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Non-Monetary Incentives in Education: Investigating the Impact of Four-Day School Week on Teacher Retention & Hiring

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Investigating the Impact of Four-Day School Week on Teacher Retention & Hiring

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Abstract
This study examines the impact of the four-day school week (FDSW) on teacher retention in Texas public schools, a policy adopted by a growing number of districts in response to staffing challenges and operational pressures. Using quasi-experimental methods and administrative data, the analysis finds that FDSW adoption increases overall teacher retention by approximately 3 percentage points and reduces the proportion of new hires by a similar margin, suggesting a stabilizing effect on the workforce. The results are particularly pronounced for early-career teachers, with a 4.4 percentage point increase in retention among those with five or fewer years of experience, and for female teachers, whose retention rises by 2.5 percentage points. Event study estimates show that these effects become significant in the second year after adoption, with retention increasing by nearly 5 percentage points. Evidence also suggests that FDSW may improve the retention of certified teachers over time. These findings highlight the potential of FDSW as a policy tool to mitigate teacher turnover, especially among groups most at risk of attrition, while also underscoring the need for further research on its long-term and broader labor market impacts.

1. Introduction

A four-day school week (FDSW) schedule eliminates one required school day per week - either a Monday or Friday. In the U.S. a typical school has between 175 and 180 school days in an academic year. Comparatively, a four-day school has on average 148 school days (Thompson, 2021). In order to comply with state-mandated minimum instructional hours requirements schools extend their school day by a few hours on the remaining four days. School districts are motivated by various reasons to shift to a four-day schedule including, reduction in operational costs, reducing student and teacher absenteeism, increasing teacher retention and morale, as well as attracting new teachers (Barnes & McKenzie, 2025). Anecdotally, school administrators across the country have reported improvements in the areas mentioned above after adopting a four-day school week. However, there is still little empirical research on its impact, particularly regarding teacher retention and hiring.

In Texas, four-day schools were made possible when lawmakers passed House Bill (HB) 2610 in 2015 which changed how classroom instruction was timed. Instead of mandating 180 days, the new law required school districts to provide a minimum of 75,600 minutes of instruction. This gave school districts more flexibility with their schedules. However, the move to an alternative schedule was not immediate. By 2018 only 1 school had adopted a FDSW schedule. The recent discussion in the Texas legislature over Senate Bill 2368[1] – that would eliminate FDSW - brought to light considerable anecdotal information and opinions on the advantages and disadvantages of the FDSW. It also highlighted the need for rigorous empirical research that examines the effect of this change in school

[1] The bill was proposed by State Sen. Donna Campbell (R) and sought to end four-day weeks in schools by mandating a minimum of 175 instructional days during the year. The senator said her reasoning for introducing the bill was the negative impacts of four-day school week on students and families.

schedule, especially on factors of primary importance to policymakers and practitioners such as teacher turnover. This paper makes an important contribution to our understanding of the merits of FDSW in Texas by employing quasi-experimental research methods in combination with rich administrative data from Texas to examine the effect of the FDSW on teacher turnover.

1.1. Four-day School Week in Texas

School districts in Texas have been struggling with teacher retention, especially since the COVID-19 pandemic. Like many states across the country, during the pandemic Texas saw a record number of teachers retiring and resigning (Adams, 2024). Given that the Texas Legislature has not increased the basic allotment — the main component of student funding — since 2019, despite inflationary double-digit price increases, schools are left with few options to incentivize teachers (Silva, 2024). Many school districts are therefore switching to a four-day school week schedule primarily as a means to attract and retain high-quality teachers.

> "Our 'why' is simple and straightforward. We want to find, recruit and retain the best teachers in the state in the classrooms for our students. This change [to four-day school week] immediately makes Crosby ISD a top destination for educators in Harris County."
>
> Superintendent Paula Patterson. Source: Admas, 2024.

This is especially true for rural districts in North and East Texas that are often unable to compete with higher salaries and other amenities offered by larger schools (TCTA, 2022). There is some anecdotal evidence about how the fifth day allows teachers some reprieve by giving them more time to plan their lessons and catch up on work. Therefore, in the absence of a pay increase, a FDSW might be considered a positive incentive for teachers.

However, some school administrators and parents are also skeptical about the switch to a FDSW. These concerns range from the effect of FDSW on students' academic performance, to their mental and physical well-being, to broader concerns about providing childcare on the fifth day as well as implications for delinquency in the district. At the time of this research 108 school districts have adopted a FDSW with another 20 school districts operating on a hybrid schedule[2] (Admas, 2024). As more schools consider making the switch, it is important to move beyond anecdotal evidence and support this idea with empirical research.

2. Literature Review

2.1. Teacher retention

Recruiting and retaining teachers is recognized as one of the most important policy issues in education policy by researchers and practitioners (Hanushek & Rivkin, 2006). This is why "strategic priority one" in the Texas Education Agency's strategic plan for 2021-2025 is to "recruit, support and retain teachers and principals" (2020). Teacher turnover is often referred to as teacher mobility in research. Whenever a teacher switches schools, their role in a school (from teaching to non-teaching), or leaves the profession entirely they are contributing to teacher turnover. A more sophisticated analysis breaks down the mobility status of a teacher into further categories like stayer, mover, or leaver (National Center for Education Statistics, 2024). The latest data shows that teacher turnover in the United States has hovered around 8% annually (Texas Education Agency, 2020-B). This leaves schools with an unstable workforce and the tremendous burden of hiring thousands of teachers each

[2] Hybrid schedules vary across school districts but usually involve the school adopting a four-day school for part of the school year.

year. Studies have shown that high turnover can have significant administrative costs for school. According to Ryan et al. (2017) 'the National Commission on Teaching and America's Future estimates the cost of a teacher leaving to be as high as $17,862 per teacher. Additionally, if one assumes that teachers improve with experience (Berry, 2010), then high turnover also reduces a school's capacity to support new teachers as well as spend more resources on training. Furthermore, as Redding and Henry observe using data from North Carolina, new teachers turnover at incredibly high rates, "only 38% of them remain in the school they started", and "8% of them leave within the first year" (2019).

Alternatively, it could be argued that some teacher turnover is beneficial for schools. If the teachers entering the school are more effective than those leaving it then turnover could be positive. Some researchers have found that removing the least effective teacher from school improves student achievement (Hanushek, 2009). Additionally, some scholars argue that turnover may not necessarily be a bad thing for an organization because it "[brings] fresh energy and new ideas by exiting poor performers" (Merrill, 2013).

How can schools incentivize teachers to stay or join in the first place? Research shows that salaries are important in any discussion about teacher attrition, retention and job satisfaction (Leachman et al., 2017). Furthermore, salary differentials between teachers and alternative occupations also influence teacher shortages (Rumberger, 1987). Unfortunately, as mentioned earlier, school districts often do not have the resources to offer teachers higher salaries. Traditionally, schools may offer teachers additional responsibilities, such as coaching or leading extracurricular activities. However, school districts with tight budgets often start by reducing spending on extracurricular activities. This could potentially have an even stronger negative impact on teacher retention as studies have shown that teachers who participate in coaching sports also remain associated with teaching longer (Brown, 2012; Cauley, 2011).

