK findings could reflect differential preferences and not differential access or awareness.

Third, for states weighing TK programs, our findings offer two bright spots. One is that as intended, TK helped facilitate one of Michigan's policy aims of moving the kindergarten entry cutoff from December 1 to September 1. Cohorts are older on average and thus on average likely more developmentally ready for the demands of kindergarten. The other bright spot is that TK does not seem to have reduced overall enrollment in state-funded Pre-K (GSRP) despite inducing some substitution away from it. When children who would otherwise enroll in GSRP opt to enroll in TK, their spots in GSRP seem to be filled by other children. This suggests that TK raises Michigan's overall capacity to serve four-year-olds in state-funded programs. All else equal, that would be an improvement to the early learning landscape; however, we cannot definitively draw that conclusion without knowing whether TK causes *non-public* programs to close or reduce capacity, which we cannot determine with our data.

Ultimately, TK's effects on equity also depend on its effectiveness at improving children's learning outcomes relative to other options. In related work we find that attending Michigan TK in one's Pre-K year improves children's third grade math scores by around 0.29 standard deviations (Berne et al., 2024a). This impact is large relative to other findings in the Pre-K literature (Phillips et al., 2017), which fits with the fact that TK contains many research-aligned program elements. However, there have not been any rigorous studies in Michigan or elsewhere that estimate TK's impact relative to *specific* alternatives or for older children who use TK to redshirt, nor has this work extended yet beyond elementary school. More research is needed to fully assess TK's potential, especially studies that can identify the effects of TK relative to other specific early learning options and not only a mixed counterfactual.

Our findings have several important limitations that should also be accounted for in considering implications. As we detailed in our data section, state administrative records required extensive triangulation to verify which districts had TK programs in our focal time period; we discovered some districts with TK programs do not record children as enrolled in TK even though they are. These districts were excluded from our analysis of which children in TK-offering districts enroll in the program.

Included TK-offering districts are mostly similar to excluded TK-offering districts in terms of student race/ethnicity but are larger, less economically disadvantaged, and more likely to be in suburban areas (Appendix Table B1). Also due to data limitations, our causal analysis of the substitution patterns TK induces is limited to a small set of districts that is not representative of the entire state. Accordingly, our findings may have less generalizability than is ideal.

Taken together, our findings demonstrate how TK can alter the already complicated early learning landscape. Our results impart lessons for TK programs in other states and likely for other universal Pre-K programs too—especially those in which localities opt into offering a given program. As the U.S. early learning landscape continues to evolve, a deeper understanding of targeting, access gaps, substitution, and crowd-out of existing programs is critical for promoting equitable outcomes.

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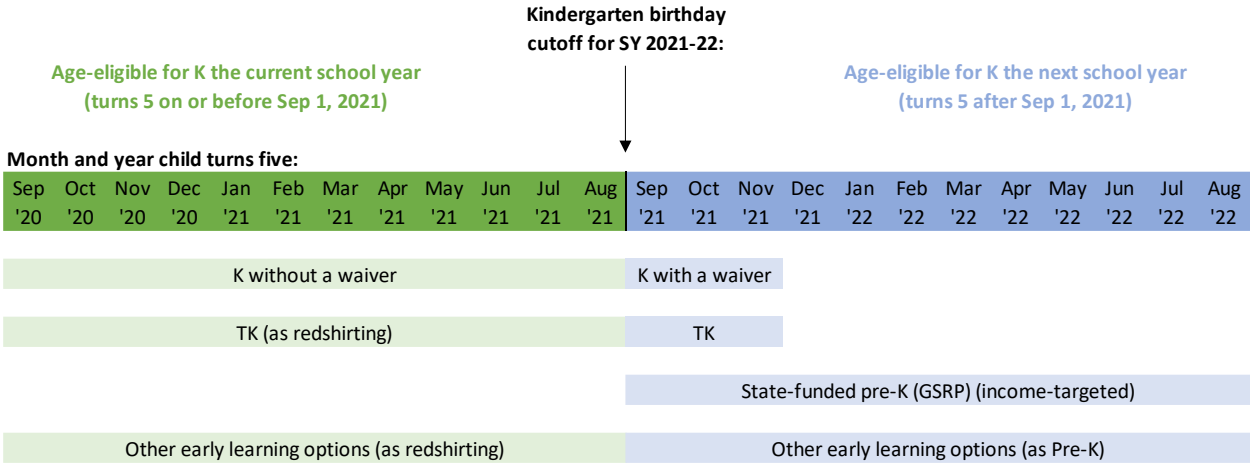
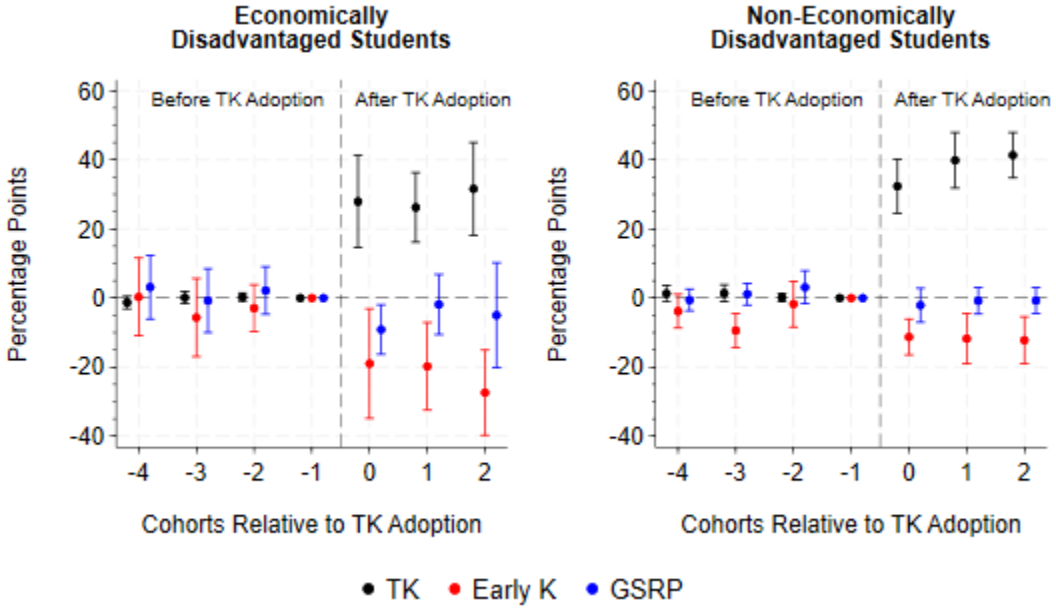
Tables and Figures

Figure 1: Age-eligibility of early learning options in SY 2021-22 in Michigan districts that offer TK, by month and year child turns five



