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Teacher Retention and Quality in the Four-Day School Week

Andrew Camp
University of Arkansas

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TEACHER RETENTION AND QUALITY IN THE FOUR-DAY SCHOOL WEEK

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Andrew Camp†
University of Arkansas
ac103@uark.edu

ABSTRACT

The four-day school week is a school calendar that has become increasingly common following the COVID-19 pandemic. Proponents of the calendar often claim that offering teachers a regular 3-day weekend will help schools better retain existing teachers and recruit new teachers to their district without incurring additional costs due to higher salaries or other pecuniary benefits. However, there is scant empirical evidence assessing these claims. I use difference-in-differences and synthetic difference-in-differences models to assess the impact of four-day school week calendars on teacher retention and teacher quality in Arkansas. I find evidence that the calendar may help retain teachers who otherwise would have moved to another school and suggestive evidence that retention in non-adopting schools may be harmed by the four-day school week adoption in nearby districts. Results examining changes in teacher quality are inconclusive. These results have significant implications given the rapid growth in four-day school week calendars in recent years.

Keywords: Teacher Turnover, Teacher Retention, Teacher Quality, Four-Day School Week

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† Corresponding author.

Four-day school week (4DSW) calendars are a set of alternative school calendar arrangements with the defining characteristic of students being required to attend school for four days each week, although the length of those school days and opportunities available on the fifth "off" day vary from district to district. Districts adopt a 4DSW calendar for a host of reasons including perceived cost savings, reducing teacher and student absenteeism, and boosting teacher retention (Barnes & McKenzie, 2023a). While anecdotal reports of increased teacher retention are prevalent (Barnes & McKenzie, 2023a; Kilburn et al., 2021), there are few quantitative analyses that examine the effects of 4DSW calendar adoptions on teacher retention with one recent study indicating potential negative effects (Nowak et al., 2023).

Despite the relative lack of evidence concerning the effects of 4DSW calendars, these policies have gained significant momentum in recent years following the COVID-19 pandemic. In 2022, there were 900 districts operating on 4DSW calendars nationwide compared with 650 districts in 2019 (Peetz, 2024), representing 38% growth in just 3 years. The rapid adoption of 4DSW calendars has been especially prevalent in relatively more rural states such as Missouri, Arkansas, and Oklahoma. While motivations for adoption have not been fully documented, coverage of the 4DSW calendar in the popular media has focused on the potential for 4DSW calendar arrangements to offer increased flexibility to teachers and students. Furthermore, qualitative interviews of superintendents adopting a 4DSW calendar in Arkansas indicate that many educational leaders believe that the calendar will aid their district in better recruiting and retaining teachers (Barnes & McKenzie, 2023a).

Teachers are the largest school-based factor related to students' academic outcomes and have effects on students long after their time in schools (Chetty et al., 2014; Gershenson, 2021; Hanushek, 2010; Rivkin et al., 2005). Teacher turnover also has negative impacts on student achievement (Hanushek et al., 2016; Kraft et al., 2016) and hiring replacement teachers is costly for districts (Barnes et al., 2007; Milanowski & Odden, 2007). Examining the impacts of 4DSW calendar adoption on both teacher retention and quality is of particular importance following widespread disruptions in the Arkansas teacher labor market during the COVID-19 pandemic (Camp et al., 2023) and in other states (Bastian & Fuller, 2024; Goldhaber & Theobald, 2023) and the significant challenges that students face in recovering from the academic repercussions of the pandemic (Callen et al., 2023, 2024; Goldhaber et al., 2022; Hanushek, 2023).

Understanding the impacts of the 4DSW calendar on teacher retention and the distribution of teacher quality is thus of substantial policy relevance as policymakers attempt to confront the lasting impact of the pandemic and alternative calendars like the 4DSW expand across the country. This study contributes to the evidence base surrounding 4DSW calendars by estimating the impact of adopting a 4DSW calendar on teacher retention and new hire quality. To my knowledge, this is the first paper to examine teacher retention in 4DSW settings using statewide administrative data and the first to examine changes in teacher quality in 4DSW districts.

1 Literature Review

Despite teacher retention and recruitment being a major reason for 4DSW calendar adoption in recent years (Barnes & McKenzie, 2023a), little empirical research exists connecting the 4DSW calendar with teacher preferences, working conditions, or actual turnover. The exception, as noted above, studies teacher retention in a metropolitan Colorado district that adopted a 4DSW calendar in the 2018–19 school year (Nowak et al., 2023). Using a difference-in-differences identification strategy, this study finds negative effects on teacher retention for teachers with 5–15 years of experience through the 2019–20 school year. Interestingly, the negative effects on teacher retention found by Nowak et al. (2023) are at odds with recent surveys of educators' preferences for 4DSW calendars, which indicate that nearly two-thirds of teachers and principals would view the calendar as an attractive feature of a job offer (Peetz, 2024). This study adds to the literature on the 4DSW calendar's effects on teacher retention and recruitment using statewide administrative data that encompass multiple 4DSW districts, many of which are located in rural areas.

1.1 Factors Associated with Teacher Turnover

Teacher turnover has been found to have negative impacts on both students' academic achievement (Hanushek et al., 2016; Kraft et al., 2016) and school finances (Barnes et al., 2007; Milanowski & Odden, 2007). As a result, researchers have long sought to better understand factors contributing to teacher turnover and evaluate the impacts of policies designed to better retain teachers (see Nguyen et al., 2020 for a meta-analytic synthesis of this literature). The literature surrounding teacher turnover has primarily focused on the association between turnover and individual teacher characteristics or working conditions. However, some studies have also explored the interaction between turnover and labor market opportunities outside the education sector such as the unemployment rate (Corcoran et al., 2004; Goldhaber & Theobald, 2022).

Teacher turnover is often found to be associated with experience and age and typically follows a "U-shaped" pattern, with retention highest among mid-career and middle-aged teachers (Nguyen et al., 2020; Papay et al., 2017). In addition to normal patterns of early-career attrition and late-career retirement, often present in other careers, this "U-shaped" curve may partially be explained by the push and pull incentives created by typical teacher pension systems that significantly backload pension wealth accrual and create strong incentives to exit after retirement eligibility (Costrell & McGee, 2010; Costrell & Podgursky, 2009). Retention also appears to vary by teacher ethnicity, with Hispanic teachers less likely to be retained than white teachers (Nguyen et al., 2020; Redding & Baker, 2019), although this relationship may not hold when controlling for school characteristics in some settings (see Nguyen et al., 2020 for a meta-analytic synthesis of this literature).

School factors, such as student body demographics and leadership, have also been found to be correlated with teacher turnover. For example, schools serving higher proportions of economically disadvantaged or minoritized students have historically faced higher levels of teacher turnover (Nguyen et al., 2020; Papay et al., 2017), although this relationship appears to have weakened during the 2020–21 school year as a result of the COVID-19 pandemic (Camp et al., 2023). School leadership is also associated with teacher retention, as teachers working with principals who are viewed as effective are better retained in teaching roles (Grissom, 2011). Additionally, teacher satisfaction with school culture and their relationships with their colleagues appear to be positively correlated with intentions to remain in their positions (Johnson et al., 2012), and teachers working in more supportive environments appeared more likely to report sustained feelings of success in the initial months of the COVID-19 pandemic (Kraft et al., 2021).

External labor market conditions, such as the economy-wide unemployment rate, also correlate with teacher turnover and the quality of new teachers entering the profession. Corcoran et al. (2004) document a decline in academic achievement as measured by college entrance exam scores of new female teachers entering the profession as it became more socially acceptable for women to enter traditionally male-dominated professions such as doctor or lawyer. Similarly, Nagler et al. (2020) find that teachers who entered the profession during economic recessions are, on average, more effective at promoting student growth and have higher value-add scores than teachers who enter the profession during more prosperous times. Relatedly, Goldhaber and Theobald (2022) use 35 years of administrative data from Washington State and find that lower unemployment rates are correlated with higher levels of teacher turnover, suggesting that teachers may respond to external labor market opportunities.