For teachers, budget cuts do not just equate to subpar salaries but also lead to a lack of supplies and supports at schools. These include things like fewer teacher aides, lack of classroom resources, or reduction in the number of nurses or librarians on campus. These factors are also linked to job stress for a teacher and may influence their decision to leave the profession (Pogodzinski, 2014). According to a National Center for Education Statistics report, 31% teachers who moved from public schools between 2021 SY and 2022 SY cited "school factors" as the main reason for moving. Similarly, a study examining working conditions for Arkansas teachers found that those considering leaving their current schools frequently cited "feeling unsupported, lacking influence over school policies, and insufficient planning time" as critical factors (Zamarro, McGee, & Schellhase, 2024).

In addition to these general budgetary challenges, teachers in rural areas face unique circumstances that further complicate their working conditions. The rural context is particularly important to consider because, as this paper will show, most schools that adopt a FDSW schedule in Texas are in rural areas. Rural schools also face additional challenges such as transportation, long bus rides, time to work on family farms and ranches (Morton & Thompson, 2024), a limited teacher labor market, and poorer infrastructure compared to schools in more urban areas. This leads to greater hiring and retention challenges for schools in rural areas (Burton et al., 2013; Ingersoll, 2001; Monk, 2007). As Maiden et al. note, the most difficult challenge for rural schools when it comes to teacher recruitment is ""trying to attract teachers to high-needs, low-amenity areas while being unable to pay salaries competitive with suburban and urban schools" (Maiden et al., 2020).

2.2.2. Four-day school week and teacher retention

The earliest documented four-day school week in the United States is 1931 in Madison, South Dakota (Anderson & Walker, 2015; Donis-Keller & Silvernail, 2009). Looking at the early history of FDSW in the country one can see that this alternative schedule is

always born out of necessity. In the early 1970s the shortened school week gained popularity due to the energy crisis (Ryan, 2009) where schools tried to reduce transportation and utility costs (Anderson & Walker, 2015). In the 2000s, the national economic downturn led to a decrease in per-pupil funding in many states which prompted some state legislatures to allow for more flexible school calendars (Anderson & Walker, 2015).

The last two decades have seen a sharp increase in the adoption of FDSW schedules across the country., According to research by Morton and Thompson, from 1999 to 2019 the number of school districts with FDSW schedules increased from 257 schools to 1,607 schools (2024). In their conservative estimation across the United States 2,100 schools in 900 school districts have transitioned to some form of FDSW schedule (2024). According to data collected for this study, Texas has also seen a sharp increase in FDSW adoption since 2018. While Texas only had one school district with a FDSW schedule in 2018, by 2024 the state will have around 108 districts.

Previous research has considered various impacts of this schedule change, from broader organizational effects like school finances ((Chmelynski, 2003; Thompson, 2021) to effects on student achievement (Thompson, 2021-B; Morton & Thompson, 2024) and health (Tomayko et al., 2021). There is, however, little empirical research on its impact on teacher retention and hiring. Previous qualitative work by Marion (2018) examines the perception of school administrators, counselors, and teachers on FDSW and its impact on retention, recruitment and job satisfaction. The participants in the study found the new schedule to be a significant positive in their personal lives - allowing them to balance family and work better (Marion, 2018). Additionally, some schools also confirmed that the new schedule has improved teacher recruitment and retention (Marion, 2018). This positive relationship, however, is limited to two out of the three schools that participated in the case study and therefore provides little evidence on the impact of FDSW schedule on teacher retention.

Another study by Maiden et al. (2020) aims to uncover "empirical linkages between FDSW and retention" in Oklahoma. While the study finds positive effects of teacher salaries, and instructional and support expenditure on teacher retention it finds no evidence that the implementation of FDSW improves teacher retention over time (Maiden et al., 2020). This study is limited by the fact that most districts in Oklahoma adopted the new schedule after 2017 and therefore the study does not have a robust number of districts with FDSW schedule (Maiden et al., 2020).

More recent studies add mixed evidence regarding the impacts of FDSW. For instance, Camp (2024) finds that in Arkansas, the adoption of FDSW appears to help retain teachers who otherwise might move to other districts but may negatively affect retention in nearby non-adopting schools, although the evidence on teacher quality remains inconclusive (Camp, 2024). Camp et al. (2024) highlight that in Missouri, FDSW calendars have had only small and imprecisely estimated positive effects on teacher retention, underlining significant uncertainty regarding the effectiveness of FDSW as a retention strategy (2024). Similarly, Morton and Dewil (2024) report small negative or statistically insignificant impacts on teacher retention in Colorado, suggesting that anticipated benefits to recruitment and retention may not materialize, especially in non-rural settings (Morton & Dewil, 2024). Moreover, Nowak et al. (2023) observe a significant negative effect on teacher retention among experienced teachers in a metropolitan district in Colorado, where retention decreased by about 5 percent after adopting a FDSW, highlighting potential unintended consequences of this policy in urban contexts (2023).

While several quantitative studies have highlighted mixed and often uncertain effects of the four-day school week (FDSW) on teacher retention, a mixed-methods study by Fay (2019) in rural Missouri provides complementary insights into why and how this policy might influence teachers' decisions to remain in their positions. Teachers reported

significant improvements in staff morale, enhanced work-life balance, reduced stress, and better overall preparation for teaching due to the extended weekends offered by the FDSW schedule (Fay, 2019). Principals in these districts also observed notable increases in both teacher applicant pools and retention rates following the policy shift. Additionally, the FDSW model contributed positively to student attitudes and attendance, although it presented some instructional challenges related to longer weekends and missed instructional time. Despite these perceived benefits, Fay (2019) found no significant difference in academic performance in ELA and Math MAP scores before and after implementation of the four-day schedule, suggesting that the shortened week neither significantly harmed nor improved student achievement. Given these mixed and limited findings in existing literature, there is a clear need for additional rigorous, quantitative analyses on this topic.

This research, therefore, is one of the first in Texas, and perhaps the country, to provide empirical evidence on the use of FDSW schedule as a school policy intended to improve teacher recruitment and retention.

3. Data

The research combines data from two main sources: the first is an original dataset that identifies all school districts in Texas based on whether they have adopted a FDSW modality or not. For those districts which have adopted this modality this data set captures the school year in which this transition occurred as well as other relevant operational details such as how the 5th school day was utilized. In addition, this data also includes information such as school location, school start and end time and instructional time. This data was compiled using online news sources that reported on Texas schools, the Texas Classroom Teachers Association, and the Texas Education Agency. To ensure the

information was accurate and up to date, I also reviewed individual school district websites when available. When information was missing or unclear, I contacted districts directly using the contact details listed on their websites. All sources were corroborated and cross-checked to provide the most reliable record of four-day school week adoption.