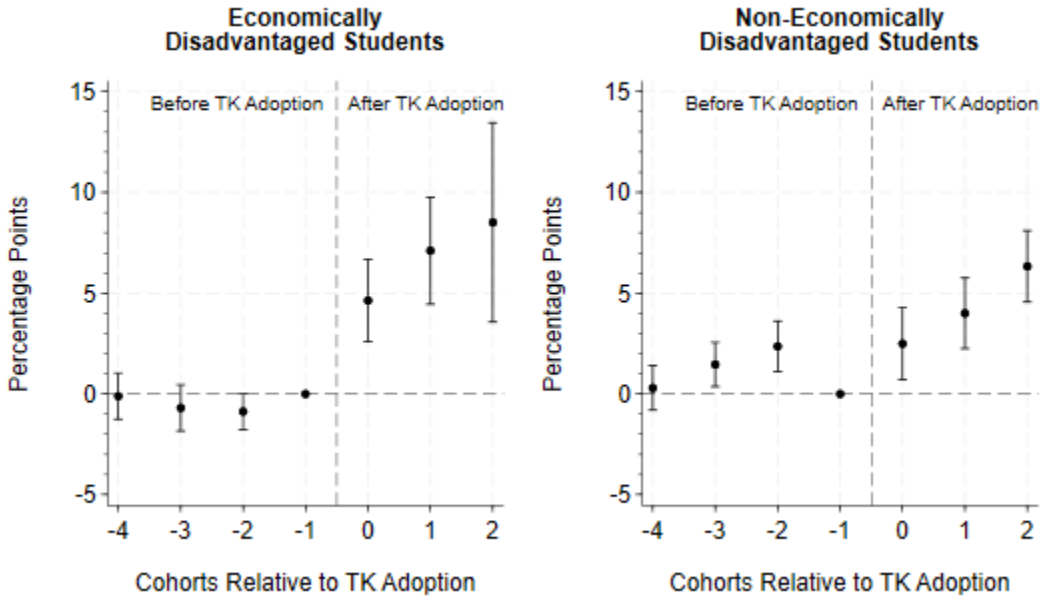
Notes: In SY 2021-22, school districts could receive state funding for any TK student who turned five on or before December 1, 2021, as reflected in the figure. Districts are unlikely to enroll children born after December 1 due to the restriction on funding. In practice, TK enrollment was greatest among children who turned five in the summer and fall (i.e., June 1, 2021 through December 1, 2021). GSRP = Great Start Readiness Program. In addition to age-eligibility criteria, GSRP students must also satisfy income or other needs-based eligibility criteria. "Other child care" refers to other public (e.g., Head Start), private, and informal care options.

Figure 2: Effect of TK adoption on early learning program enrollment among fall-born children in their Pre-K year



Notes: Each point in this figure is a difference-in-differences estimate, i.e., the difference between program enrollment in districts with and without TK, relative to the difference in period –1. The vertical bars extending from each point estimate indicate 95% confidence intervals. The sample is limited to children born in the fall. For context, in districts without TK, 46% of fall-born children waived into kindergarten early and 24% of fall-born children enrolled in GSRP in SY 2021-22. GSRP = Great Start Readiness Program.

Figure 3: Effect of TK adoption on kindergarten redshirting



Notes: Each point in this figure is a difference-in-differences estimate, i.e., the difference between program enrollment in districts with and without TK, relative to the difference in period –1. The vertical bars extending from each point estimate indicate 95% confidence intervals. The sample includes children born in any month. For context, in districts without TK, 4% of children who turned five by the kindergarten cutoff redshirted in SY 2021-22.

Table 1: Characteristics of districts and charters with and without TK in SY 2021-22

	Districts				Charter Schools			
	No TK	**Has TK**	**Diff.**	**P-value**	**No TK**	**Has TK**	**Diff.**	**P-value**
Student characteristics								
White (%)	52	72	-20	0.000	25	40	-15	0.000
Black (%)	27	10	17	0.000	58	33	25	0.000
Hispanic (%)	11	8	3	0.000	8	13	-6	0.000
Asian (%)	3	4	0	0.000	4	5	-1	0.000
Other (%)	6	6	0	0.000	5	8	-3	0.000
LEP (%)	10	7	3	0.000	11	11	0	0.976
Economically disadvantaged (%)	68	50	18	0.000	85	66	19	0.000
SPED (%)	16	16	0	0.548	12	13	-1	0.001
# Students	136,197	352,786			53,536	19,034		
District characteristics (%)								
K enrollment	124	238	-114	0.000	63	86	-24	0.000
K students who attended state-funded Pre-K (%)	37	29	7	0.000	30	27	3	0.189
City (%)	6	7	-1	0.674	51	25	26	0.000
Suburb (%)	14	37	-24	0.000	32	48	-17	0.033
Town (%)	10	21	-11	0.001	4	5	-2	0.596
Rural (%)	70	35	36	0.000	14	21	-7	0.250
3rd grade M-STEP math score (SD)	-0.14 (0.46)	0.01 (0.36)	-0.15	0.000	-0.57 (0.49)	-0.17 (0.45)	-0.40	0.000
3rd grade M-STEP ELA score (SD)	-0.14 (0.44)	0.01 (0.32)	-0.15	0.000	-0.49 (0.50)	-0.12 (0.42)	-0.36	0.000
# Districts	229	305			176	57		

Notes: Statistics in this table are calculated using administrative data from SY 2021-22. Student characteristics are calculated using students in grades 1-5. Test scores are measured in standard deviation (SD) units. The parentheticals under the mean district test scores are the standard deviations of the district test scores. District-level designations for TK and no-TK are based on administrative records and primary data collection (described in the text). "State-funded Pre-K" refers to students who enrolled in Michigan's Great Start Readiness Program (GSRP) or a GSRP/Head Start blend program.