1.2 Initiatives to Better Retain Teachers

The majority of initiatives designed to better retain teachers, or subsets of teachers, in the profession have centered on the role of financial incentives. For example, Clotfelter et al. (2008) found evidence that an annual bonus of $1,800 for teachers working in math, science, and special education was effective in reducing turnover rates among targeted teachers. More recent work from Theobald et al. (2023) found that a $10,000 bonus for special education teachers in Hawai'i was effective at lowering the vacancy rate for teachers in these positions, but that this lower rate was driven by general education teachers moving into special education roles and not increased retention among special education teachers. Efforts to provide effective teachers with merit pay, which are often intended to either improve teacher effectiveness through increased effort or bolster retention, have not been consistently effective at improving teacher retention (Jackson et al., 2014; Pham et al., 2021).

2 DATA

To examine the effects of 4DSW calendars on teacher retention and quality, I use individual-level job assignment data maintained by the Office for Education Policy at the University of Arkansas. These longitudinal data capture the universe of traditional public and charter school employees in Arkansas schools from the 2013–14 through 2023–24 school years. I identify teacher turnover and retention using these data. I define an individual working in an Arkansas public school as a teacher if they serve as the primary teacher of record for one or more courses in that district or have job codes indicating that they work as a special education teacher in an inclusion setting.

I then construct a categorical variable representing teachers' retention outcomes at the end of each school year based$t$ on job assignment data from the beginning of the subsequent school year $t+1$. If a teacher is observed working in the same district in years t and $t+1$ they are classified as a "Stayer." Teachers who work in a different district in year $t+1$ than they did in year t are classified as "Movers" and teachers who are not observed in the universe of Arkansas public school employees in year $t+1$ are classified as "Exiters." As my objective in this study is to identify the effects of a district's switch to a 4DSW on retention in that district, individuals may still be classified as Stayers or Movers even if they no longer work as a teacher in year $t+1$ so long as they are employed by an Arkansas public school.

To examine changes in the distribution of teacher quality resulting from a move to a 4DSW calendar, I combine these job-assignment data with information on each teachers' years of experience, educational attainment, and value-added scores from up to five years.[1] Two of these variables, experience and value-added scores, are commonly accepted as meaningful proxies for teacher quality (Chetty et al., 2014; Wiswall, 2013). While

there is more mixed evidence supporting the relationship between holding an advanced degree (i.e., masters or higher) and classroom effectiveness (Buddin & Zamarro, 2009; Gershenson, 2021; Rockoff et al., 2011), interviews of superintendents leading 4DSW adopting

[1] Value-added scores are for the 2017–18, 2018–19, 2020–21, 2021–22, and 2022–23 school years. Scores for teachers with multiple observations (i.e., teaching more than one subject or scores for multiple years) are constructed as a weighted average, with weights capturing the number of students contributing to each score. Results, available upon request, are quantitatively similar when estimated separately by subject instead of combined.

districts in Arkansas indicated that adopting increased the proportion of new hires holding an advanced degree (Barnes & McKenzie, 2023a), which administrators incorrectly believe is an unambiguous signal of teacher quality. For this reason, I also explore the effect of 4DSW calendar adoption on the probability that new hires to the district hold advanced degrees.

I identify 4DSW calendar adoption for all schools in Arkansas using calendar status reports from the Arkansas Department of Education's data center.[2] These data allow me to not only identify when a school district adopts a 4DSW calendar, but also to verify that no school in the three years before when my teacher-level panel data began was operated using a 4DSW calendar. This helps ensure that pre-treatment trends are not the result of calendar changes before the start of the observed data. While two charter schools adopted a 4DSW calendar in the 2017-18 school year, these schools are unique in that they focus on providing educational opportunities to at-risk students or individuals over the age of 19. Due to these stark differences in mission and operations, which also likely influence the pool of prospective teachers who would work in these schools, I exclude any observations from these two charter schools across all years. With these sample restrictions in place, the first 4DSW calendar adoption in my panel occurs in the 2019–20 school year. Figure 11 displays the growth of 4DSW calendar adoptions since the 2019–20 school year.

<< *Figure 1 – Growth of Four-Day School Week Calendar Use in Arkansas* >>

In addition to these individual-level and calendar adoption data, I use data from the Arkansas Department of Education data center to construct variables representing a school's grade level (i.e., elementary, middle, or secondary), student enrollment, socio-economic status of its

[2] https://adedata.arkansas.gov/statewide/ReportList/Schools/SchoolStatusFourDay.aspx

students, and average teacher years of experience, which are included in some models. Lastly, I obtain school latitude and longitude coordinates from the Common Core of Data at the National Center for Education Statistics, which will later be used in my empirical approach to account for spatial spillovers in estimating the effect of adopting a 4DSW. As location data for the 2023–24 school year is not available in the Common Core of Data, I impute locations for schools based on where they were located during the 2022–23 school year instead. For 23 schools that opened or moved in the 2023–24 school year, I obtained location data using Google Maps.

<< Table 1 – Characteristics of 4DSW, Nearby, and 5DSW Schools >>

Table 1 displays characteristics of schools that operated on a 4DSW calendar, schools nearby (within 31km) 4DSW schools, and schools on a 5DSW calendar during the 2021–22 school year. While spillover distances will be formally defined later, this rough approximation is useful for highlighting similarities and differences between schools in each category. In general, 4DSW schools tend to have lower enrollments and employ fewer teachers than nearby or 5DSW schools. Consistent with prior research (Anglum & Park, 2021), I also find that these schools are far more likely to be in rural settings than nearby or 5DSW schools, with just 1.3% of 4DSW schools located in an urban setting. Additionally, I find that schools operating on a 4DSW calendar are more likely to teach students who qualify for free- or reduced-priced lunch and that they enroll a higher proportion of white students than either nearby or 5DSW schools. Finally, 4DSW schools are less likely than either nearby or 5DSW schools to be charter schools. These differences present some challenges in determining an appropriate counterfactual group, which will be discussed later.

3 Analytic Approach

Identifying and estimating the causal impact of 4DSW adoption on teacher retention and teacher quality presents several challenges. While the staggered adoption of a 4DSW calendar by districts lends itself to identification using a difference-in-differences approach, after methods are adapted to take into account the staggered design (Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021), the degree to which teacher labor markets are often highly localized introduces additional threats to identification. In particular, potential spillover effects introduce challenges for the identification of appropriate comparison districts and could bias estimates if not taken into account. Additionally, adopting districts are often different in terms of observable and potentially unobserved characteristics than non-adopting districts, adding to the challenge of finding appropriate comparison districts due to the potential for selection bias.

Adding to these challenges, the adoption of a 4DSW calendar itself is non-random and introduces potential selection. The remainder of this section explains my approach to estimating the causal effect of 4DSW calendar adoption that addresses these identification and estimation issues.

3.1 Addressing Spatial Spillovers

Spatial spillovers arise when the proximity of treated units to control units might impact the behavior of either the treated or control unit. In the context of 4DSW calendar adoption, it is reasonable to expect that individuals in non-adopting districts who value the 4DSW calendar arrangement will respond to adoption by seeking opportunities to leave their current district and gain employment in the adopting district (i.e., spillover effects on control units). Similarly, teachers in adopting districts who do not prefer working under the 4DSW calendar may be enticed by the proximity of 5DSW districts to leave their current district for working conditions that they favor (i.e., spillover effects on treated units). In addition to the effect that a calendar change might have on an individual's willingness to continue teaching in a district that adopts a 4DSW calendar, spillover effects on control units are interesting quantities to estimate in that they represent effects on nearby districts resulting from competition in the teacher labor market.

Butts (2021) formalizes these spillovers in the context of difference-in-differences models and shows that the estimated causal effect in the standard difference-in-differences model estimated via two-way fixed effects (TWFE) can be biased by both spillovers simultaneously, as shown in (1).

$$\begin{gathered} Y_i = \lambda_i + \gamma_t + \beta_{TWFE} D_{it} + e_i \\ \beta_{DiD} = \tau_{\text{direct effect}} + \tau_{\text{spillover on treated}} - \tau_{\text{spillover on control}} \end{gathered} \tag{1}$$

In the context of 4DSW calendar adoption, the effect on treated units (i.e., the sum of the direct effect and spillover effects on the treated) and the effect on control units are both distinct and policy-relevant quantities of interest that should be identified separately. Additionally, failing to distinguish between these two may lead to inaccurate conclusions about the effect of 4DSW adoption. For example, if teachers generally view a 4DSW as a preferable working condition then we might expect the effects on retention for treated units to be positive and the effects on retention for control units to be negative. In this scenario, we would overestimate the effect of a 4DSW calendar on teacher retention as the counterfactual trend for teacher retention would be biased downward.