This dataset is complemented by extensive data from the Education Research Center (ERC) at The University of Texas at Dallas. This data contains information on student demographics, test scores, attendance and disciplinary outcomes as well as postsecondary enrollment and competition. The data also contains extensive information on teachers which can be linked to students at grade level. Access to this data was granted by the Texas Higher Education Coordinating Board. The combined dataset consists of a school-level panel for the years 2011 to 2023.

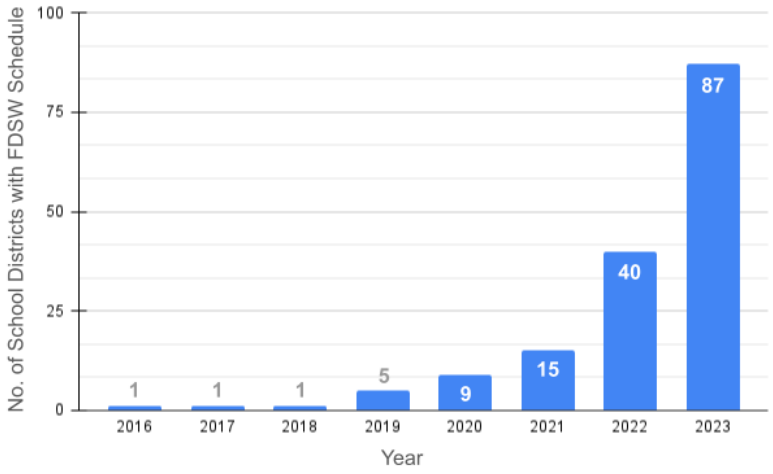

Figure 1: Total No. of School Districts Adopting FDSW by Year in Texas

According to the data collected for this research, in 2023 SY in Texas 87 school districts adopted Four-day school week schedules. More schools are considering the switch to a four-day school week or hybrid schedule. According to the most recent reports by KXAN 108 school districts in Texas have moved to a four-day week which affects more than 117,000 students (Adams, 2024). A few school district boards in the state have already approved the

change in schedule to take place in 2025 SY. Over two-thirds of the schools in the data collected for this paper take a Friday off, the remaining take Mondays off. The map below shows that the 4DSW schedule is particularly popular in rural districts in north and east Texas. Another important thing to note on the map is how FDSW adoption (shown in orange) happens in clusters. This suggests that a school district's decision to move to FDSW is not completely isolated from neighboring districts' schools schedules. This has important implications for the validity of some of the assumptions made in this paper and these implications are discussed in the methods sections below.

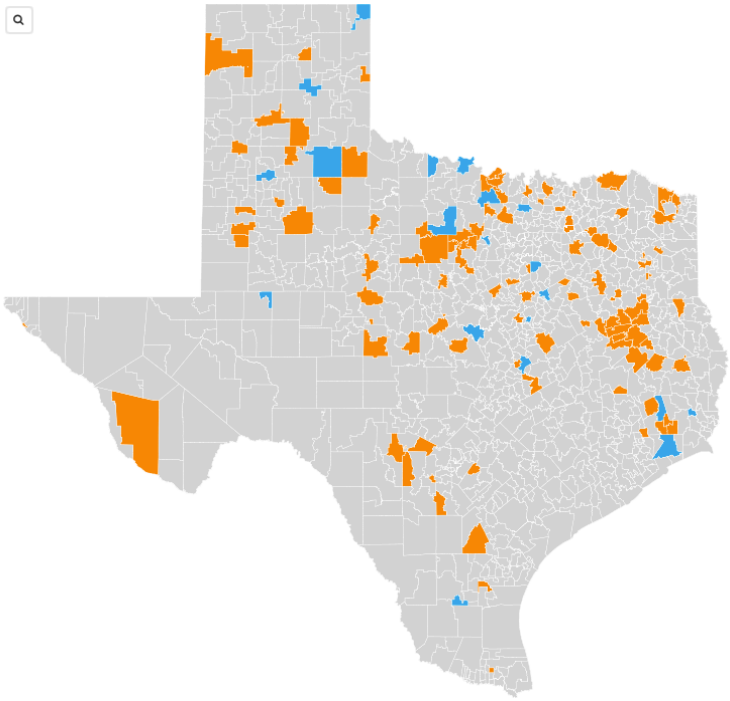

Figure 2: School Districts in Texas with FDSW and Hybrid Schedules. Source: Adams, 2024

Furthermore, it is important to consider how schools that adopt FDSW schedules are different from schools that do not. Table 1 below provides summary statistics on how these schools differ along with the p-value for the t-test for differences in means. FDSW schools are mostly located in the rural parts of the state. Out of the 81 schools that adopt a FDSW schedule, 47 schools (58%) are in rural areas. Looking at the demographics among these

schools, FDSW schools are smaller than five-day schools in terms of both the total number of students and teachers. The student to teacher ratio at FDSW schools is also lower at almost 12 students per teacher compared to around 15 students per teacher in five-day schools. Schools that adopt a FDSW schedule have 25 teachers on average compared to 41 teachers, and more importantly around 12 students per teacher compared to around 15 students per teacher in schools that do not have a FDSW schedule.

Table 1: Descriptive Statistics on Five-day and Four-day Schools (2011 - 2023)

	Five-day Schools (1)	**Four-day Schools (2)**	**T-test (p-values) (3)**
Teacher characteristics			
Avg. no. of teachers	42.51	27.06	0.000
Avg. no. of students per teacher	15.47	12.53	0.000
Fraction of Black teachers	0.11	0.05	0.000
Fraction of Hispanic teachers	0.28	0.06	0.000
Fraction of White teachers	0.85	0.9	0.000
Fraction of male teachers	0.2	0.23	0.000
Prop. of certified teachers	0.38	0.35	0.000
Student characteristics			
Prop. of FRPL students at school	0.63	0.64	0.043
Fraction of Black students	0.15	0.12	0.000
Fraction of Hispanic students	0.04	0.008	0.000
Fraction of white students	0.74	0.83	0.000
N	112,718	1,843	- -

Notes: all statistics report the average number or proportion in schools by year. Demographic statistics on teachers and students do not add to 1 because I have excluded other minority ethnic groups from this table.

Four-day schools also differ from five-day schools in terms of the makeup of their teachers and students. As Table 1 shows about 90% of teachers in schools that adopt a FDSW are white compared to 86% in schools that do not adopt a FDSW schedule. Another important difference to highlight is the proportion of free and reduced-price lunch (FRPL) students in schools. Schools that adopt a FDSW schedule have 67% FRPL students

compared to 63% in schools that do not adopt a FDSW schedule. Table 2 provides a breakdown of the differences in teacher retention rates between four-day and five-day schools.