Table 2: SY 2021-22 TK enrollment rates by student characteristics and season children turn five, for SY 2022-23 kindergarten students

	Overall	Spring 2021	Summer 2021	Fall 2021
All students (%)	22	6	22	36
Student characteristics (%)				
White	24	7	25	39
Black	13	4	11	25
Hispanic	22	7	23	32
Asian	12	1	9	24
Other	19	5	19	34
Male	24	8	27	38
Female	19	5	17	35
LEP	16	4	14	29
Non-LEP	22	7	23	37
Economically disadvantaged	20	7	20	31
Non-economically disadvantaged	24	6	24	42
SPED	32	16	38	41
Non-SPED	20	5	20	36
Attended state-funded Pre-K	16	7	18	24
Did not attend state-funded Pre-K	24	6	24	40
Locality (%)				
City	14	3	11	29
Suburb	22	6	23	37
Town	25	8	26	40
Rural	29	14	31	42
# Districts	209			

Notes: Statistics in this table are calculated using administrative data from SY 2021-22 and SY 2022-23. The sample is limited to the 209 districts with reliable TK enrollment information (as discussed in the text). Enrollment rates are calculated using the relevant number of kindergarten students in SY 2022-23 in districts that offered TK. For example, among districts that offered TK, 24% of all White kindergarten students in school year 2022-23 had enrolled in TK the previous year. Spring birth dates are defined as March-May, summer birth dates are defined as June-August, and fall birth dates are defined as September-November. Percentages across the spring, summer, and fall columns do not sum to 100 because each is calculated using a different base (that is, children born in the spring, summer, or fall, respectively). Children who turn five in fall 2021 who attended state-funded Pre-K prior to TK would have done so at age three; although the program is intended for four-year-olds, fall-born three-year-olds are sometimes allowed to attend when there is unfilled capacity.

Appendix A

To answer our research question on substitution patterns (RQ 3) we use two complementary approaches. The first is an event study approach utilizing longitudinal data and exploiting the timing of TK adoption. The second approach uses only cross-sectional data but includes a much larger set of TK districts than the first approach. Both approaches estimate the treatment effect of TK availability on enrollment in early learning options. In this appendix, we provide more detail on the methodology of each approach.

A. Event Study Approach

Our first approach uses an event study framework that makes comparisons across time and space. The treated group is 14 districts that adopted TK between SY 2016-17 and SY 2020-21. (See Appendix Table B4 for a comparison of all TK districts and the 14 TK districts in this event study sample.) We restrict our attention to these particular districts because the timing of their adoption matches in the two data sources available to us: state administrative records and a survey we conducted among a subset of districts. (Recall that we have highly reliable information on which districts offered TK only for SY 2021-22.) The untreated group includes all 206 districts that never had TK between SY 2012-13 and SY 2021-22. When we examine Pre-K year program enrollment (TK, GSRP, and early kindergarten), we further limit the sample to those born in September through November since children born later aren't eligible for TK yet.

We implement this framework with two model specifications. Using i to denote children, d to denote districts, t to denote school years, and e to denote event time, the first specification is:

Equation 1

$$Y_{idt} = \beta + \sum_{e=-4}^{-2} \tau^e Treat_{dt}^e + \sum_{e=0}^{2} \delta^e Treat_{dt}^e + X_i\Gamma + \gamma_d + \lambda_t + \varepsilon_{idt}$$

which we estimate with a two-way fixed-effects estimator. The outcome Y_{idt} is enrollment in an early learning option (TK, GSRP, early kindergarten entrance, or redshirting); $Treat_{dt}^e$ is a treatment indicator that equals 0 for the untreated group and 1 for treated districts when they are e years away from TK adoption; X_i is a vector of child-level controls (sex and race/ethnicity), and γ_d and λ_t are district and year fixed effects, respectively. The τ^e coefficients trace out placebo effects before TK adoption, and the δ^e

coefficients trace out treatment effects after.[11] The results from estimating this model specification are shown in Figures 2 and 3; Appendix Figures B2, B3, and B4; and Appendix Table B5.

The second model specification is identical to the first except that it pools together the four pre-treatment periods. Formally, the model is:

Equation 2

$$Y_{idt} = \beta + \sum_{e=0}^{2} \delta^{e} Treat_{dt}^{e} + X_i \Gamma + \gamma_d + \lambda_t + \varepsilon_{idt}$$

This model is closer to a traditional two-by-two difference-in-differences model, but we allow the effects to vary by time since introduction. The estimates discussed in the main text come from this specification.

As the recent difference-in-differences literature has revealed, two-way fixed-effects estimators may not estimate parameters of interest when treatment timing is staggered and effects are heterogeneous across districts (Roth, Sant'Anna, Bilinski, and Poe, 2023). TK adoption is indeed staggered in our sample, and treatment effect homogeneity seems unlikely. However, we show in Appendix Table B5 that our results are highly robust to using an alternative estimator.

Identification in this analysis requires a "parallel trends" assumption. In other words, it must be true that the treated group's outcomes would have evolved in parallel with the untreated group's outcomes in the absence of treatment. We cannot test this assumption directly, but we can assess its plausibility by examining the evolution of outcomes before treatment. The τ^e coefficients in our first specification represent these "pre-period" effects. As Figures 2 and 3 show, outcomes generally evolved in parallel across treated and untreated districts before TK adoption. However, for non-economically disadvantaged children, τ^{-3} for early kindergarten entry and τ^{-3} and τ^{-2} for redshirting deviate from 0. These deviations are somewhat concerning, but the stark changes in trend upon TK adoption provide some reassurance that post-period effects are driven by TK rather than other confounding factors. Moreover, for early kindergarten, the overall pre-period trend is relatively flat and the τ^{-3} estimate, while statistically significant, is smaller than every post-period estimate.

B. Cross-Sectional Approach

[11] Note that children born in the fall are exposed to TK in their Pre-K and kindergarten years, except for the cohort that is kindergarten age the year their district adopts TK. Therefore, in the redshirting event studies, the "treatment" is slightly different for the first cohort than the subsequent cohorts.

The main limitation of our event study analysis is that we can only estimate impacts for a small subset of districts with TK. To assess the generalizability of our results, we conduct a second analysis that doesn't require longitudinal data or information on the timing of TK adoption. Instead of making comparisons across time and space—as in the event study—we make comparisons only within cohort. Limiting our analysis in this way allows us to use data just from SY 2021-22 (i.e., the year in which we have reliable data on which districts had TK). Specifically, we compare program enrollment rates in SY 2021-22 between the 209 districts with TK and reliable student-level data and the 229 non-TK districts. This type of simple cross-sectional (CS) analysis has the benefit of utilizing a broader set of TK districts, but it imposes additional assumptions.[12]

Intuitively, districts without TK are informative about what enrollment rates in early learning options would be in TK districts if they did not have TK. With cross-sectional data, the simplest estimate of TK's impact on alternative program enrollment would be the difference in program enrollment between districts with and without TK. However, simple differences may not reflect causal substitution effects if TK and non-TK districts differ in ways other than TK that affect program enrollment. We show in Table 1 that TK and non-TK districts differ in observable ways, and they likely differ in unobservable ways too. Accordingly, in all our analyses, we estimate models that control for differences in observable characteristics. When we analyze the effect of TK on GSRP enrollment, we use a strategy that also accounts for differences in unobservable characteristics.

See Appendix Table B4 for a comparison of all TK districts, the TK districts in the event study sample, and the TK districts in the CS sample. As expected, the event study TK districts differ somewhat from the full set of TK districts. The event study TK districts have more White students and lower third grade test scores, on average. On the other hand, as intended, TK districts in the CS sample are highly similar to the full set of TK districts.