Intuitively, these spillover effects can be thought of as a contamination of the control or comparison group. Butts (2021) proposes that so long as we are willing to assume that spillover effects attenuate with distance and that units at some distance are not subject to spillovers, we can remove the bias caused by spillovers on control units with a minor modification to the difference-in-differences model represented by (1). Specifically, including either a single indicator for units that may be subject to spillovers or a set of indicators for units at varying distances (i.e., concentric rings) that may be subject to spillover effects with differing intensities results in valid comparisons between treated units and "true control" units. The latter approach has the added advantage of estimating the effect of spillovers on control units as captured by the estimated parameter for their respective indicator variable.

<< Figure 2 – Density of Distances Between Old and New Districts for Movers

I identify spillover distance thresholds using a data-driven approach that leverages observations between the 2013–14 and 2018–19 school years, during which time there were effectively no 4DSW schools in the state. I begin by identifying all instances of teachers moving to another district. In total, I identified 12,629 such instances. For each move, I calculate the geodesic, "as the crow flies," distance between the school they moved from and the school they moved to. The distribution of these movements, in kilometers, is displayed in Figure 2. Butts (2021) notes that as treatment effects on spillover units are expected to attenuate with distance, the use of multiple concentric rings may be appropriate to estimate these separate treatment effects. Using these observed patterns of movement pre-4DSW adoption, I identify distances corresponding to each decile of teacher movements to model heterogeneity in spillover effects by distance. Subsequently, for the 2019–20 through 2023–24 school years, when public schools in Arkansas started adopting 4DSW calendars, I identify schools falling within these distances from a school operating on a 4DSW calendar. This process for schools falling in the first through fifth decile can be visualized in Figure 3.

<< Figure 3 – Growth of 4DSW Districts and Spillovers >>

3.2 Staggered Treatment in Difference-in-Differences Settings

While difference-in-differences identification strategies with staggered treatment have long been used in applied research, recent developments in the econometrics literature indicate that these models may produce estimates that are biased towards zero in the presence of treatment effect heterogeneity (Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021; Sun & Abraham, 2021). In the case of 4DSW calendar adoption, differences in implementation or dynamic treatment effects may result in such heterogeneity. To avoid these estimation issues, I use the two-stage difference-in-differences approach developed by Gardner (2022). This approach differs from traditional estimation via two-way fixed effects by subtracting group and time fixed effects, which are estimated using untreated units in the first stage, from the observed outcomes before estimating treatment effects. Following this approach, I obtain my main results using the two-stage difference-in-differences estimator as specified by (2).

$$Y_{ist} = \lambda_{school} + \gamma_{time} + \tau_{\text{direct effect}} D_{ist+1} + \sum_{j=1}^{5} \tau_{\text{spillover j}} G_{ist+1} + e_{st} \qquad (2)$$

Here, Y_{ist} is a binary variable indicating different retention outcomes (i.e., Stayers, Movers, or Exiters) at the end of year t and entering year $t + 1$. I define treatment and spillover status depending on school calendars used in year $t + 1$.[3] Structuring the data in this way reflects the decision process that a teacher would make in deciding whether or not to remain in the same school given knowledge of a change in calendar status in this district or in a nearby district. Thus, λ_{school} and γ_{time} are school and year fixed effects, D_{ist} is a variable taking a value of 1 if individual i works in school s that will operate using a 4DSW calendar in year $t + 1$ and 0 otherwise, and G_{ist+1} are a set of indicators that take a value of 1 if individual i works in school s that will be in a spillover distance of a 4DSW calendar school in year $t + 1$ and 0 otherwise.

Standard errors are clustered at the school-by-year level to account for school-level shocks such as administrator turnover that may impact the probability of retention for all teachers in a given school and year. I do not include covariates in this specification as relevant covariates (e.g., enrollment or student demographics) are time-varying which introduces requirements for additional assumptions that are likely not satisfied in the case of 4DSW adoption (Sant'Anna & Zhao, 2020).

3.3 Choice of Spillover Thresholds

Specifying a regression such as (2) requires researchers to choose thresholds to classify schools as spillovers. While my choice of the thresholds themselves is based upon observed

[3] Media coverage and qualitative evidence indicate that most school districts announce changes to a 4DSW calendar before the end of the preceding school year (i.e., before the end of year t), however as teacher retention outcomes are defined based on where and if teachers are observed in years t and $t + 1$, a change announced over the course of the summer would still allow teachers to make retention decisions based on 4DSW calendar adoption and, so, these would be accounted for in my measure of turnover.

patterns of teacher movements before any districts adopted a 4DSW calendar, as described above, a concern might be that the set of indicators included in specification (2) results in point estimates or standard errors that are spurious. This concern is analogous to the "garden of forking paths" as described by Gelman and Loken (2013) which notes that researcher decisions at various stages of an empirical project may produce findings that reflect only a narrow subset of possible valid comparisons with a given research question, methods, and data. The concern that Gelman and Loken (2013) raise is that the results presented in a paper may be caused by a very particular set of researcher decisions, often made with no ill intent, that produce estimates which are qualitatively different from other reasonable ways to approach this same issue.

In the context of this paper, a large portion of this "garden" is composed of different ways to specify spatial spillovers. Each additional spillover indicator changes the reference group for treatment effects and, so, there are many possible comparisons that could be made with different combinations of indicators. Given that the choice of spillover indicators to include in model specifications is weakly informed by my assumption that spillover effects attenuate with distances, I conduct specification curve analyses (Simonsohn et al., 2020) which estimate results using all possible combinations of spillover indicators. These analyses result in 511 separate regressions for each outcome, with point estimates and confidence intervals presented visually. If the results of my primary analysis were the result of a particular subset of decisions or peculiarities of the data, then they would be substantially different from other alternative specifications.

3.4 Comparability with Other Schools

As previously mentioned, 4DSW-adopting schools differ from many other schools in the state in terms of observed, and presumably unobserved, traits. These differences justifiably raise concerns about the comparability of any 4DSW adopting school with schools on a 5DSW calendar. To obtain a more robust counterfactual for teacher retention in 4DSW schools, I conduct a secondary analysis using a synthetic difference-in-differences estimator (Arkhangelsky et al., 2021).

This approach begins by aggregating teacher retention to the school level, thus converting the binary indicators for Stayers, Movers, and Exiters into continuous indicators for the proportion of teachers in school s and year t that realize each outcome entering year $t+1$. Next, I construct a synthetic control of comparison schools as a weighted average of 5DSW schools to match pre-treatment trends on school-level teachers' labor transition patterns over time. Notably, this approach differs from the matching estimators of synthetic control methods in that the objective in the context of difference-in-differences methods is to match the pre-treatment trend and not the exact outcome level of treated units. To address the potential for spillover effects, I withhold spillover schools at varying distances, mirroring the specification-curve-style approach described above, from the pool of potential comparison schools to be used to build the synthetic control.

This approach has the added advantage of being able to include time-varying covariates to improve the precision of estimates, as these covariates can be included in a regression adjustment before constructing a synthetic comparison unit. Therefore, I include indicators for different grade levels, the natural log of student enrollment, the percent of students in the school who qualify for free- or reduced-price lunch, and the average years of experience for teachers in that school. This process results in separate difference-in-differences style comparisons for each cohort of adopting schools, as shown in Figure 4. I aggregate these separate estimates into an overall ATT as the average of each effect weighed by the share of treated schools[4] in each cohort.

[4] While other weighting schemes (e.g., by share of teachers treated in each cohort) would be possible, the outcome in this analysis is a school-level variable (retention). Future research will examine if alternative weighting schemes impact results.

<< Figure 4 – Synthetic Difference-in-Differences Comparisons >>

3.5 Estimating Effects on New Hire Quality

A common belief reported by administrators and advocates of adopting a 4DSW calendar is that the arrangement will help the school attract higher-quality teachers. To examine this claim, I estimate difference-in-differences models like (2) but restrict the analysis to the pool of teachers who either move schools or are new to the Arkansas teacher workforce each year $t + 1$. This allows me to study to what extent the introduction of a 4DSW calendar helps increase the quality of new teachers attracted to the school. Outcomes in these regressions include proxies for teacher quality (i.e., value-added scores and years of experience) as well as a binary indicator for a teacher holding an advanced degree.