Table 2: Retention Rates for Four-day and Five-day Schools (2011 - 2023)

	Five-day Schools	Four-day Schools	T-test (p-values)
	(1)	(2)	(3)
Prop. of teachers	0.76	0.73	0.000
Prop. of female teachers	0.77	0.75	0.000
Prop. of teachers with > 9 years experience	0.83	0.80	0.000
Prop. of teachers with <= 5 years experience	0.63	0.60	0.000
Prop. of teachers with certification	0.75	0.72	0.000
Prop. of new teachers	0.23	0.27	0.000
N	73,386	1,279	- -

Notes: all rows report the proportion of teachers retained

4. Methodology

4.1. Two-way fixed effects difference-in-differences

Similar to previous work by Thompson and Ward, (2022) and Anderson (2015) I plan on using a difference-in-differences methodology that exploits the temporal and spatial variation in adoption of FDSW to estimate its effects on student achievement and teacher turnover. This method allows me to exploit the panel nature of my data by estimating a model that includes school fixed effects and year effects. Having access to ERC data also allows me to conduct the analysis both with and without a host of observable characteristics of schools, students, and teachers.

The main measure of proportion of teachers retained is created by dividing the number of teachers who were in school *s* in both years *t-1* and year *t* with the number of teachers in school in school *s* in year *t-1*.

$$Proportion\ of\ Teachers\ Retained = \frac{No.\ of\ teachers\ in\ school\ s\ in\ year\ t\ \&\ t-1}{No.\ of\ teachers\ in\ school\ s\ in\ year\ t}$$

I use a similar formula to create other outcome variables such as: "proportion of certified teachers retained", and "proportion of teachers with more than 5 years of experience retained". The outcome variable "proportion of female teachers" is measured slightly differently, where instead of having all teachers in school s in year t I use the number of female teachers in school s in year t.

$$Proportion\ of\ Female\ Teaches\ Retained = \frac{No.\ of\ female\ teachers\ in\ school\ s\ in\ year\ t\ \&\ t-1}{No.\ of\ female\ teachers\ in\ school\ s\ in\ year\ t}$$

The empirical strategy is based on estimating the equation 1 below:

$$Y_{sdt} = \beta_0 + \beta_1 FDSW_{sdt} + \beta_2 X_{sd} + \omega_s + \nu_t + \varepsilon_{sdt} \qquad (Eq.1)$$

Where Y_{sdt} is the outcome of interest for school *s* located in district *d* in year *t* - in this paper the main outcome variable is the proportion of teachers retained. $FDSW_{sdt}$ is an indicator variable that takes value 1 if school *s* has adopted a four-day school week schedule in year *t* and is zero otherwise. The coefficient of interest β_1, represents the marginal effect of switching to a FDSW schedule. X_{sd} is a vector containing school level characteristics, ω_s is school level fixed effects and ν_t represents a survey year fixed effect. The school level fixed effects control for permanent differences across schools (differences that are time-invariant), and year fixed effects control for differences across time that are common to all schools.

Here it is important to include a discussion about sources of bias in my estimates. One potential source could be that only certain types of teachers may be attracted to schools with a FDSW schedule. If I assume, for example, that shortened school week could decrease the cost of commuting to schools for teachers so that this schedule could appeal more to teachers who are relatively more burdened by commuting costs. If these types of

teachers are systematically more or less likely to leave the school then estimates of the effect of FDSW schedule on teacher retention at the school level would be biased. I address this source of bias by disaggregating teacher retention in schools by teacher experience and teacher certification. Both characteristics are considered to be important indicators of a teacher's quality. Future work on this would also include teacher value added scores as a measure of teacher quality to really home in on what kind of teachers are driving retention rates.

Another source of potential bias in my estimates could come from selection bias, which is to say that schools choose their own schedules. Low-income, rural schools often do poorly when it comes to hiring and retaining teachers. Anecdotal evidence would suggest that the switch to FDSW often comes as a response to downward trends in teacher retention and hiring. If only low-income schools change to a FDSW schedule then any observed relationship between teacher retention and FDSW may simply reflect the financial status of the school (Anderson & Walker, 2015). Using school fixed effects in the regression specification discussed above as well as covariates such as proportion of free and reduced-price lunch students at a school help to purge my estimates of this sort of bias. School fixed effects, however, do not account for unobserved time-varying factors that simultaneously influence teacher retention and school's choice of schedule.

4.2. Event study

Any causal interpretation of difference-in-differences estimates is based on the assumption that teacher turnover in schools that adopt FDSW would have followed a similar trend to schools that did not implement FDSW in the absence of the treatment. Additionally, previous research shows that such administrative changes in schools may take time to emerge, i.e. the size of the treatment effect varies with time (Thompson, 2022). One might expect that the effect of a four-day week could vary depending on the length of time since

the school implemented the four-day schedule. For example, Thompson (2019b) finds that students may experience an initial decline in achievement when they switch schedules but then stabilize to pre-switch achievement levels over time. Alternatively, students' achievement may be benefited or harmed by the schedule the longer they are exposed to the treatment, resulting in a dynamic effect (positive or negative) of the four-day week over time. In order to account for heterogeneity in treatment effect due to treatment duration, as well as provide more evidence that the control group is adequate, I implement an event study methodology. In particular, I estimate the following equation:

$$Y_{st} = \beta_1 X_{st} + \nu_t + \omega_s + \sum_{\tau=-2}^{2} \gamma_\tau \, d\tau_{st} + \varepsilon_{st} \qquad (Eq. 2)$$

Here Y_{st} is teacher turnover in school *s* in year *t*, X_{st} is a vector of time-varying school-level characteristics, ω_s is school-level fixed effects, and ν_t is a calendar year fixed effect. The term $\sum_{\tau=-2}^{2} \gamma_\tau \, d\tau_{st}$ is a collection of binary variables for lags and leads around the event. For example, $d(-1)_{st}$ is an indicator variable equal to 1 if school *s* implemented FDSW one period ago as of year *t*. Similarly, $d(1)_{st}$ is an indicator variable equal to 1 if school *s* implemented FDSW one period after year *t*. Intuitively the coefficients on these lag and lead terms estimate the difference between teacher turnover trends of schools who do implement FDSW relative to the teacher turnover of schools who either never implement FDSW or have not yet implemented FDSW.

4.3. Callaway & Sant'Anna Estimator

A developing body of literature has highlighted concerns when using two-way fixed effects (TWFE) difference-in-differences (DID) models with staggered treatment timing, as employed in this study. The TWFE estimator effectively produces a weighted average of various two-by-two period-specific DID estimates. However, these weights are influenced by the proportion of treated units and the variance of treatment status in each comparison,

leading to potential biases (Morton, 2022). Crucially, TWFE estimators implicitly include "forbidden comparisons" – comparisons between units that have already been treated at different points in time. These comparisons are problematic because they assume that the treatment effect is constant across all treated groups, regardless of their treatment timing (Goodman-Bacon, 2021; de Chaisemartin & D'Haultfoeuille, 2020; Callaway & Sant'Anna, 2021; Sun & Abraham). This assumption is often unrealistic, as treatment effects may vary over time due to factors like adaptation, learning, or changing economic conditions. When treatment effects are heterogeneous across adoption times, these forbidden comparisons can lead to severe biases in the TWFE estimates (Goodman-Bacon, 2021; de Chaisemartin & D'Haultfoeuille, 2020; Callaway & Sant'Anna, 2021; Sun & Abraham).