B.1. Early Kindergarten Entry and Kindergarten Redshirting

Beginning with early kindergarten entry and kindergarten redshirting, we estimate substitution using the following model:

Equation 3

$$Y_{id} = \beta + \tau Treat_d + X_i\Gamma + \varepsilon_{id}.$$

[12] See Appendix Table B6 for a comparison of the TK CS districts and the universe of all regular public-school districts in Michigan. TK districts in the CS sample are generally similar to the average Michigan school district but do have more White students and fewer economically disadvantaged students and are more likely to be located in suburbs. These results mirror those discussed in the RQ 1 section and shown in Table 1.

The outcome Y_{id} is an indicator either for early kindergarten entry or for redshirting; $Treat_d$ is a treatment indicator that equals 0 for districts without TK and 1 for districts with TK; and τ is our estimate of TK's impact on program enrollment. The vector X_i includes student-level controls (sex and race/ethnicity) and district-level controls (standardized test scores, urbanicity, enrollment, share of students receiving special education services, share of students eligible for free- or reduced-price lunch, and total per-pupil revenue). For the early kindergarten models, we restrict the sample to children born in the fall because children born in other months are not eligible to waive into kindergarten in their prekindergarten year. For the redshirting models, we use children born in any month since all children are eligible for TK in their kindergarten year.

Our CS estimates for early kindergarten and redshirting substitution are presented in Appendix Table B7. The results are highly comparable to our event study results using the sample of 14 TK districts. Although the CS estimates should not be interpreted as causal since we cannot control for unobservable differences between districts, the similarly of our estimates across approaches suggests that the event study estimates may have broad generalizability.

B.2. GSRP Enrollment

To estimate GSRP substitution, we exploit a second source of cross-sectional variation to obtain more plausibly causal estimates. Specifically, we exploit within-cohort variation in eligibility for TK during one's Pre-K year stemming from birthdays. Recall that only children born in the fall are eligible for TK in their Pre-K year. Children born in December through August are thus a natural control group, not directly affected by the presence of TK in their district. This setup lends itself to a cross-sectional difference-in-differences (DiD) strategy where the first difference is across district (TK vs. non-TK) and the second difference is across birth season (fall vs. other seasons). Intuitively, the second difference nets out differences in enrollment rates driven by unobservable characteristics since differences for children born December and later cannot be driven by TK.

We implement the cross-sectional DiD strategy with the following regression model. The notation remains the same, but we introduce a binary variable $Eligible_s$ to indicate age-eligibility for TK in one's Pre-K year, with s indexing season of birth:

Equation 4

$$Y_{ids} = \beta_0 + \beta_1 Treat_d + \beta_2 Eligible_s + \tau Treat_d \times Eligible_s + X_i\Gamma + \varepsilon_{ids}.$$

As before, τ is our estimate of program substitution. Y_{ids} is enrollment in GSRP, and the vector X_i includes the same student- and district-levels controls as in the other CS analyses. The sample includes children born in any month. The results are presented in Appendix Table B7. As with early kindergarten and redshirting, our CS estimates of GSRP substitution are highly similar to our event study estimates.

We view our CS estimates for GSRP as more plausibly causal than our CS estimates for early kindergarten and redshirting. Unfortunately, we cannot use the cross-sectional DiD strategy for early kindergarten and redshirting. With early kindergarten entry, enrollment patterns of children born after the fall are uninformative because none of these children are eligible to waive into kindergarten early. For redshirting, there is no control group within cohort because all children are eligible to use TK as a redshirting option in their kindergarten year. However, despite the limited cross-sectional identification strategies available to us for these two programs, we still obtain results that are highly consistent with our event study results.

Although we view our cross-sectional DiD strategy as highly beneficial for estimating GSRP substitution, it relies on the imperfect assumption that children born December and after are not affected by the presence of TK in a district. If this group is affected indirectly, our estimates may be biased. Suppose GSRP has excess demand in a district. If TK-eligible children substitute away from GSRP to enroll in TK, there will be more GSRP slots available for TK-ineligible children. This type of contamination could inflate GSRP enrollment among TK-ineligible children and downwardly bias the substitution estimate for TK-eligible children, which corresponds to artificially high substitution in absolute value. We find evidence of this situation in Appendix Figure B4 as discussed in the RQ 3 section of the main text.

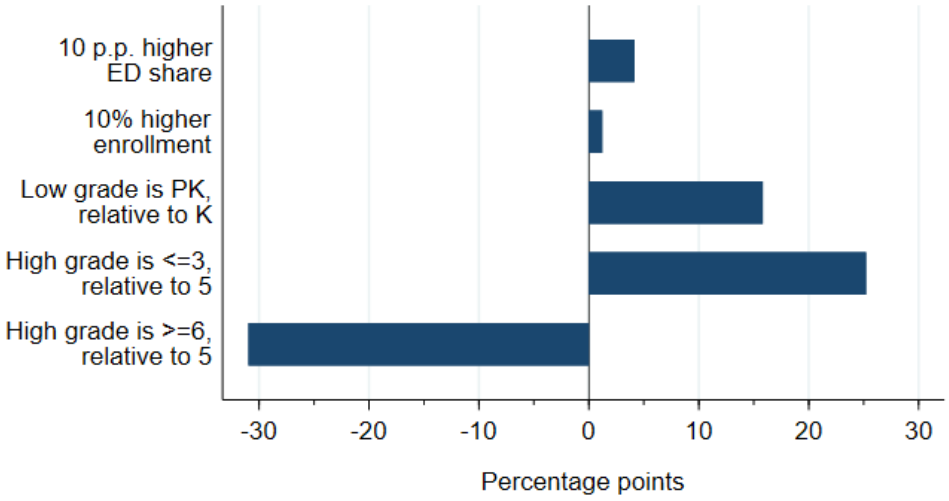
There are a few reasons to expect that this potential source of bias is small. For one, the estimated impacts are similar in the event study and CS approaches. Second, bias should only exist in districts with capacity constrained GSRP programs. In districts without excess demand, a reduction in GSRP enrollment by TK-eligible children should not change GSRP enrollment among TK-ineligible children. Finally, in the subset of districts with capacity constrained GSRP programs, the true impacts are likely at least 75% of what we would estimate. Observe that children age-eligible for TK in their Pre-K year comprise one fourth of their cohort. If these children reduced their GSRP enrollment, the freed-up slots would be distributed over a group of children three times as large. All else the same, enrollment among age-ineligible children could rise by, at most, one third of the drop in enrollment for age-eligible children.