4 RESULTS

4.1 Effects on Teacher Retention

The estimated effects of 4DSW calendar adoption on the probability of a teacher remaining in the same district, moving districts, and exiting the Arkansas education sector workforce entirely are displayed in Table 1. Results for models that include spillover effects are qualitatively similar to results from models that do not model these spillover effects. I find consistent evidence that adopting a 4DSW calendar has a negative impact on the likelihood that a teacher will move districts, which appears to correspond more with an increase in retention in the district than an increase in exits from the education sector. All else equal, 4DSW calendar adoption reduces the likelihood of a teacher moving districts by 1.4 percentage points. This estimate is significant at the

95% confidence level. Relative to the statewide average proportion of teachers who move districts each year (approximately 5%), this is a relatively large effect.

While the estimated effects of 4DSW adoption on the likelihood of a teacher staying in the same school or exiting the Arkansas teacher workforce are not statistically significant at conventional confidence levels, point estimates for each are both positive. The point estimates for Stayers and Exiters sum to be nearly identical in magnitude to the point estimate for Movers. This implies that the reduced probability of teachers moving schools, which is significant, is caused by teachers either remaining in the same school or exiting the Arkansas teacher workforce entirely. Future research should investigate potential heterogeneity in these changes.

<< *Table 2 – Effect of 4DSW Calendars on Teacher Retention* >>

While estimated spillover effects on control units are not statistically significant at conventional confidence levels, there do appear to be meaningful patterns in magnitude and direction of point estimates. For all three potential labor outcomes, the point estimates associated with the nearest spillover category (e.g., schools located 0 to 11 kilometers from a 4DSW school) are the largest in magnitude. These point estimates attenuate towards zero as spillover categories move further away from 4DSW schools; a pattern that would be expected in the presence of spatial spillovers. Additionally, the point estimates for the probability that a teacher remains in a spillover district (i.e., Stayer) are negative, while the probability that a teacher moves districts is positive for two out of three estimates. Although imprecisely estimated, these patterns are consistent with teachers in spillover schools moving to 4DSW schools.

<< Figure 5 – Specification Curve Analysis for Movers >>

I conduct specification curve analyses to ensure that researcher-driven choice of spillover categories does not drive these results. The results of the specification curve analysis for the effect of 4DSW adoption on the probability of teachers moving districts are shown in Figure 5.[5] The top portion of Figure 5 displays the point estimate and 95% confidence interval for a wide range of model specifications, as described previously. Blue point estimates are significant at the 95% or greater confidence level, while red point estimates are not. The bottom portion of this figure indicates which combination of spillover indicators is included in that model. For example, the far left point estimate includes only an indicator for spillovers between 0 and 11km from a 4DSW school, while the far right contains indicators for all seven thresholds included in this figure (e.g., up to 71km). In Figure 5, I find consistent evidence that the point estimates displayed in Table 2 are not driven by my choice of spillover categories. Across many combinations of spillover indicators, I find a statistically significant and negative effect of 4DSW adoption on the probability of a teacher moving districts that cluster around the estimated effect of -1.4 percentage points reported in Table 2.

Combinations that produce estimates that are not significant at the 95% or greater confidence level include spillovers that are between 51 and 71km away from adopting districts, a distance greater than 70% of between-district teacher movements, and so are not representative of typical teacher decisions. The imprecision of these estimates is therefore unsurprising as it substantially reduces the size of the "true control" comparison group; however, the point estimates are in line with those from specifications using more narrow bands of spillovers.

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[5] Specification curve analyses (available upon request) for Stayers and Exiters show consistent null results.

4.2 Results from Synthetic Difference-in-Differences

As an alternative approach to estimating treatment effects, I estimate a series of synthetic difference-in-differences. Figure 6 reports the effect of 4DSW adoption on the school-level average rate of Stayers, Movers, and Exiters across a variety of spillover conditions. The first row in Figure 6 represents a scenario in which no spillovers are included in the synthetic difference-in-differences model and, so, mirrors the results presented in columns 1–3 of Table 2. Each subsequent row of Figure 6 excludes spillovers at an expanding radius from 4DSW schools from the construction of the synthetic control. For example, the final row of Figure 6 excludes any schools that are within 51km of a 4DSW school when constructing the synthetic comparison.

<< *Figure 6 – Synthetic DiD Estimates of 4DSW Effects on Treated Schools* >>

In contrast with results in Table 2 and Figure 5, I find less consistent evidence that 4DSW adoption decreases the rate of Movers as only point estimates accounting for no spillovers and for spillover schools within 11km are statistically significant at conventional confidence levels. However, the sign for point estimates on Stayers and Movers are in line with the results presented in Table 2.

Figure 7 adapts the synthetic difference-in-differences approach to attempt to estimate the effect of 4DSW adoption on nearby 5DSW schools. Here, each row represents a comparison between schools within a particular spillover range (e.g., between 0 and 11km of 4DSW schools) and a synthetic control school which is created using schools that are more than 71km away from any 4DSW school and are thus less likely to be affected by 4DSW calendar adoptions. Interestingly, I find evidence that 4DSW adoption has negative effects on teacher retention in

5DSW schools that are within 11km of 4DSW schools and positive effects on the proportion of teachers who move districts. Again, this evidence is consistent with labor market movements that we would expect if teachers sought out employment in 4DSW schools.

<< Figure 7 – Synthetic DiD Estimates of 4DSW Effects on Spillover Schools >>

4.3 Effects on Teacher Quality

Results for the effect of 4DSW adoption on the quality of new hires are presented in Table 3. While I do not find meaningful patterns for differences in terms of new hire experience, I do find evidence that new hires to 4DSW schools may be more likely to hold an advanced degree and suggestive evidence that new hires in 4DSW schools may have higher average value-add than non-adopting schools.

All else equal, new hires in 4DSW schools are 5.9 percentage points more likely to hold an advanced degree (master's degree or higher) than new hires in schools at least 25km from a 4DSW school. This estimate is significant at the 95% confidence level. Interestingly, I also find evidence that new hires to spillover schools located 12-17km from a 4DSW-adopting school are similarly more likely to hold an advanced degree.

<< Table 3 – Effect of 4DSW Calendars on New Hire Quality >>

When not considering spillovers, as in column 5 of Table 3, the estimated effects of 4DSW adoption on new hire value-added are positive but not statistically significant at conventional confidence levels. However, when accounting for spatial spillovers, this estimate grows in magnitude and gains significance. All else equal, new hires at 4DSW schools have value-added scores that are 13.7% of a standard deviation higher than in schools located at least 25km from a 4DSW school. This estimate is statistically significant at the 90% confidence level. The difference in point estimates with and without spillovers appears to be driven by new hires in spillover schools located between zero and 11km from a 4DSW school, as the estimated effect for these schools is somewhat large and negative, though not statistically significant at traditional confidence levels.

4.4 Discussion & Conclusions

Districts are increasingly changing to a 4DSW calendar to, among other objectives, better retain and recruit teachers. Especially given the significant needs of students following the COVID-19 pandemic, such initiatives targeting the teacher workforce have grown in popularity. However, there is scant evidence of the extent to which adopting a 4DSW calendar is successful at improving teacher retention or boosting the quality of new hires. My results contribute to the literature surrounding 4DSW calendars using data from Arkansas, a state that has experienced significant growth in 4DSW adoption in recent years.

Using both difference-in-differences and synthetic difference-in-differences models, I find evidence that adopting a 4DSW calendar improves teacher retention by reducing the likelihood that teachers move to other districts. The estimated effect, a decrease in the probability of being a Mover of approximately 1.4 percentage points, is large relative to the share of teachers who normally move districts each year. Given that approximately 5% of Arkansan teachers move districts each year, this implies a 28% decrease in the proportion of teachers from 4DSW schools who move to other districts each year. These estimates are robust to the inclusion of spatial spillovers. I additionally find suggestive evidence that 4DSW adoption has negative impacts on retention in nearby schools, which may be indicative of teachers expressing a preference for working in a 4DSW school.