To mitigate these concerns, this analysis complements the original static DID point estimates with reweighted estimates generated using the "csdid" Stata package, which implements the Callaway and Sant'Anna estimator. This approach focuses on "good comparisons" – comparisons between treated units and units that have not yet been treated or will never be treated (2022). By isolating these relevant comparisons, the Callaway and Sant'Anna estimator provides a more robust and accurate estimate of the average treatment effect (ATE) in the presence of staggered treatment adoption and heterogeneous treatment effects.

4.4. Matching

As mentioned earlier, for the above equation to be a causal model it must satisfy two important assumptions: firstly, the treatment received by one school should not influence the outcome I observe for another school (also known as the stable unit treatment value assumption - SUTVA). This means that the potential effect on teacher retention of a school that switches to four-day schedule should only be influenced by its own schedule switch and not another school's. In reality however, it is not difficult to imagine a scenario where if one

school district switches to a FDSW schedule, it results in some migration of teachers from neighboring districts (assuming teachers prefer to work in a school with a four-day schedule) with a five-day schedule. This means that the causal estimates I obtain are not stable and probably biased upwards. In another study I observe the proportion of teachers that switch schools in Texas and find that as of school year 2020 this proportion is on the rise[3]. In order to investigate this further, I estimate the effects of switching to a four-day school week on the proportion of new teachers at a school in a separate specification of equation 1.

The second important assumption in a difference-in-differences analysis is the parallel trend assumption, where it is assumed that the control group's change over time is equivalent to the treatment group's change over time in the absence of any treatment effect. This is difficult to accomplish when the treated group is much smaller in comparison to the control group. To reduce concerns about differential trends between schools with and without FDSW confounding our estimates, I choose control schools that are similar on a set of observable characteristics using a nearest neighbor matching procedure. According to this procedure, matched schools must have values of observable characteristics that lie within a prespecified caliper width. To ensure that matched pairs of treatment and control schools can be meaningfully compared I match exactly on school's NCES location. Additionally, I specify the caliper width to be within 1 standard deviation for share students receiving free or reduced-price lunch, share non-Hispanic White students, share non-Hispanic Black students, share Hispanic students, average number of students served per teacher, proportion of black teachers, proportion of Hispanic teachers, and average

[3] Proportion of teachers that switch schools was 10.6% in SY 2020, 12.6% in SY 2021, and 14.6% in SY 2022, as shown on the graph included in Appendix A.

professional experience at school. Each school with a FDSW schedule is paired with five never-treated schools. I also match control schools on proportion of teachers retained prior to any treatment.

5. Results

5.1. Impact of FDSW adoption on teacher retention

As stated in the methodology section, first I estimate the effect of FDSW adoption using a two-way fixed effects difference-in-differences strategy (equation 1). Table 3 presents results for the following outcomes: proportion of teachers retained in a school, proportion of new teachers at a school, and proportion of female teachers retained. Each column illustrates results from a separate regression and all models include school and year fixed effects. I do not include covariates in this specification for two reasons, firstly relevant covariates such student or teacher demographics are time-varying. Secondly, FDSW adoption might have unexpected impacts on student behavior, teacher morale, or family dynamics, which could significantly influence the covariates. To accurately account for these changing factors, I would need to make strong assumptions about how these covariates interact with the four-day school schedule policy (Camp, 2024; Sant'Anna & Zhao, 2020).

The results show that FDSW adoption is associated with an almost 3 percentage point increase in overall teacher retention. I also find that the proportion of new teachers at a school that adopts FDSW schedule decreases by about 2.9% percentage points. This would indicate that the schedule change has a strong effect on retaining teachers at a school year-to-year and therefore these schools do not need to hire new teachers.

Table 3 also shows that the proportion of female teachers retained increases by 2.5 percentage points in schools that adopt a FDSW schedule. As mentioned above, the proportion of female teachers retained is calculated from all female teachers at the school as opposed to all teachers at a school. The result here shows that switching to a FDSW

schedule is associated with the school retaining 2.5 percentage point more proportion of female teachers. This suggests that perhaps the flexibility that the new schedule offers is particularly important to female teachers.

Table 3: Effects of Adopting a FDSW Schedule

	Prop. of Teachers Retained (**1**)	**Prop. New Teachers** (**2**)	**Prop. of Female Teachers Retained** (**3**)
FDSW adoption	0.0302***	-0.0292**	0.0250**
	(0.00935)	(0.0101)	(0.0104)
N	4,074	4,074	4,074
R^2	0.033	0.021	–
School fixed effects	Yes	Yes	Yes
Year effects	Yes	Yes	Yes

Notes: each column presents the results from a separate OLS regression. The dependent variable is equal to the proportion of teachers retained by categories like female, experience & certification. No control variables were included in this specification. Standard errors, corrected for clustering at the school level are in parentheses.
**Statistically significant at 10% level; **significant at the 5% level; ***significant at the 1% level.*

5.2. Impact on Certified and Experienced Teachers

Next I disaggregate teacher retention by years of experience and certification. This is important to consider because Texas relaxed certification and preparation requirements to help school districts that were struggling with teacher recruitment and retention (Aragon, 2016). Additionally, teacher certification status has also been linked to unequal quality of instruction in the classroom with some studies suggesting that students who are taught by teachers who were prepared through an alternative pathway have lower test scores on end-of-course State of Texas Assessment of Academic Readiness (Mansell, 2024). Using the two-way fixed effects difference-in-differences model in Equation 1, I find that switching to a

FDSW schedule does not have a significant effect on retaining teachers with standard certification[4] (results included in Appendix A, Table 5).

Another indication of teacher quality is experience. In a review of existing research on teacher effectiveness, Kini & Podolsky find that teaching experience is positively associated with student achievement gains throughout a teacher's career (2016). In Table 4 I look at the proportion of teachers retained by teacher experience. I find that switching to FDSW is associated with an almost 4.4 percentage point increase in the proportion of teachers retained with less than or equal to 5 years of experience. I also find that the proportion of teachers retained with more than 5 years of experience increases by only 2.2 percentage points (half that of teachers with less than 5 years of experience). Finally, in column 3 I find no significant effects on retention for teachers with greater than 9 years of experience. These findings suggest that the FDSW schedule might provide a greater incentive for newer teachers to stay compared to teachers with more experience in the profession.

5.3. Event Study

For reasons already discussed in the methodology section, I generate event study estimates, with the year before adoption is used as the reference period, for proportion of teachers retained (as well as other outcome variables) using the matched sample. I report point estimators associated with 3 leads and 4 lags and their associated 95% confidence intervals. These results presented in Figure 3 show a slightly noisier pre-trend for proportion of teachers retained; however, the estimates are not statistically distinguishable from zero at

[4] Standard certification requires a four-year bachelor's degree in education or related field, and includes a period of unpaid student teaching

the 95% confidence interval. I find that this supports the key identifying assumption about parallel trends in my model.