For an arbitrary value of the true effect, Δ, a DiD analysis would estimate an effect no greater than $\Delta+(1/3)\Delta$, implying that the true effect is at least three-fourths of the estimated effect.[13]

[13] This bounding exercise assumes GSRP programs do not close because of increased competition from TK. An event study analysis using our 14-district sample supports this assumption (see Appendix Figure B4), as does a simple inspection of long-run GSRP enrollment trends among all districts that had TK in SY 2021-22.

Appendix B

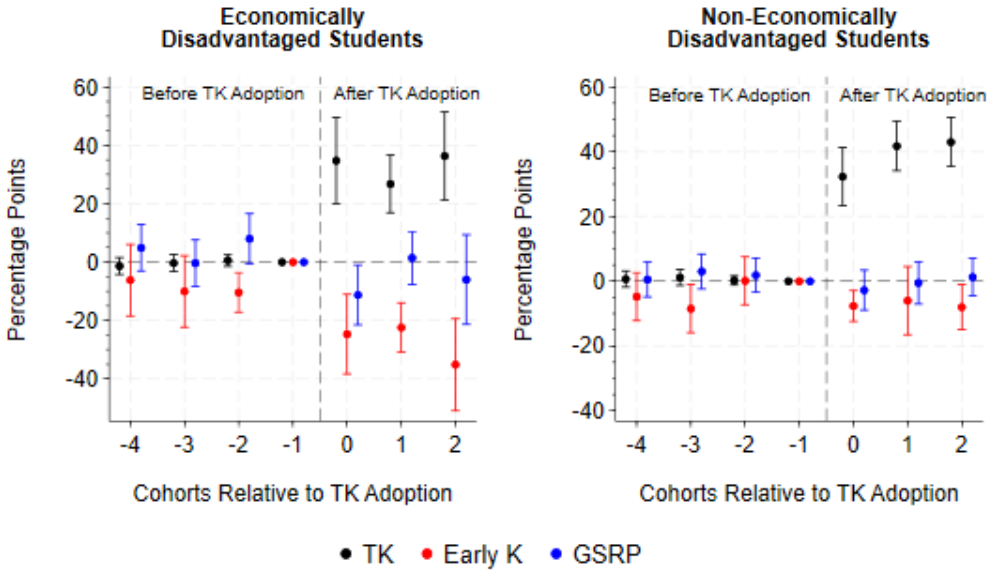
Appendix Figure B1: Predicted changes in the probability a school has TK in SY 2021-22



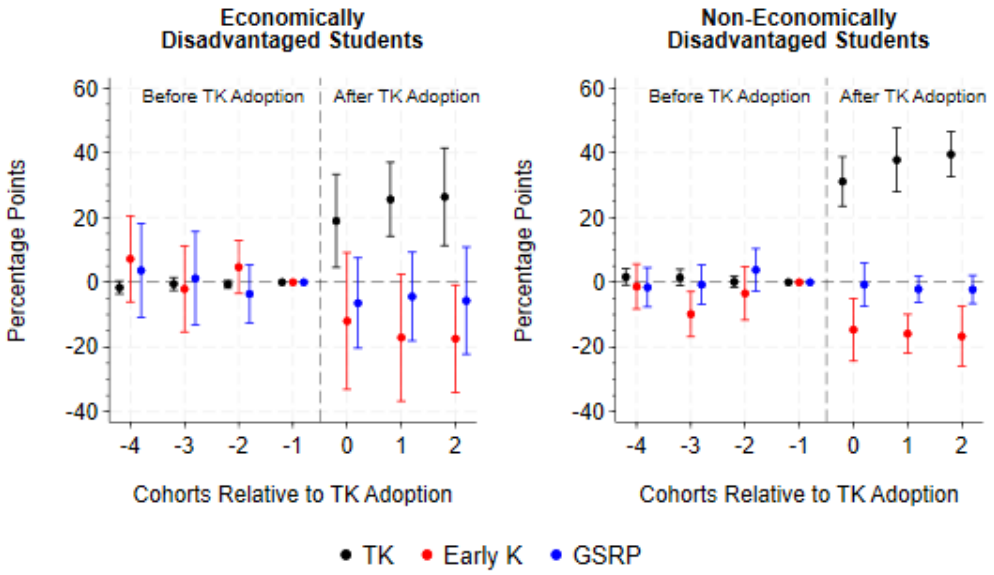
Notes: 52% of all districts with TK have TK in every building. The estimates in this figure come from the 48% that have TK in some but not all buildings. We regress a binary indicator for having TK on a school's share of economically disadvantaged students, share of white students, log of enrollment, mean math MSTEP score (the Michigan standardized assessment), indicators for the lowest and highest grades offered, and district fixed effects. The inclusion of district effects ensures that we are comparing schools within the same district. The results are highly similar when estimating OLS and logit regressions.

