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ABSTRACT

Does a Day Lost Equal Dollars Saved? The Effects of Four-Day School Weeks on School District Expenditures*

While cost savings is the primary motivation for the switch to four-day school weeks in many school districts, do these school schedules save school districts any money? To answer this question, this study uses a difference-in-differences analysis using a unique, self-collected longitudinal dataset of four-day school week use from 1999-2015 and National Center for Education Statistics data on school district expenditures. School districts that switch to the four-day school weeks reduce operating expenditures per pupil by 3.1 percent. The largest percentage reductions occur in spending areas where services are reduced one day per week (e.g., food service, transportation), with little to no change in instructional expenditures. Although employment in many of these student service subcategories holds steady after the switch to a four-day school week, some of the burden of reduced service provision is shifted onto hourly workers as spending on employee compensation falls for these types of services.

JEL Classification: H72, I21, I22

Keywords: four-day school weeks, school districts, expenditures

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1. Introduction

The aftermath of the Great Recession saw large reductions in school funding, leading to increased financial pressures and budgetary issues in many school districts. According to the Center on Budget and Policy Priorities, state funding for schools fell by around $850 per student between 2008 and 2013 and local funding fell by around $175 per pupil over the same time period. These financial pressures have persisted well after the Great Recession, due to difficulty in raising new taxes – both due to persisting declines in property values and tax limitation policies – and slowly recovering state funding levels. In fact, by 2016, twenty-five states were found to have general formula aid that was still below 2008 levels (Leachman, Masterson, and Figueroa, 2017). Further exacerbating the financial problems, expenditures have been rising in many school districts. Most notably, employee benefits increased by 22 percent between 2005-2014 (Machitello, 2018) and pension/retirement costs have increased from 4.8 percent of total per pupil expenditures in 2004 to 10.6 percent of total expenditures in 2018 (Costrell, 2018).

These increased financial pressures have left many school districts attempting to find unique ways to balance budgets. School districts have traditionally dealt with budget deficits by laying off teachers and staff, increasing class sizes, closing schools, instituting student activity fees (e.g., pay-to-play athletics) and some states have developed financial intervention systems to monitor school district financial health and intervene in school districts to help alleviate financial problems.[1] As an alternative to these approaches, recently, there has been a growing trend of, primarily rural, school districts switching to four-day school weeks as a way to cut costs in the face of these financial pressures. In fact, a recent survey (Thompson, et al., 2019) of four-day school week school districts across the country finds that financial motivations are the primary rationale for the switch to four-day school weeks, suggesting that cost savings is an important metric on which to base the effectiveness of four-day school week schedules. Currently, 1,500 schools in approximately 600 school districts across at least 24 states operate on a four-day school week schedule (Thompson, et al., 2019)

Despite the growing use of these school schedules nationwide, little causal evidence exists on the effects of these policies on school, community, and student outcomes. To date, a handful of studies have conducted quasi-experimental analyses of the unintended effects of four-day school weeks on student achievement (Anderson and Walker, 2015; Thompson, 2019), juvenile crime (Fischer and Argyle, 2018), and maternal labor supply (Ward, 2019), but this is the first study to causally examine the direct effects

[1] While these approaches have helped these school districts become more financially viable, many of these – increasing class sizes (e.g., Krueger, 1999), closing schools (e.g., Engberg, et al., 2012), and financial intervention systems (e.g., Thompson, 2016) in particular – have been found to negatively impact student achievement.

of four-day school weeks on cost savings. This study uses a difference-in-differences analysis using a unique, self-collected national longitudinal dataset of four-day school week use from 1999-2015 and National Center for Education Statistics data on school district expenditures to assess whether the switch to a four-day school week saves school districts money and, if so, which components of expenditures are seeing the greatest reductions. Although there are small, imprecise impacts of four-day school weeks on total expenditures per pupil, I do find that these school schedules reduce operating expenditures per pupil by 3.1 percent. The largest percentage reductions are found for student support services, operations and maintenance, food service, and transportation expenditures, areas where service provision is reduced one day per week. Although employment in many of these student service subcategories holds steady after the switch to a four-day school week, some of the burden of reduced service provision is shifted onto hourly workers as spending on employee compensation falls for these types of services.