Table 4: Effects of Adopting a FDSW Schedule by Teacher Experience

	Prop. of Teachers with ≤ 5 years Experience (**1**)	**Prop. of Teachers with > 5 years Experience** (**2**)	**Prop. of Teachers with > 9 years Experience** (**3**)
FDSW Adoption	0.0438** (0.0186)	0.0221* (0.0114)	0.0153 (0.0108)
N	3,890	3,890	3,890
R^2	0.012	0.022	0.016
School fixed effects	Yes	Yes	Yes
Year effects	Yes	Yes	Yes

Notes: each column presents the results from a separate OLS regression. The dependent variable is equal to the proportion of teachers retained by categories like female, experience & certification. Standard errors, corrected for clustering at the school level are in parentheses.
**Statistically significant at 10% level; **significant at the 5% level; ***significant at the 1% level.*

Figure 3 also shows that generally, with increased duration of FDSW schedule in schools the proportion of teachers retained increases. In the first year of adoption (time = 0) the proportion of teachers retained is less than 0 but not significant. In the year following the switch to FDSW schedule, the proportion of teachers retained is positive but still not significant. Most notably, compared to the year before adoption, the proportion of teachers retained increases by 4.9 percentage points in the second year of adoption of FDSW schedule. This corroborates other research that suggests that the effects of FDSW adoption may take time to emerge (Thompson, 2021; Thompson & Ward, 2022). Figure 6 in the Appendix A also shows results for other outcome variables however none of the results are significant at the 95% confidence interval.

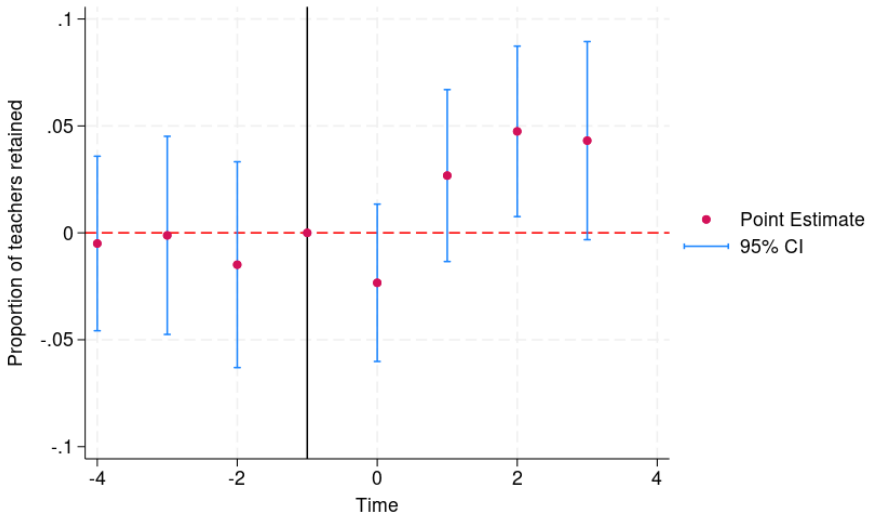

Figure 3: Event Study Results - Proportion of Teachers Retained[5]

5.4. Callaway & Sant'Anna Estimator

Finally, I deploy a robustness check to address a key assumption of the two-way fixed effects (TWFE) difference-in-differences specification with variation in treatment timing. As discussed in the methodology section, a growing body of literature shows that the TWFE model puts heavier weights on inappropriate comparison groups, which calls into question the interpretability of the average treatment effect (Morton, 2022; Khalid, 2024). Therefore, In Figure 4 I examine the effect of FDSW adoption on teacher retention by length of exposure using the estimator proposed by Callaway and Sant'Anna (CS). The CS estimator corrects the major issue in the TWFE by not including any post-treatment controls for treated schools and only comparing treated schools with either untreated or not-yet-treated schools (Khalid, 2024). Each point in Figure 4 represents an estimate of a year either before or after adoption. I report point estimators associated with 3 leads and 3 lags, and their

[5] The vertical bars depict the 95% confidence interval for the estimated effect for each year of event time. The point estimates are given along the Y-axis (in standard deviation units) and are relative to the year before four-day school week adoption (t =– 1).

associated 95% confidence intervals shown by the shaded area[6]. The proportion of teachers retained at school is significantly impacted by FDSW adoption 2 years after the schedule change is implemented. These results would suggest that my findings are consistent with an underlying causal relationship between adoption of FDSW and teacher retention.

In Appendix A I include Figure 7 which shows results for other outcome variables such as proportion of certified teachers and proportion of teachers with greater than 5 years of experience. I find that most of those results are not significant. However, interestingly when I use the CS estimator instead of TWFE, I find that the proportion of certified teachers is positive and significant in the second year of adoption of the FDSW schedule. All other results are not significant at the 95% confidence interval.

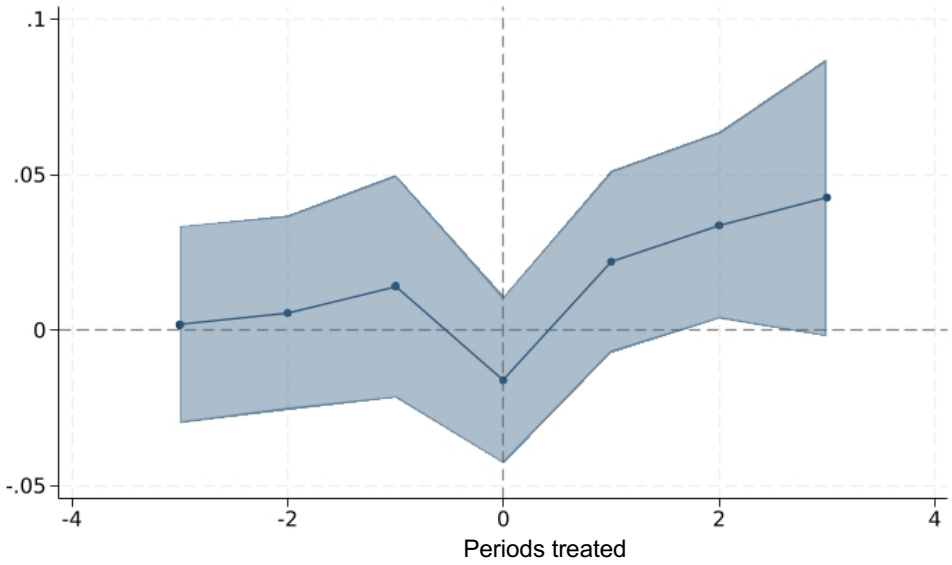

Figure 4: Event study results - using CS estimates[7]

[6] As Jonathan Roth notes, event study plots generated from CS estimates may show a kink or jump due to the asymmetric construction of pre-treatment and post-treatment coefficients, regardless of any treatment effect (2024). In order to combat this, I use "long-differences" for the pre-treatment coefficients as well as the post-treatment coefficients. In the STATA "`csdid`" package this can be done by using base_period = "`universal`" and "`long2`" (Roth, 2024).