While these results are informative for investigating the short-term impacts of 4DSW calendar adoption on teacher retention and recruitment, future research should investigate what long-term equlibria might look like in a policy environment that is permissive of districts adopting the calendar. Given that the largest predictor of 4DSW adoption is proximity to a district already on a 4DSW calendar (Anglum & Park, 2021), the calendar may proliferate throughout a local labor market until each individual district experiences no advantages in terms of teacher retention or recruitment. Alternatively, the longer-term equilibrium may resemble scattered adoption in communities that are amenable to 4DSW calendars, with teachers having already sorted between districts according to individual preferences. In this scenario, I would not expect to find meaningful differences in teacher retention, as teachers' preferences would already match their district’s calendars. However, there could still be differences in the recruitment of newly credentialed teachers if teacher quality correlated with a preference for the school calendar.

While I do find evidence that new hires in 4DSW districts are more likely to hold an advanced degree than in 5DSW districts, it is important to note that educational attainment is a poor proxy for teacher quality. I additionally find suggestive evidence that 4DSW schools might be able to attract teachers with higher average value-add scores after 4DSW adoption. However, the mechanisms behind these effects are unclear. One possible explanation is that schools adopting a 4DSW calendar receive more applications for open teaching positions, resulting in administrators in these schools having a wider pool to recruit from. Future research should investigate the extent to which 4DSW-adopting districts are better able to fill open teaching positions or otherwise are able to recruit from a larger pool of applicants.

Ultimately, decisions about 4DSW calendar adoption should consider effects on student outcomes above effects on teacher retention. If a 4DSW calendar is able to better retain teachers at the expense of student learning and engagement, policymakers should make efforts to dissuade districts from adopting the calendar. Here, the research is inconclusive but indicates that 4DSW calendars may have negative (Morton et al., 2024) or at best null impacts (Barnes & McKenzie, 2023b; Morton, 2021) on students' academic outcomes. Additionally, research finds that 4DSW calendar adoption has no impact on student attendance but was successful at reducing bullying and fighting incidence by more than 20% (Morton, 2023). Taken together, my results and the existing literature on 4DSW calendars should be cause for concern to those considering adoption. The marginal benefits in terms of teacher retention and cost reduction do not appear to benefit students. Districts choosing to adopt the calendar should establish clear plans for monitoring student outcomes and revert to a 5DSW calendar if there are signs of negative impacts. Policymakers may wish to make these plans a requirement before approving 4DSW adoptions.