2. Conceptual Framework

The primary mechanism for why four-day school weeks are expected to reduce school districts' costs is the reduction of student services one day a week. In theory, this could lead to multiple avenues for savings, as closing the school building to students one day a week is likely to yield savings on heating and cooling, janitorial services, support/administrative staff salaries, food services, and bus transportation. Hypothetically, the maximum amount that could be saved through the switch to these four-day school weeks is 20 percent, if all costs were cut proportionately to the reduction in the number of days per week. As this hypothetical savings assumes that all educational costs are variable costs, the true cost savings is expected to fall well below this hypothetical maximum. Griffith (2011) – the only previous study to examine effects of four-day school week on cost savings – projected that the switch to a four-day school week could produce a maximum cost savings of up to 5.4 percent, but finds that school districts often only realize savings of between 0.4 and 2.5 percent.

The failure of districts to achieve these maximum cost savings may be due to both the nature of the costs school districts incur and how school districts structure these four-day school weeks. In particular, instructional expenditures (e.g., teacher costs) – which are often the largest expenditure for school districts[2] – are unlikely to be impacted much by the switch to the four-day school week. This is due to the fact that teachers are often on fixed collectively-bargained salary schedules with a set number of contract days, regardless of the number of student days. There may also be minimal reductions in general district

[2]As noted in Table 1, instructional expenditures make up over 50 percent of all per pupil expenditures.

administration expenditures as the central district office is likely to be open five days a week regardless of the structure of the school district schedule. The largest percentage reductions are likely to occur in services seeing losses in service provision one day per week, such as student transportation and food services. Maximal savings for these types of spending may also not fully be realized, however, as some school districts receive substantial reimbursement for busing from the state and free and reduced lunch programs are provided through federal funds with little fungibility to offset budgetary issues. Thus, even if school districts set out to reduce costs by implementing these school schedules, the nature of these costs may make it difficult for large financial savings to be realized.

Additionally, the structure of these four-day school weeks may dampen the effectiveness of the four-day school week as a cost saving measure. In particular, many school districts with four-day school weeks keep their school buildings open on at least some, if not all, of the fifth-days each year, in order to offer fifth-day enrichment programs to students, teacher professional development, or to hold sporting events.[3] If these school buildings are open on the off day, these school districts may not realize the same level of savings on operational costs (e.g., heating and cooling, electricity) that schools that completely close their building do. In the same vein, school buildings are often open longer on the remaining four school days each week, which may further cut into any potential cost savings from operating the school building or reductions in hourly staff wages. Services, such as busing and food services, are less likely to be impacted by longer school days and so may see larger reductions in expenditures relative to other spending categories. Due to the array of factors noted here, it is hypothesized that the switch to a four-day school week will reduce costs, but the overall size of these cost savings will be small in magnitude.

3. Data and Empirical Methods

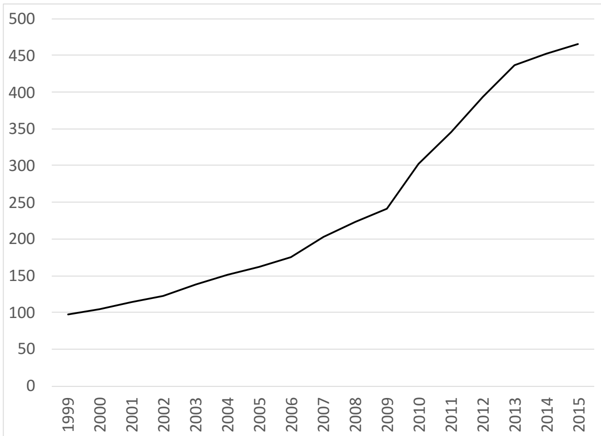
3.1. Data

This study uses a self-collected longitudinal nationwide school district-level four-day school week data set – the first of its kind to my knowledge. To identify which school districts operated on four-day school week, lists of four-day school week districts were collected from state department of education websites.[4] While some states contained historical lists of four-day school week use, to find out when