[7] Point estimator associated with 3 leads and 3 lags and their associated 95% confidence intervals shown by the shaded area

6. Conclusion & Discussion

Superintendents frequently cite teacher retention and recruitment as a key justification for adopting a FDSW schedule[8]. The problem of teacher retention in Texas has been particularly exacerbated by the COVID-19 pandemic with a record number of teachers resigning since the pandemic (Adams, 2024). The findings from this study provide strong evidence that the adoption of a FDSW has a meaningful impact on teacher retention in Texas public schools. Schools that transition to a FDSW schedule see an increase in overall teacher retention by approximately 3 percentage points and a corresponding decrease in the proportion of new teachers by nearly the same margin. This suggests that the schedule change has a stabilizing effect on the teaching workforce, reducing turnover and the need for new hires. Additionally, the retention of female teachers increases by 2.5 percentage points, indicating that the flexibility afforded by a FDSW schedule may be particularly appealing to female educators, possibly due to improved work-life balance considerations.

When disaggregating retention by teacher experience and certification status, the results reveal a more nuanced impact. The FDSW schedule appears to be most beneficial for early-career teachers, with a 4.4 percentage point increase in retention for those with five or fewer years of experience. In contrast, the effect on more experienced teachers diminishes as tenure increases, with no significant impact observed for teachers with more than nine years of experience. These findings suggest that FDSW may serve as an effective policy lever for improving retention among newer teachers, a group that historically faces high attrition rates.

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[8] In October 2023 Oregon State University organized a two-day conference on four-day school week where I got the chance to hear from superintendents, practitioners and researchers

Interestingly, the results indicate that while the retention of teachers with standard certification does not significantly change with FDSW adoption in the TWFE model, robustness checks using the Callaway and Sant'Anna estimator reveal a significant positive effect on the proportion of certified teachers in the second year of adoption. This suggests that FDSW may eventually contribute to retaining more certified educators, although the impact takes time to manifest.

The event study estimates provide further evidence supporting the causal link between FDSW and teacher retention. While the immediate effect of FDSW adoption is negligible, the impact becomes more pronounced in the second year of implementation, with a 4.9 percentage point increase in teacher retention. This delayed effect aligns with prior research suggesting that the benefits of FDSW policies may take time to materialize (Thompson, 2021; Thompson & Ward, 2022).

The implications of these findings may be significant for school districts facing persistent teacher shortages. The results suggest that FDSW adoption may prove to be a viable strategy to improve teacher retention, particularly among early-career educators and female teachers. School administrators and policymakers should consider the potential benefits of FDSW as part of a broader strategy to enhance teacher job satisfaction and reduce turnover. The findings also highlight that the policy may not have uniform effects across all teacher demographics, necessitating targeted retention strategies for more experienced teachers.

With only 103 out of 1,200 Texas school districts using it, this FDSW schedule remains far from widespread adoption. While this study provides valuable insights, several avenues for future research remain. First, further investigation into the long-term effects of FDSW on teacher retention beyond the initial years of adoption is needed as these effects

may not be long-lasting[9]. Additionally, as more research on how FDSW affects teacher job satisfaction, instructional quality, and student achievement comes to light, it is also important to consider the role of contextual factors, such as district characteristics and community support, in shaping the effectiveness of FDSW policies. Finally, expanding the analysis to other states that have adopted FDSW schedules could provide comparative insights into the generalizability of these findings.

One limitation of this study is that it does not adequately account for the spillover effects of FDSW adoption. When one school district implements a FDSW schedule, it may influence teacher retention and hiring in surrounding districts. For example, neighboring districts that continue with a traditional five-day schedule may experience higher turnover rates as teachers seek the perceived benefits of a FDSW schedule elsewhere. Alternatively, FDSW adoption in one district could lead to an influx of teachers from surrounding areas, impacting the overall labor market for educators. Future research should investigate these spillover effects by examining cross-district teacher movement and retention patterns to better understand the broader impact of FDSW adoption.

Overall, this research contributes to the growing body of literature that is examining the effects of FDSW on various aspects of school operations, including teacher retention, instructional quality, student achievement, and student well-being. While much of the existing research has focused on student academic performance and financial savings associated with FDSW adoption, fewer studies have rigorously analyzed its impact on teacher workforce dynamics. By providing empirical evidence on the retention effects of

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[9] Research by Thompson on the impact of FDSW on student achievement shows that students may experience an initial decline in achievement when they switch schedules but then stabilize to pre-switch achievement levels over time (2019).

FDSW, this study fills a critical gap in understanding how schedule changes influence teacher stability, particularly for early-career and female educators. Furthermore, by employing robustness checks such as the Callaway and Sant'Anna estimator, this study strengthens the methodological rigor in evaluating the causal effects of FDSW policies. These findings offer valuable insights for policymakers and administrators seeking strategies to improve teacher retention while balancing the broader implications of FDSW adoption on educational outcomes.