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6 FIGURES

Figure 1 – Growth of Four-Day School Week Calendar Use in Arkansas

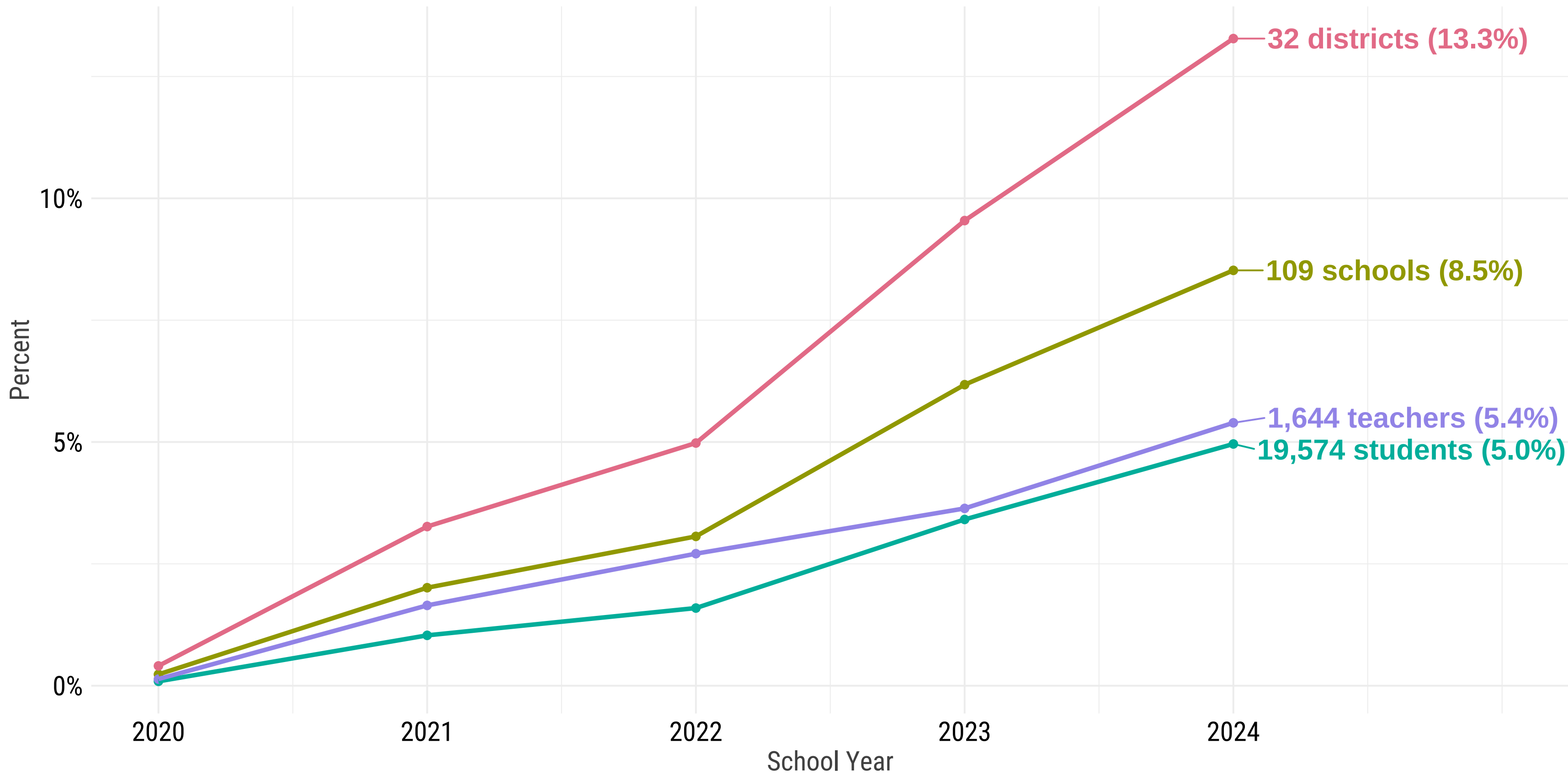


Figure 2 – Density of Distances Between Old and New Districts for Movers

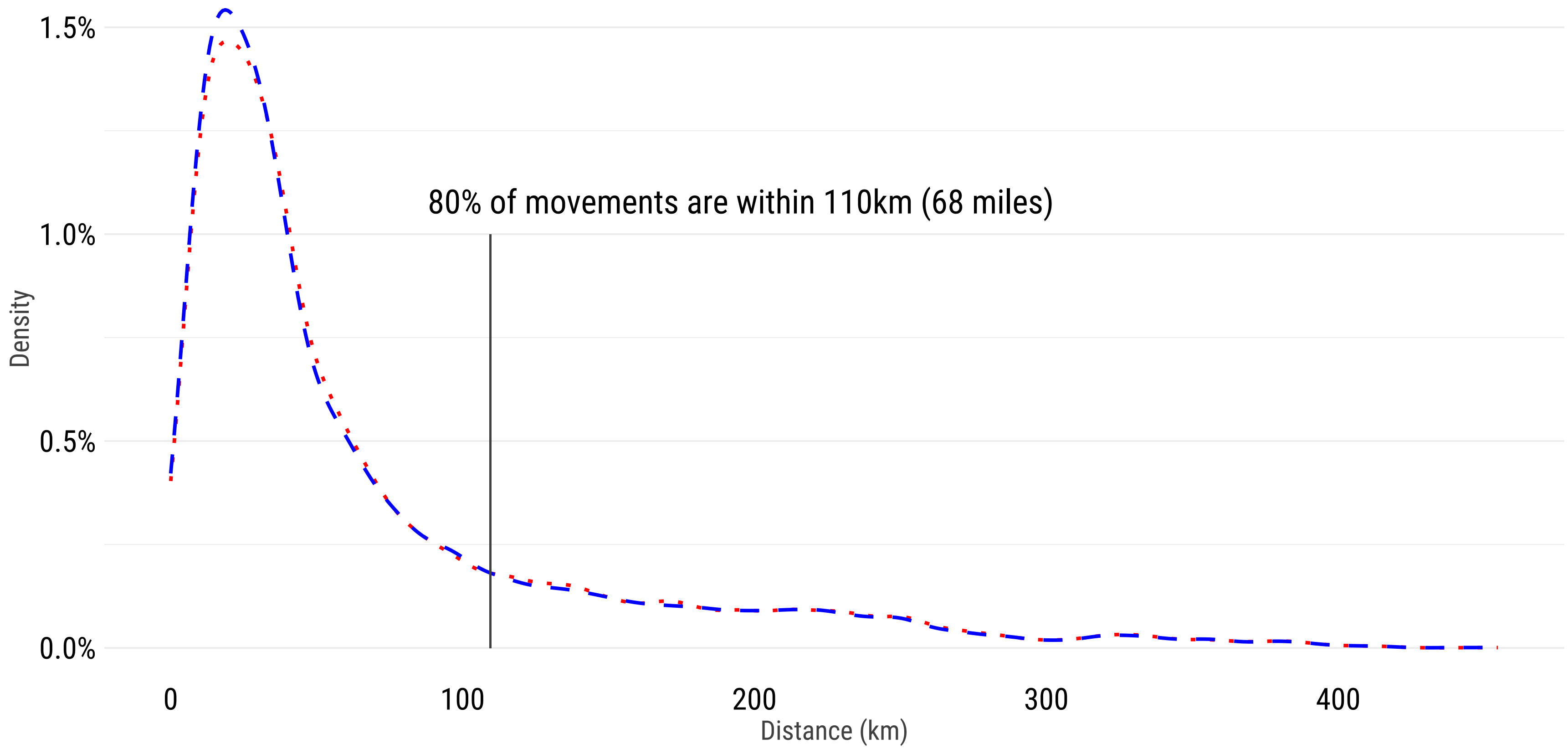


Figure 3 – Growth of 4DSW Districts and Spillovers