Appendix Figure B2: Subgroup analysis of Pre-K year program enrollment

Panel A. Boys



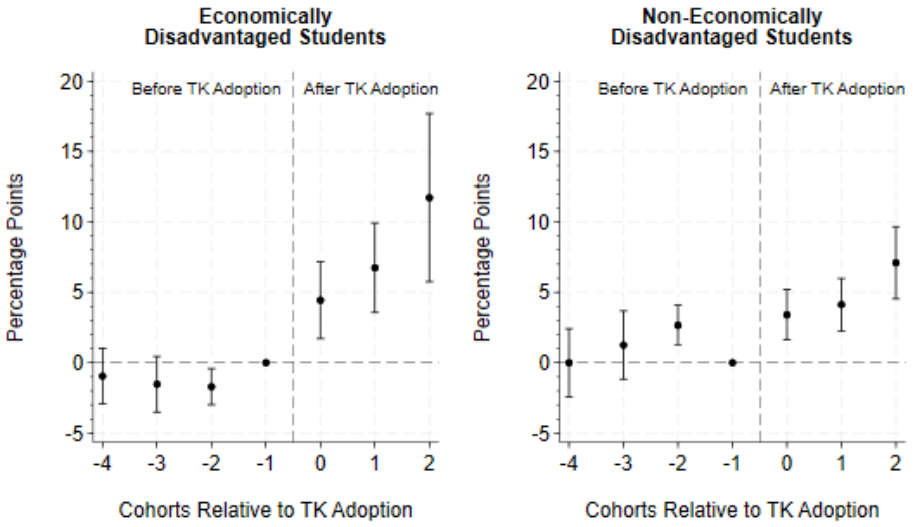
Panel B. Girls



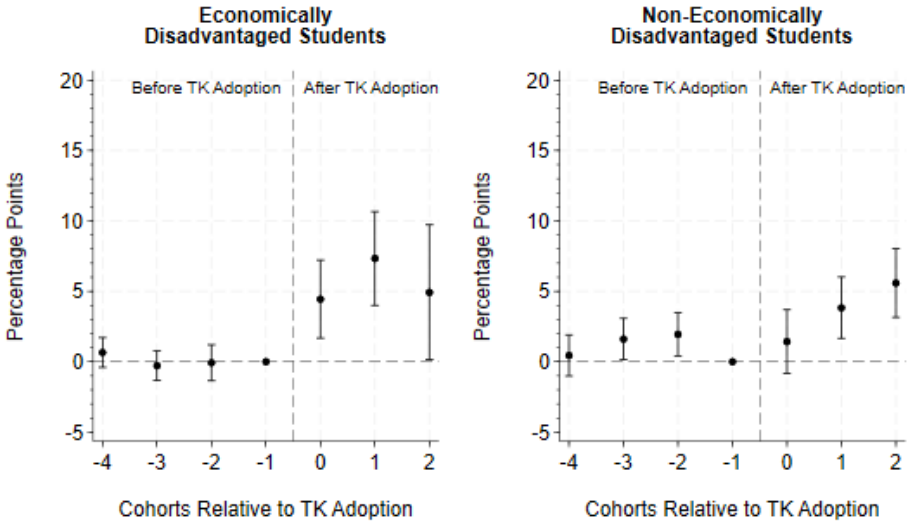
Notes: Each point in this figure is a difference-in-differences estimate, i.e., the difference between program enrollment in districts with and without TK, relative to the difference in period –1. The vertical bars extending from each point estimate indicate 95% confidence intervals. For context, in districts without TK, 46% of fall-born children waived into kindergarten early and 24% of fall-born children enrolled in GSRP in SY 2021-22. GSRP = Great Start Readiness Program.

Appendix Figure B3: Subgroup analysis of redshirting

Panel A. Boys

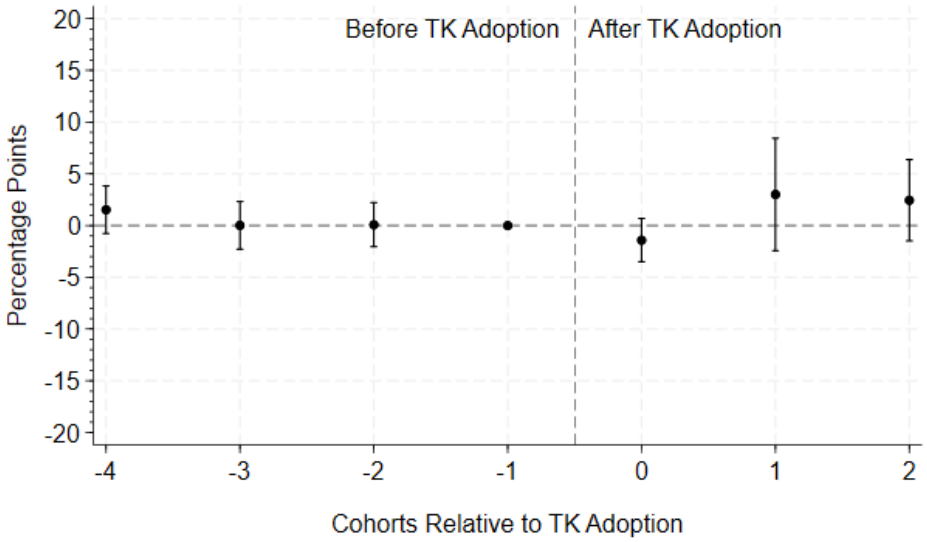


Panel B. Girls



Notes: Each point in this figure is a difference-in-differences estimate, i.e., the difference between program enrollment in districts with and without TK, relative to the difference in period –1. The vertical bars extending from each point estimate indicate 95% confidence intervals. For context, in districts without TK, 4% of children who turned five by the kindergarten cutoff redshirted in SY 2021-22.

Appendix Figure B4: Effect of TK adoption on GSRP enrollment among all children in their Pre-K year



Notes: Each point in this figure is a difference-in-differences estimate, i.e., the difference between program enrollment in districts with and without TK, relative to the difference in period –1. The vertical bars extending from each point estimate indicate 95% confidence intervals. We estimate these effects using the event study model described in Appendix A. However, instead of limiting the sample to children born in the fall, as we do in Figure 2, the sample for this analysis includes all children in a Pre-K cohort regardless of birthday or economic disadvantage status. GSRP = Great Start Readiness Program.

Appendix Table B1: Characteristics of TK districts and charters with and without 10 or more TK students reported in the SY 2021-22 administrative data

	Districts				Charter Schools			
	<10	10+	Diff.	P-value	<10	10+	Diff.	P-value
Student characteristics								
White (%)	72	72	0	0.688	37	63	-26	0.000
Black (%)	13	9	4	0.000	35	21	15	0.000
Hispanic (%)	7	8	-1	0.000	14	9	5	0.000
Asian (%)	2	4	-3	0.000	6	1	5	0.000
Other (%)	6	6	0	0.611	9	6	2	0.000
LEP (%)	4	8	-4	0.000	12	5	7	0.000
Economically Disadvantaged (%)	57	48	9	0.000	67	60	7	0.000
SPED (%)	18	16	2	0.000	13	16	-3	0.000
# Students	78,136	274,650			16,547	2,487		
District characteristics (%)								
K Enrollment	188	261	-73	0.003	91	60	31	0.014
K students who attended state-funded Pre-K	32	28	3	0.061	27	26	2	0.722
City (%)	5	7	-2	0.498	29	0	29	0.000
Suburb (%)	22	44	-23	0.000	48	50	-2	0.920
Town (%)	29	18	11	0.034	4	13	-8	0.535
Rural (%)	44	31	13	0.030	19	38	-19	0.355
3rd Grade M-STEP Math Score (SD)	-0.06	0.04	-0.10	0.025	-0.19	-0.04	-0.15	0.345
3rd Grade M-STEP ELA Score (SD)	-0.07	0.04	-0.11	0.007	-0.15	0.04	-0.18	0.296
# Districts	96	209			49	8		

Notes: Statistics in this table are calculated using administrative data from SY 2021-22. Student characteristics are calculated using students in grades 1-5. Test scores are measured in standard deviation (SD) units. "<10" refers to districts and charter schools with TK that have fewer than 10 TK students reported in the administrative data. "10+" refers to districts and charter schools with TK that have 10 or more TK students reported in the administrative data. "State-funded Pre-K" refers to students who enrolled in Michigan's Great Start Readiness Program (GSRP) or a GSRP/Head Start blend program.