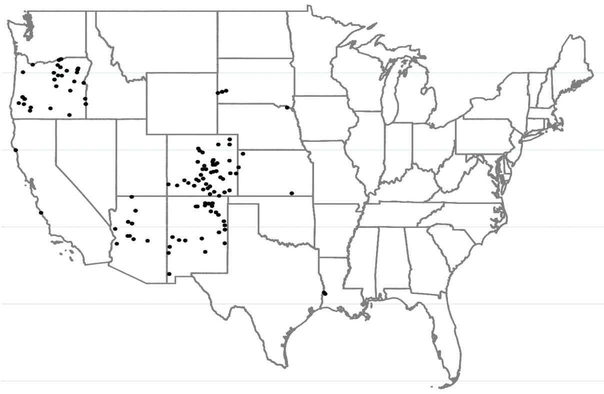
[3]As noted in Thompson, et al. (2019), over 80 percent of four-day school week districts have Fridays off. As most school districts hold football games and other athletic and extracurricular events on Fridays, it may be the case that the Friday-off model would potentially yield lower cost savings than those using the Monday-off model.

[4]In addition to these state department of education lists, the lists of four-day school week districts for several states came from news articles discussing the extent of four-day school weeks in those states.

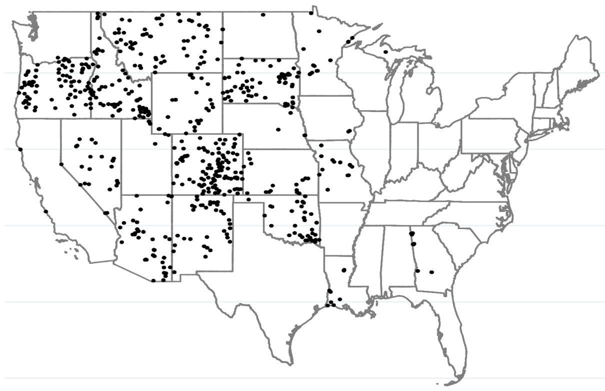
Figure 1: Four-Day School Week Policy Variation



(a) Growth in FDSW School Districts, 1999-2015



(b) FDSW school districts, 1999



(c) FDSW school districts, 2015

each school district started their four-day school week, email and phone correspondence was conducted with these identified school districts and additional information was collected from archived newspaper reports. In total, the data set contains full historical four-day school week use for 1,552 out of the nearly 1,800 schools (86 percent) that have been identified as ever having a four-day school week.[5] As shown in Figure 1a, there has been massive growth in the number of school districts with at least one school operating on a four-day school week schedule over the past two decades. There were 95 school districts with at least one school operating on a four-day school week in 1999, but that number has risen to 465 school districts by 2015.[6] As noted in Figures 1b and 1c, there also has been notable four-day school week expansion geographically. In 1999, four-day school weeks were found in eight states – although the bulk were primarily found in four states (AZ, CO, NM, OR) – and that number had risen to 24 states by 2015. This across time and spatial variation in the adoption of these school schedules is the major source of identification in the analysis presented in this study.

This national data set of four-day school week use is augmented with the National Center of Education Statistics F-33 financial database that contains detailed yearly financial data by expenditure type for all public K-12 school districts in the US from 1999-2015. These financial variables are converted to per-pupil terms by dividing each by the total enrollment of the school district. In addition to total expenditure and revenue variables, I collect the disaggregated totals for operating and capital expenditures and local and state revenue. To determine exactly which types of school district expenditures are seeing reductions as a result of the four-day school week, I also collect data on the following expenditure categories: (a) instructional; (b) general district administration; (c) school administration; (d) student support services; (e) food service; (f) operations and maintenance; (g) transportation. To control for differences in student composition across these districts, I use National Center for Education Statistics Common Core of Data variables such as the percentage of students eligible for free and reduced lunch, percentage of minority students, pupil-teacher ratios, percentage of English Language Learners, and those with Individualized Education Plans.

Table 1 provides descriptive statistics for these expenditure types and demographic characteristics across the different categories of four-day school week use.[7] Prior to the switch to the four-day school

[5] Of the remaining 248 schools, partial historical data has been collected for 145. Years not corroborated by states, districts, and/or news reports are coded as missing in the analytic sample. Given the retrospective nature of the historical data, there may be some years that are misclassified (e.g., coded as a four-day when actually a five-day). Although we expect the rate of misclassification to be small, these types of misclassification errors would bias the results against finding an effect of four-day school weeks.