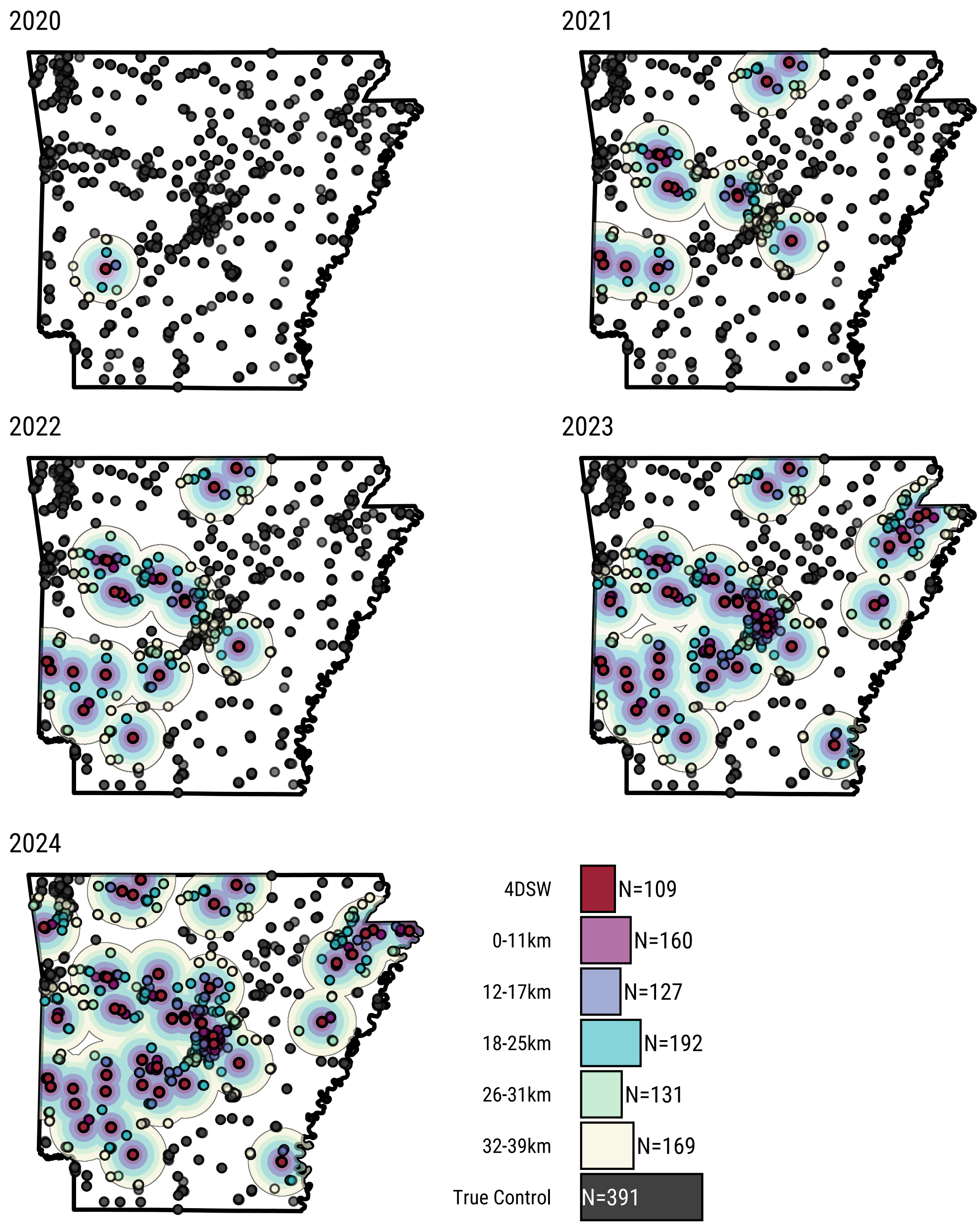


Figure 4 – Synthetic Difference-in-Differences Comparisons

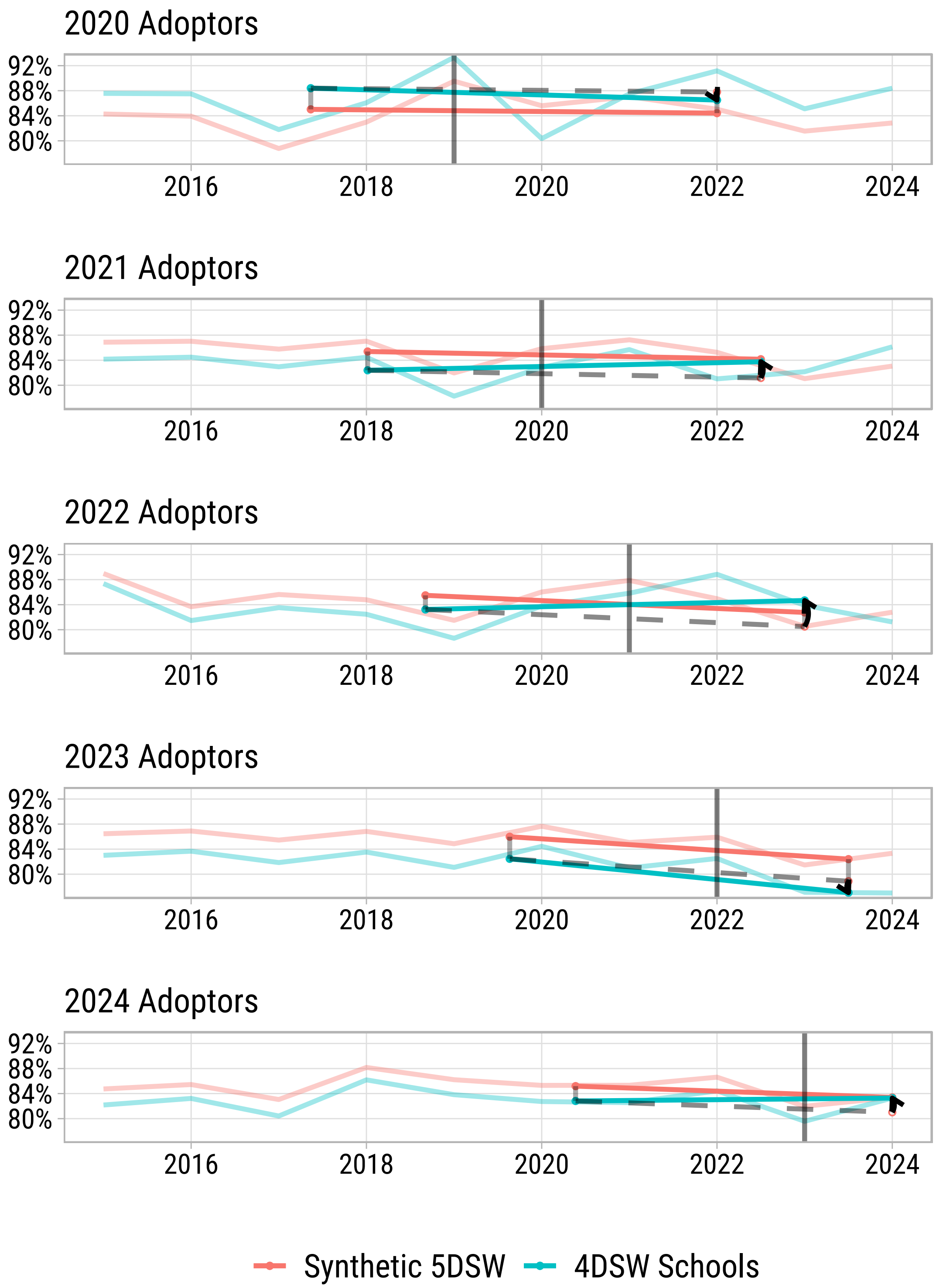


Figure 5 – Specification Curve Analysis for Movers

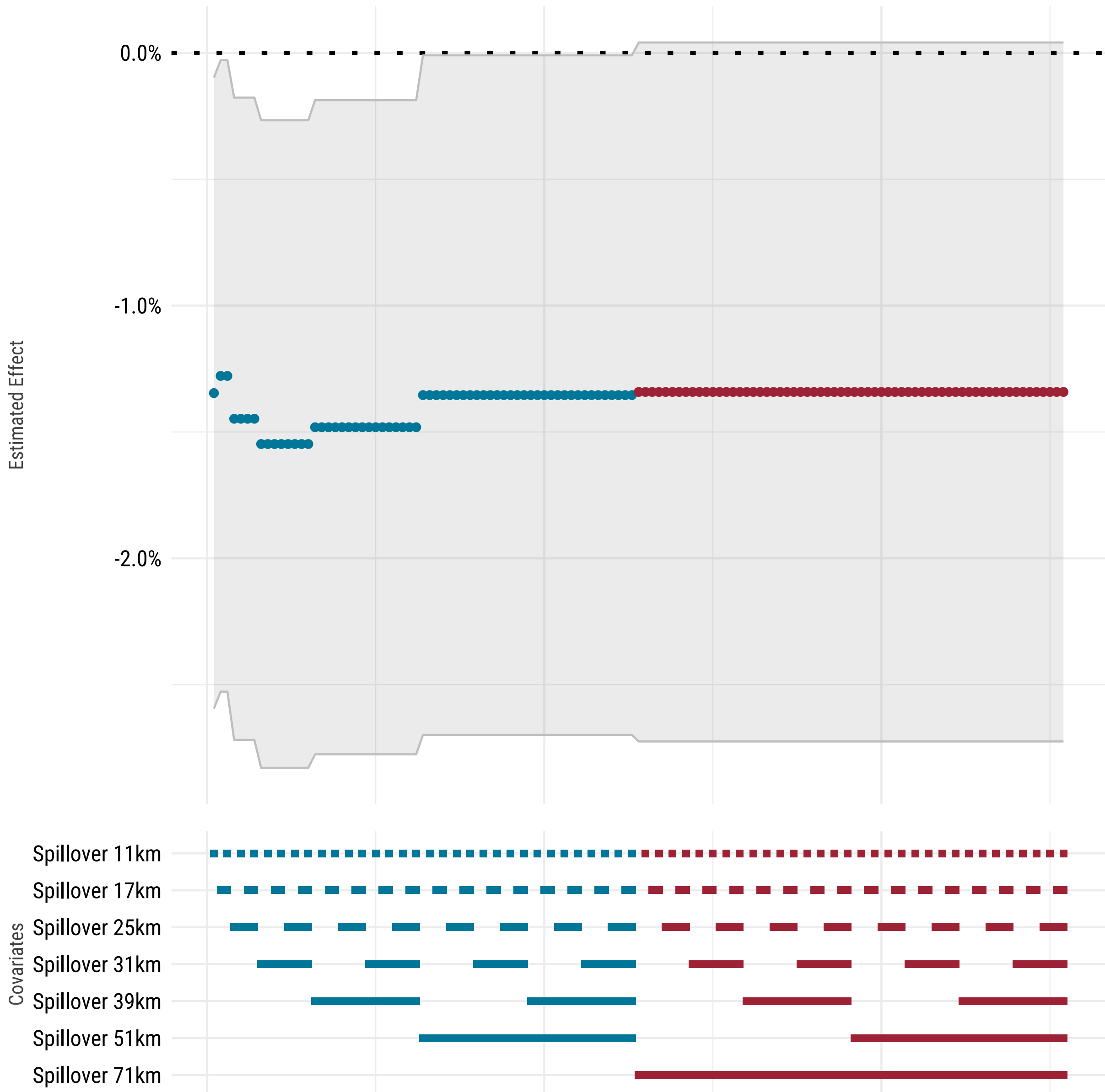
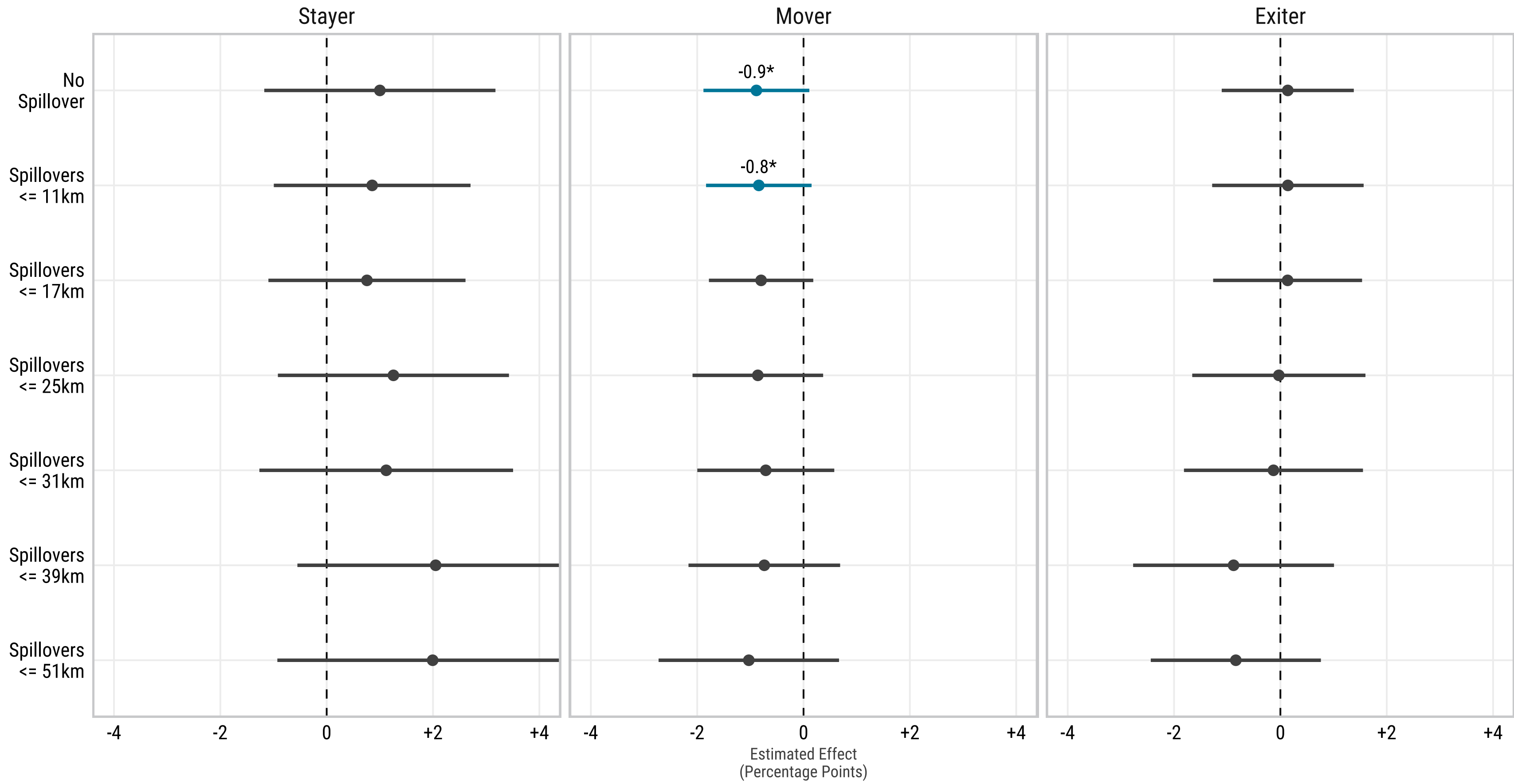
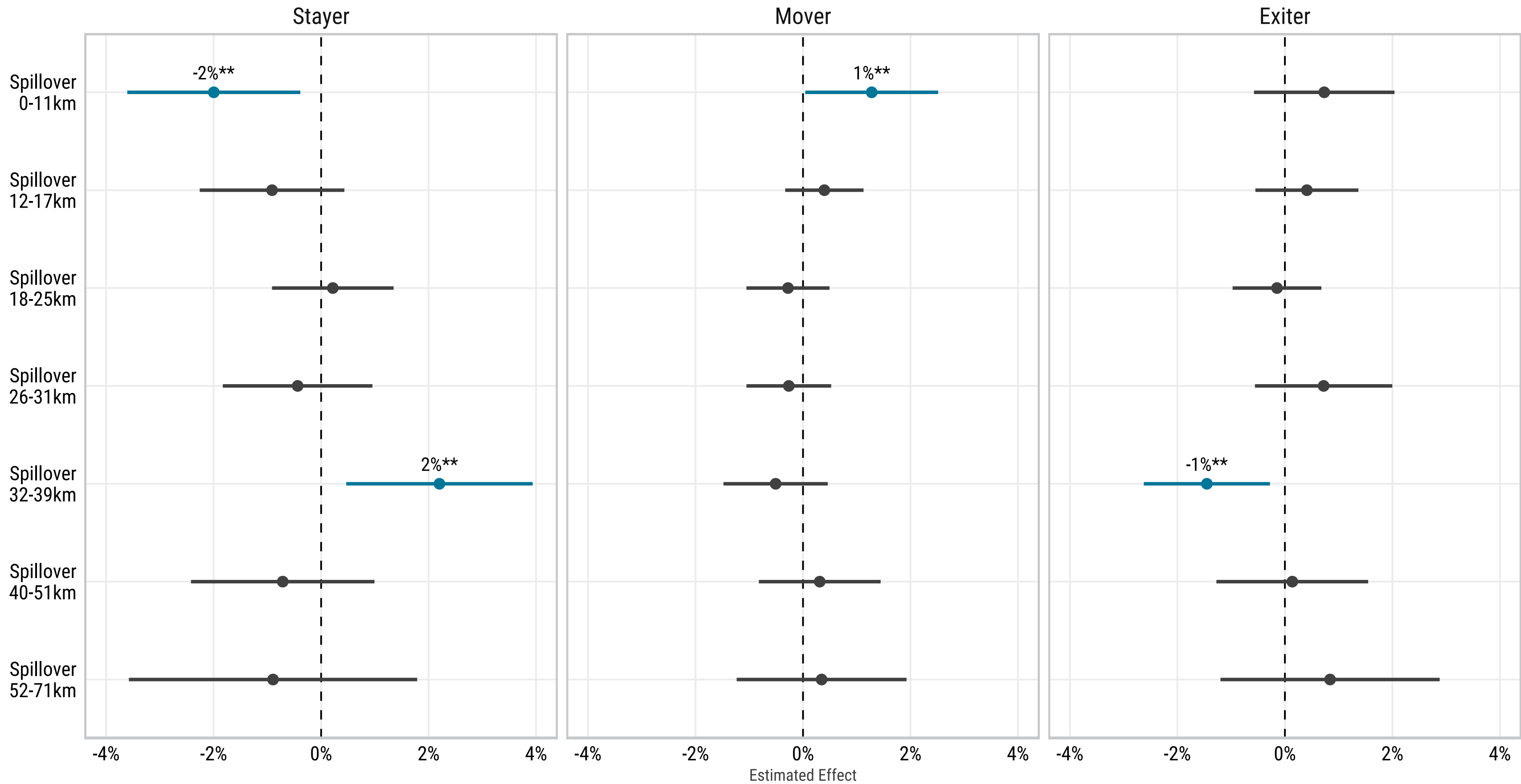