Appendix Table B2: Regression-adjusted predictors of district-level TK take-up in SY 2021-22

	1	2	3	4	5	6
Suburb	0.166	0.144	0.193*	0.147	0.114	0.183
	(0.110)	(0.114)	(0.113)	(0.100)	(0.116)	(0.112)
Town	0.231*	0.221	0.235*	0.243**	0.196	0.230
	(0.134)	(0.138)	(0.140)	(0.110)	(0.122)	(0.140)
Rural	0.064	0.060	0.124	0.091	0.098	0.121
	(0.138)	(0.145)	(0.147)	(0.118)	(0.126)	(0.147)
Log(Enrollment)	0.149***	0.155***	0.169***	0.175***	0.183***	0.177***
	(0.024)	(0.025)	(0.027)	(0.028)	(0.025)	(0.034)
% Economically disadvantaged	-0.536***	-0.365**	-0.124	-0.521***	-0.570***	-0.249
	(0.140)	(0.144)	(0.164)	(0.152)	(0.161)	(0.190)
% White	0.061	0.092	0.166	0.150	0.101	0.209
	(0.191)	(0.188)	(0.215)	(0.130)	(0.180)	(0.213)
Log(PPE)	-0.124	-0.104	-0.002	-0.135	-0.224**	-0.005
	(0.084)	(0.082)	(0.096)	(0.088)	(0.108)	(0.099)
% Attended GSRP in 2012		-0.357***	-0.365***	-0.352***	-0.380***	-0.376***
		(0.119)	(0.135)	(0.101)	(0.125)	(0.136)
Math MSTEP score				-0.127	-0.158*	-0.094
				(0.080)	(0.081)	(0.082)
ISD fixed effects	No	No	Yes	No	No	Yes
Model	LPM	LPM	LPM	LPM	Logit	LPM

Notes: "LPM" stands for linear probability model. The results in the "Logit" column are average marginal effects calculated after estimating a logit model. All standard errors are clustered at the ISD level. Log(PPE) is the logarithm of per-pupil expenditures. Math test scores are measured in standard deviation units.

Appendix Table B3: Regression-adjusted predictors of student-level TK take-up in SY 2021-22, by season children turn five

	Summer 2021			Fall 2021		
	1	2	3	4	5	6
Female	-0.073***	-0.090***	-0.090***	-0.031***	-0.042***	-0.041***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Black	-0.056***	-0.116***	-0.114***	-0.050***	-0.120***	-0.122***
	(0.014)	(0.017)	(0.016)	(0.016)	(0.020)	(0.020)
Hispanic	-0.030**	0.001	0.005	-0.028*	-0.028	-0.026
	(0.014)	(0.018)	(0.018)	(0.017)	(0.021)	(0.020)
Asian	-0.042***	-0.107***	-0.117***	-0.083***	-0.168***	-0.163***
	(0.015)	(0.017)	(0.019)	(0.021)	(0.030)	(0.028)
Other	-0.051***	-0.068***	-0.063***	-0.014	-0.034*	-0.033*
	(0.014)	(0.015)	(0.014)	(0.017)	(0.020)	(0.019)
Economically disadvantaged	-0.021***	-0.040***	-0.040***	-0.075***	-0.114***	-0.113***
	(0.008)	(0.011)	(0.011)	(0.009)	(0.014)	(0.014)
SPED	0.111***	0.140***	0.135***	-0.053***	-0.062***	-0.062***
	(0.014)	(0.016)	(0.015)	(0.014)	(0.016)	(0.016)
LEP	-0.025	-0.108***	-0.117***	-0.014	-0.054**	-0.058**
	(0.015)	(0.017)	(0.018)	(0.017)	(0.027)	(0.029)
Attended state-funded Pre-K	-0.008	0.018	0.018			
	(0.009)	(0.012)	(0.012)			
School fixed effects	Yes	No	No	Yes	No	No
Model	LPM	LPM	Logit	LPM	LPM	Logit

Notes: The outcome variable for summer children is "TK in one's kindergarten year," and the outcome variable for fall children is "TK in one's Pre-K year." "LPM" stands for linear probability model. The results in the "Logit" column are average marginal effects calculated after estimating a logit model. All standard errors are clustered at the school level.

Appendix Table B4: Characteristics of all TK districts and TK districts in the event study sample in SY 2021-22

	Comparison of TK districts in event study sample to all TK districts				
	Event study TK Districts	**All TK Districts**	**Difference**	**P-value**	**TK districts in CS sample but not event study sample**
Student characteristics					
White (%)	61	72	-11	0.000	72
Black (%)	16	10	6	0.000	9
Hispanic (%)	7	8	-1	0.000	8
Asian (%)	9	4	5	0.000	4
Other (%)	7	6	1	0.076	6
LEP (%)	8	7	1	0.001	8
Economically disadvantaged (%)	47	50	-3	0.000	48
SPED (%)	17	16	1	0.005	16
# Students	16,059	352,786			262,452
District characteristics					
K enrollment	244	238	6	0.935	263
K students who attended state-funded Pre-K (%)	35	29	6	0.315	28
City (%)	7	7	0	0.937	7
Suburb (%)	43	37	6	0.701	45
Town (%)	7	21	-14	0.078	18
Rural (%)	43	35	8	0.572	29
3rd grade M-STEP math score (SD)	-0.14	0.01	-0.15	0.238	0.04
3rd grade M-STEP ELA score (SD)	-0.13	0.01	-0.14	0.199	0.05
# Districts	14	305			198

Notes: Statistics in this table are calculated using administrative data from SY 2021-22. Student characteristics are calculated using students in grades 1-5. Test scores are measured in standard deviation (SD) units. "State-funded Pre-K" refers to students who enrolled in Michigan's Great Start Readiness Program (GSRP) or a GSRP/Head Start blend program. The classification of "event study TK districts" is described in Appendix A. "CS sample" refers to the sample used in our cross-sectional analyses of substitution patterns, also described in Appendix A. Three districts in the event study TK district sample are not in the CS sample because they don't have reliable student-level enrollment data in SY 2021-22 despite having it in earlier years.