[6] Since 2015, the number of school districts with at least one four-day school week school has continued to grow. By 2019, there are well over 600 school districts across the country with at least one four-day school week school.

[7] The "No FDSW" column provides the average expenditures and demographics for only school districts that never had a

Table 1: Descriptive Statistics

	No FDSW	Pre-FDSW	FDSW		No FDSW	Pre-FDSW	FDSW
Total Exp PP	14,652	13,313	15,346	Stu Services Exp PP	4,453	4,396	5,198
	(22,536)	(4,985)	(8,254)		(10,814)	(2,058)	(3,251)
Oper Exp PP	12,198	11,790	13,405	Food Serv Exp	443	483	544
	(18,012)	(4,455)	(6,879)		(235)	(261)	(313)
Cap Exp PP	1,263	1,147	1,458	Ops & Maint Exp PP	1,177	1,352	1,637
	(2,111)	(1,073)	(2,872)		(1,044)	(832)	(1,390)
Total Rev PP	14,734	13,431	15,572	Transp Exp PP	719	724	810
	(23,243)	(5,393)	(8,164)		(7,724)	(684)	(834)
Local Rev PP	7,046	4,836	6,088	Total Enrollment	3,388	1,712	1,794
	(15,814)	(3,318)	(5,456)		(14,680)	(14,676)	(16,810)
State Rev PP	6,512	7,200	7,772	Fraction White	0.75	0.80	0.75
	(10,421)	(3,742)	(5,075)		(0.28)	(0.22)	(0.23)
Instruct Exp PP	7,225	6,881	7,635	Fraction Female	0.45	0.42	0.47
	(8,656)	(2,559)	(3,854)		(0.11)	(0.14)	(0.06)
Gen Admin Exp PP	527	676	865	Fraction FRL	0.41	0.44	0.50
	(1,428)	(624)	(1,138)		(0.22)	(0.20)	(0.22)
Sch Admin Exp PP	610	545	580				
	(517)	(346)	(401)	School Districts	14,495	395	395

Per-pupil expenditure and revenue variables given in 2015 $. Standard deviations in parentheses. The "No FDSW" column provides the average expenditures and demographics for only school districts that never had a four-day school week between 1999 and 2015. The "Pre-FDSW" column provides the average expenditures and demographics prior to the switch to the four-day school week for school districts that eventually switched to a four-day school week between 1999 and 2015. The "FDSW" column provides the average expenditures and demographics after the switch to the four-day school week for this same set of districts.

week, these eventual four-day school weeks have lower revenues and expenditures per pupil than those that never switch to a four-day schedule. Eventual four-day school weeks are much smaller, on average, than those that never switch, with an average of 1,712 students in eventual four-day districts compared with 3,388 in never four-day districts. After the switch to the four-day school week, there is a noticeable increase in revenues and expenditures per pupil, which appears to run counter to the hypothesized effects of these school schedules being used as a cost-savings policy.

3.2. Empirical Strategy

Although many school districts are turning to four-day school weeks to alleviate financial pressures, the descriptive statistics in Table 1 suggest that these cost savings may not be realized. As costs may be generally increasing over time for these school districts, however, the raw averages may be masking potential cost savings resulting from the switch to these school schedules. In particular, the conclusions of this descriptive analysis may be driven by other factors (e.g. fixed factors about these districts, increases

four-day school week between 1999 and 2015. The "Pre-FDSW" column provides the average expenditures and demographics prior to the switch to the four-day school week for school districts that eventually switched to a four-day school week between 1999 and 2015. The "FDSW" column provides the average expenditures and demographics after the switch to the four-day school week for this same set of districts.