Figure 6 – Synthetic DiD Estimates of 4DSW Effects on Treated Schools



Note: * p < 0.1, ** p < 0.05, *** p < 0.01

Figure 7 – Synthetic DiD Estimates of 4DSW Effects on Spillover Schools



Note: * p < 0.1, ** p < 0.05, *** p < 0.01

7 TABLES

Table 1 – Characteristics of 4DSW, Nearby, and 5DSW Schools (2021–22 School Year)

	4DSW (N=109)		**Nearby (N=507)**		**5DSW (N=454)**	
	Mean	SD	Mean	SD	Mean	SD
Charter	0.026	0.160	0.097	0.296	0.073	0.260
Elementary	0.468	0.502	0.542	0.499	0.548	0.498
Middle	0.481	0.503	0.310	0.463	0.317	0.466
High School	0.494	0.503	0.272	0.446	0.286	0.453
Enrollment	279.3	122.6	489.5	326.5	463.2	345.9
Teacher FTEs	28.6	15.6	36.3	25.4	36.4	28.4
Percent FRPL	0.790	0.183	0.659	0.250	0.678	0.256
Percent Black	0.097	0.173	0.234	0.276	0.178	0.272
Percent Hispanic	0.088	0.095	0.114	0.111	0.133	0.168
Percent Other Race/Ethnicity	0.019	0.033	0.023	0.028	0.038	0.065
Percent Two or More Races	0.032	0.032	0.042	0.032	0.041	0.037
Percent White	0.765	0.193	0.587	0.299	0.610	0.289
Rural	0.857	0.352	0.379	0.486	0.465	0.499
Town	0.104	0.307	0.237	0.425	0.196	0.397
Suburban	0.026	0.160	0.114	0.319	0.112	0.316
Urban	0.013	0.114	0.270	0.445	0.227	0.419

Table 2 – Effect of 4DSW Calendars on Teacher Retention

	No Spillovers			With Spillovers		
	Stayer	**Mover**	**Exiter**	**Stayer**	**Mover**	**Exiter**
4DSW Calendar	0.012	-0.014**	0.003	0.009	-0.014**	0.004
	(0.011)	(0.006)	(0.008)	(0.012)	(0.006)	(0.010)
Spillover 0-11km				-0.021	0.011	0.009
				(0.013)	(0.008)	(0.009)
Spillover 12-17km				-0.007	0.004	0.005
				(0.009)	(0.003)	(0.008)
Spillover 18-25km				-0.001	-0.004	0.002
				(0.008)	(0.003)	(0.007)
Observations	308,582	308,582	308,582	308,582	308,582	308,582

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; Standard errors clustered at the school-by-year level.

Table 3 – Effect of 4DSW Calendars on New Hire Quality

	Advanced Degree		Experience		Value-Added	
	(A)	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**
4DSW Calendar	0.054*	0.059**	0.296	0.357	0.082	0.137*
	(0.028)	(0.028)	(0.397)	(0.417)	(0.065)	(0.082)
Spillover 0-11km		0.010		-0.134		-0.045
		(0.025)		(0.446)		(0.058)
Spillover 12-17km		0.051**		0.483		0.001
		(0.025)		(0.490)		(0.062)
Spillover 18-25km		0.003		0.085		0.006
		(0.016)		(0.357)		(0.055)
Observations	30,579	30,579	35,461	35,461	12,943	12,943

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; Standard errors clustered at the school-by-year level.