Appendix Table B5: Program substitution point estimates using alternative event study estimators

	TK		Early K		GSRP		Redshirting	
	TWFE	**C&S**	**TWFE**	**C&S**	**TWFE**	**C&S**	**TWFE**	**C&S**
				A. Economically Disadvantaged Students				
e=-4	-1.58	-0.02	1.84	1.91	4.56	3.79	-0.10	-0.51
e=-3	-0.21	0.00	-5.20	-3.83	-0.34	-2.32	-0.84	-0.95*
e=-2	0.22	-0.02	-3.07	-2.72	2.35	2.61	-0.90*	-0.99**
e=0	27.90**	28.56**	-19.13**	-19.12**	-8.81*	-8.38	4.56***	4.38***
e=1	26.29**	25.26**	-19.71***	-20.16***	-2.00	-1.01	7.15***	7.35***
e=2	32.60**	28.83**	-27.22***	-25.34***	-5.15	-3.98	8.42***	9.13***
				B. Non-Economically Disadvantaged Students				
e=-4	0.13	0.12	-1.82	-0.11	-0.82	-0.64	0.36	0.53
e=-3	0.94	0.11	-8.60***	-7.77***	0.93	0.37	1.52***	1.30**
e=-2	0.10	0.11	-1.86	-1.46	3.15	2.56	2.42***	2.32***
e=0	32.46**	32.17**	-11.44***	-9.57***	-2.11	-2.75	2.51***	2.16**
e=1	40.05**	38.59**	-12.14***	-11.18**	-0.79	-0.91	4.08***	4.36***
e=2	40.97**	40.64**	-12.69***	-11.78***	-0.47	-1.47	6.42***	6.18***

Notes: The "TFWE" columns contain results produced using the two-way fixed-effects estimator. The "C&S" columns contain results produced using the Callaway and Sant'Anna (2021) estimator. With both estimators, estimates are "long differences" with period e=-1 as the reference group. All standard errors are clustered on students' school district.

Appendix Table B6: Characteristics of all districts vs. TK districts with 10 or more TK students reported in the SY 2021-22 administrative data

	All Districts	Restricted TK Sample	Diff.	P-value
Student characteristics				
White (%)	66	72	-6	0.000
Black (%)	15	9	6	0.000
Hispanic (%)	9	8	1	0.000
Asian (%)	4	4	-1	0.000
Other (%)	6	6	0	0.145
LEP (%)	8	8	0	0.070
Economically Disadvantaged (%)	55	48	7	0.000
SPED (%)	16	16	0	0.000
# Students	488,980	274,650		
District characteristics (%)				
K Enrollment	189	261	-72	0.001
K students who attended state-funded Pre-K	33	28	4	0.001
City (%)	6	7	-1	0.630
Suburb (%)	27	44	-17	0.000
Town (%)	17	18	-1	0.738
Rural (%)	50	31	19	0.000
3rd Grade M-STEP Math Score (SD)	-0.06	0.04	-0.10	0.002
3rd Grade M-STEP ELA Score (SD)	-0.05	0.04	-0.09	0.000
# Districts	534	209		

Notes: Statistics in this table are calculated using administrative data from SY 2021-22. Student characteristics are calculated using students in grades 1-5. Test scores are measured in standard deviation (SD) units. The "All Districts" column includes all traditional public school districts. The "Restricted TK Sample" column includes traditional public school districts with TK that have 10 or more TK students reported in the administrative data. As discussed in Appendix A, this is the sample we use for our cross-sectional (CS) analysis of program substitution. "State-funded Pre-K" refers to students who enrolled in Michigan's Great Start Readiness Program (GSRP) or a GSRP/Head Start blend program.

Appendix Table B7: Event study and cross-sectional estimates of program substitution

	GSRP		Early Kindergarten Entry		Redshirting	
	Event Study	**Cross-Section**	**Event Study**	**Cross-Section**	**Event Study**	**Cross-Section**
			Panel A. Estimates by Sex			
Girls	-0.04	0.00	-0.14	-0.12	0.04	0.06
(SE)	(0.04)	(0.03)	(0.04)	(0.03)	(0.02)	(0.01)
Control mean	0.15	0.08	0.45	0.47	0.04	0.02
Boys	-0.02	-0.02	-0.14	-0.11	0.08	0.10
	(0.03)	(0.04)	(0.03)	(0.03)	(0.02)	(0.01)
	0.12	0.12	0.35	0.36	0.06	0.03
			Panel B. Estimates by Economic Disadvantage Status			
ED	-0.06	-0.10	-0.25	-0.14	0.09	0.10
	(0.07)	(0.04)	(0.04)	(0.03)	(0.03)	(0.01)
	0.29	0.25	0.45	0.46	0.04	0.02
Non-ED	-0.02	0.01	-0.09	-0.10	0.05	0.07
	(0.02)	(0.02)	(0.03)	(0.03)	(0.01)	(0.01)
	0.05	0.02	0.38	0.37	0.05	0.03
			Panel C. Estimates by Sex and Economic Disadvantage Status			
ED, Girls	-0.05	-0.10	-0.20	-0.12	0.05	0.07
	(0.08)	(0.04)	(0.06)	(0.04)	(0.02)	(0.01)
	0.30	0.24	0.47	0.49	0.03	0.01
ED, Boys	-0.08	-0.09	-0.29	-0.15	0.13	0.12
	(0.07)	(0.04)	(0.07)	(0.03)	(0.03)	(0.01)
	0.30	0.27	0.43	0.42	0.04	0.02
Non-ED, Girls	-0.03	0.03	-0.13	-0.13	0.05	0.06
	(0.02)	(0.02)	(0.04)	(0.03)	(0.01)	(0.01)
	0.06	0.00	0.46	0.46	0.03	0.02
Non-ED, Boys	-0.01	-0.01	-0.05	-0.07	0.06	0.08
	(0.02)	(0.03)	(0.03)	(0.03)	(0.01)	(0.01)
	0.04	0.04	0.30	0.29	0.07	0.05
Number of TK districts	14	209	14	209	14	209
Number of Non-TK districts	206	229	206	229	206	229

Notes: The statistical models used to estimate each effect are explained in Appendix A. The point estimates in the "Event Study" columns are for the third period after treatment (i.e., δ^2 in Equation 2). For early kindergarten entry and redshirting, the point estimates in the "Cross-Section" columns are estimates of τ in Equation 3. For GSRP, the point estimates in the "Cross-Section" column are estimates of τ in Equation 4. Standard errors are clustered on students' school district. The "control mean" is the observed

enrollment rate among “treated” children minus the estimated substitution effect. ED = economically disadvantaged. GSRP = Great Start Readiness Program.

Appendix Table B8: Characteristics of SY 2021-22 TK students and SY 2022-23 kindergarten students in TK districts with individual-level TK data

	SY 2021-22 TK Students	SY 2022-23 Kindergarten Students
Student characteristics (%)		
White	77	71
Black	6	10
Hispanic	8	8
Asian	2	5
Other	6	7
Male	58	51
Female	42	49
Economically disadvantaged	44	52
Non-economically disadvantaged	56	48
Locality (%)		
City	12	19
Suburb	57	57
Town	14	12
Rural	17	13
# Districts	209	209

Notes: Statistics in this table are calculated using administrative data from SY 2021-22 and SY 2022-23. The sample is limited to the 209 districts with reliable TK enrollment information (as discussed in the text). In the first column, each statistic gives the share of all TK students in SY 2021-22 who belong to the category defined by the row. In the second column, each statistic gives the share of all traditional kindergarten students in SY 2022-23 who belong to the category defined by the row.