in overall costs over time, changes in enrollment, regional economic trends). To more formally analyze the impact of four-day school weeks on school district finances, I estimate the following regression equation:

$$ln(Y_{dt}) = \alpha + \beta_1 FDSW_{dt} + \delta\mathbf{X}_{dt} + \lambda_d + \phi_t + \lambda_d t + \epsilon_{dt} \tag{1}$$

where Y_{dt} is a per-pupil expenditure or revenue variable of the various disaggregated types described in the data subsection; $FDSW_{dt}$ is an indicator equal to 1 if at least one school in school district, d, had a four-day school week in school year, t; $\mathbf{X}_{dt}$ is a vector of school district-level control variables;[8] λ_d is a set of school district fixed effects; ϕ_t is a set of school year fixed effects; $\lambda_d t$ is a set of school district-specific linear time trends; ϵ_{dt} is an idiosyncratic error term. We should expect that $\beta_1 < 0$ for the various expenditure types, but may be small in magnitude due to the various reasons outlined in the conceptual framework section. As services, such as busing and food service, are likely to see the greatest amount of service reduction, it is expected that β_1 will be larger in magnitude for these expenditure categories.

To examine pre-trends in these outcome variables and the long-term changes in these cost savings, I also estimate the following event study specification:

$$ln(Y_{dt}) = \alpha + \sum_{k=-3}^{3} \beta_k FDSW_{dtk} + \delta\mathbf{X}_{dt} + \lambda_d + \phi_t + \lambda_d t + \epsilon_{dt} \tag{2}$$

where $FDSW_{dtk}$ is an indicator for k years before or after the switch to the four-day school week, with $k = 0$ signifying the year of the change from five to four days. For costs that are related to student services we may expect $\beta_k < 0$ for all $k \geq 0$ as the structural changes in the school schedule should facilitate savings immediately in these areas if buildings are closed, staff hours are reduced, and food service and busing is no longer needed one day per week. Instructional costs may need more time to see savings, if any, as teacher costs may be static in the short-run due to fixed teacher contracts, but these costs may adjust over time as new contracts are collectively bargained in the future.

[8]This vector includes the fraction of district enrollment that is white, the fraction that is female, the fraction that is limited English proficient, the fraction with an Individualized Education Plan, and the fraction that receives free and reduced lunch. As many of these time-varying characteristics may be endogenously determined by the switch to the four-day school week, the main analyses omit these characteristics. While this is likely to reduce the precision of the estimate of the four-day school week effect, it will avoid introducing potential endogeneity bias into the model. The inclusion of these time-varying factors is included as a sensitivity analysis and the results are presented in Panel E of Table 3.

4. Effects of Four-Day School Weeks on School District Expenditures

4.1. Difference-in-Differences Results

The results of the main difference-in-differences analysis highlighted in equation (1) are presented in Table 2. Panel A of Table 2 presents the results of equation (1) without the inclusion of the school district-specific time trends and finds largely similar results to what was described by Table 1. Generally, the results suggest null or increasing school district expenditures as a result of the four-day school week. Most notably, total expenditures per pupil increase by 3.2 percent. I also find increases in per pupil expenditures for general school district administration, instruction, and operations and maintenance. These puzzling expenditure results may be driven, however, by the sharp decline in enrollment that is observed following the switch to the four-day school week. I observe the total enrollment falls by 10.3 percent following the switch to the four-day school week. Further analysis examining the trends in these variables, shows that this drop in enrollment began before the switch to the four-day school week and therefore these pre-trends may be biasing these results.

Table 2: Effects of Four-Day School Weeks on School District Expenditures and Revenue