Appendix A: Additional Plots and Tables

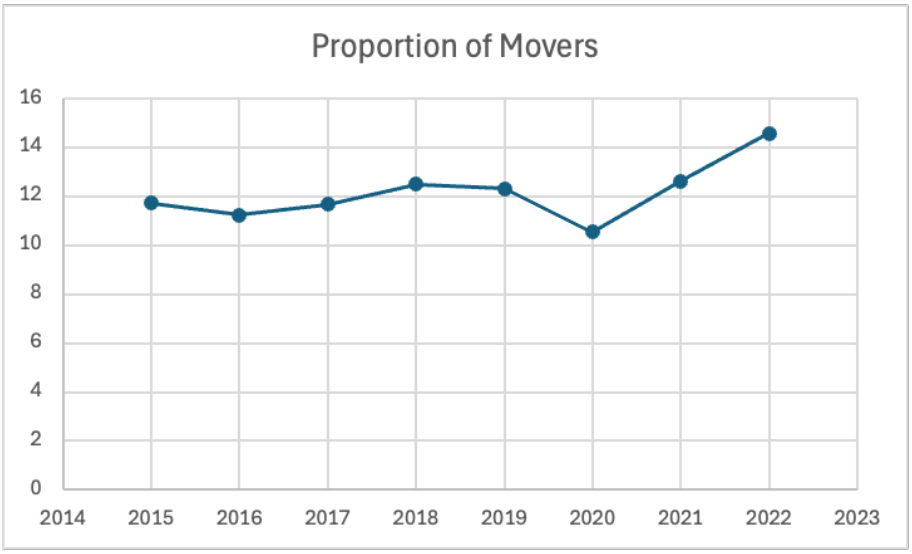

Figure 5: Proportion of Teachers that Move Between Schools by School Year

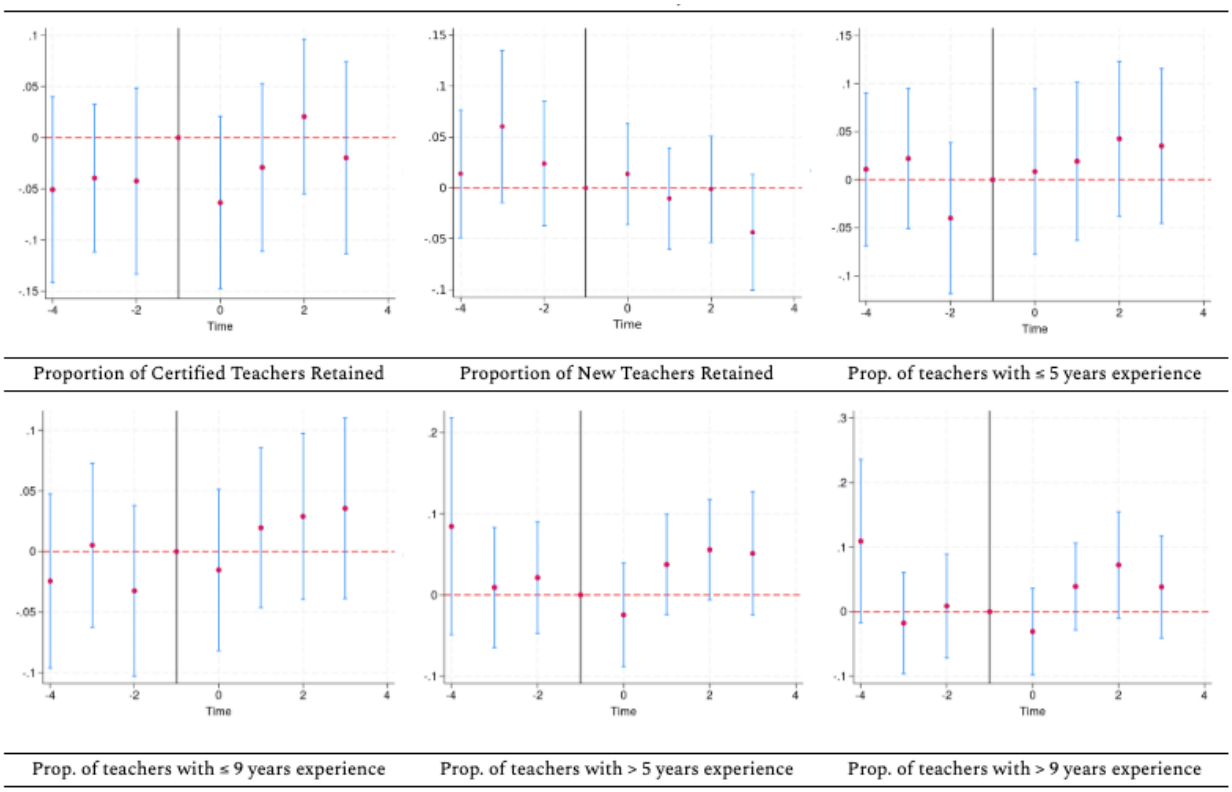

Figure 6: Additional Event-Study Results by Teacher Characteristics

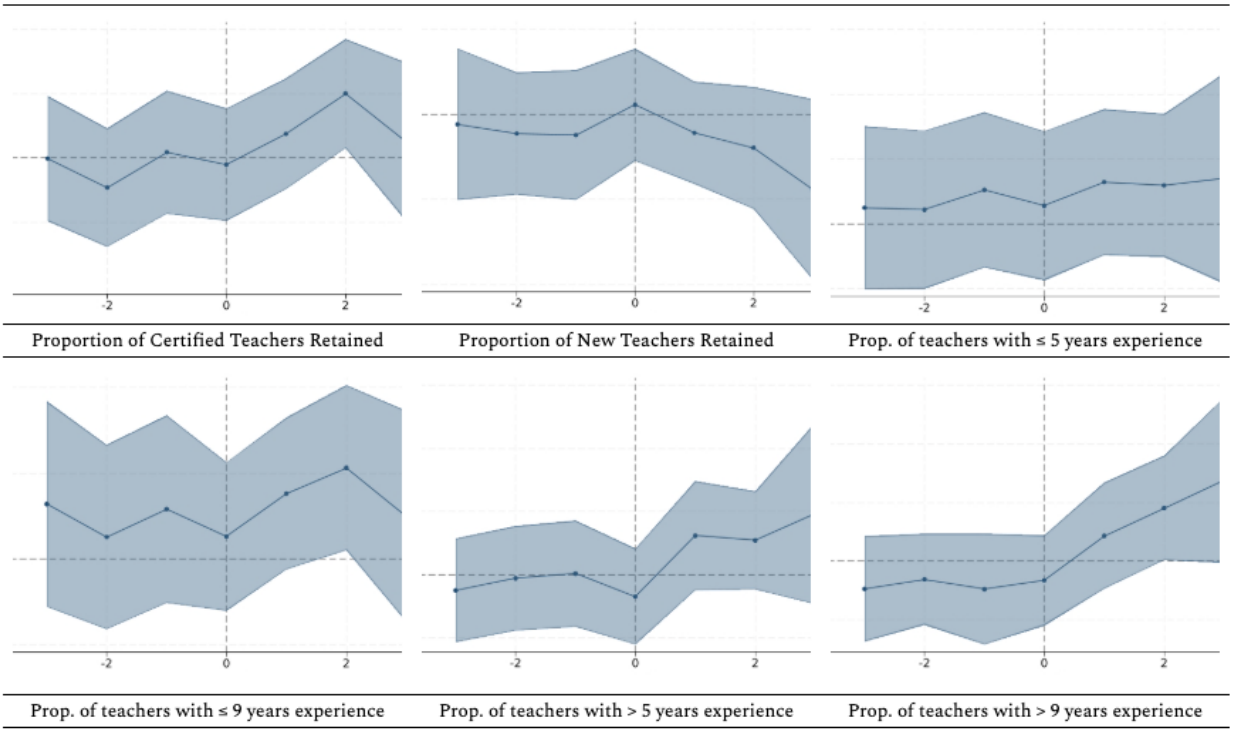

Figure 7: Additional Event Study Results Using Callaway & Sant'Anna Estimator

Table 5: Effects of Adopting a FDSW Schedule on Retention of Certified Teachers

	Prop. of Certified Teachers Retained
FDSW Adoption	0.0197
	(0.0145)
N	4,074
R^2	0.072
School fixed effects	Yes
Year effects	Yes

Notes: each column presents the results from a separate OLS regression. The dependent variable is equal to the proportion of teachers retained by categories like female, experience & certification. Standard errors, corrected for clustering at the school level are in parentheses.
**Statistically significant at 10% level; **significant at the 5% level; ***significant at the 1% level.*

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