	(1) Total Enrollment	(2) Total Expend PP	(3) Operating Expend PP	(4) Capital Expend PP	(5) Total Rev PP	(6) Local Rev PP	(7) State Rev PP	(8) Instruct Expend PP	(9) Gen Admin Expend PP	(10) Sch Admin Expend PP	(11) Stu Services Expend PP	(12) Food Service Expend PP	(13) Ops and Maint Expend PP	(14) Transp Expend PP
Panel A: Without School District-Specific Time Trends Included														
Four-day	-0.103***	0.032***	0.020**	0.072	0.031***	0.047**	-0.043**	0.020*	0.061***	-0.012	0.016	0.007	0.050***	-0.033**
	(0.013)	(0.012)	(0.010)	(0.050)	(0.011)	(0.019)	(0.019)	(0.011)	(0.021)	(0.022)	(0.012)	(0.019)	(0.014)	(0.015)
Observations	215,505	215,394	215,394	210,070	215,392	215,381	215,287	215,365	213,143	207,238	215,370	209,251	213,771	210,774
R-squared	0.991	0.766	0.869	0.284	0.841	0.916	0.818	0.858	0.887	0.728	0.86	0.834	0.799	0.885
Panel B: With School District-Specific Time Trends Included														
Four-day	0.014	-0.018	-0.031***	0.06	-0.01	0.048***	-0.046***	-0.017*	-0.047**	-0.038	-0.045***	-0.068***	-0.045***	-0.070***
	(0.012)	(0.012)	(0.009)	(0.066)	(0.011)	(0.018)	(0.017)	(0.009)	(0.021)	(0.024)	(0.012)	(0.014)	(0.014)	(0.016)
Observations	215,505	215,394	215,394	210,070	215,392	215,381	215,287	215,365	213,143	207,238	215,370	209,251	213,771	210,774
R-squared	0.997	0.834	0.928	0.404	0.901	0.951	0.891	0.921	0.935	0.828	0.922	0.906	0.874	0.933

Each column of the table presents results from a separate regression containing the natural log of the specified dependent variable. Each specification contains school year fixed effects, school district fixed effects, and school district-specific time trends. Robust standard errors, clustered at the school district-level are given in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

These findings suggest that the inclusion of school district-specific time trends may be warranted as a way to control for these pre-trends. Panel B of Table 2 presents the results of equation (1) without the inclusion of the school district-specific time trends and finds results that fall much more in line with the hypothesized cost savings outlined in the conceptual framework section. When controlling for time trends, I find that the switch to the four-day school week yields a decrease in operating expenditures of 3.1 percent. This result suggest that the reduction of school district operations and services one day a week does provide some cost savings to school districts. However, a concurrent rise in capital expenditures of six percent – albeit statistically insignificant – appears to mitigate the overall financial savings for these school districts. In total, I find a statistically insignificant reduction in total expenditures per pupil of 1.8 percent following the switch to the four-day school week. Thus, it appears that the shift to a four-day school week schedule may lead to some small cost savings or allow school districts to change their input mix by freeing up some money on the operations side of the ledger.

The savings on operational costs come from a wide array of sources, with the greatest expenditure reductions occurring in areas where service provision is likely to be reduced the most. Not surprisingly, the smallest percentage reductions of 1.7 percent come from instructional costs, which may be hard to reduce at a large scale due to teacher contracts. I find larger reductions among general district administrative costs and school administrative costs, which fall by 4.7 and 3.8 percent, respectively. The largest percentage reductions come from student services, food service, operations and maintenance, and transportation expenditures. Per-pupil expenditures fall for student services and operations and maintenance both fall by 4.5 percent, while food services and transportation expenditures fall by 6.8 percent and seven percent, respectively. The larger percentage reduction for food services and transportation is likely due to the fact that these are the two areas where the loss of one day actually means a loss of a full day of these services. The length of bus routes and the length of food service provision is unlikely to change much on the other four school days each week even if those school days are longer. Compare that with other types of spending that are likely seeing less than a full day reduction in services, both due to buildings possibly being open on the off-day and the longer school days on the other four school days each week.

4.2. Results of Sensitivity Analyses

One concern with the above analysis is that because four-day school week districts are generally smaller and more rural than their five-day school week counterparts, using all school districts in the sample does not create a representative counterfactual in the baseline difference-in-differences analysis. To test the sensitivity of the baseline analyses to alternative counterfactual groups, I restrict the sample in several ways by: (a) including only states that have ever had a FDSW; (b) including only school districts that have ever had a FDSW; (c) including only rural school districts; (d) including only school districts with fewer than 2000 students enrolled. The results of these analyses are presented in Panels A through D of Table 3 and generally find smaller magnitude effects than in the baseline case.

The most restrictive sample selection – including only those districts that ever adopted a four-day school week – yields the most conservative of these results. With this sample restriction, I find that the switch to the four-day school week yields a decrease in operating expenditures of 2.1 percent. As in the

Table 3: Sensitivity Analyses

	(1) Total Enrollment	(2) Total Expend PP	(3) Operating Expend PP	(4) Capital Expend PP	(5) Total Rev PP	(6) Local Rev PP	(7) State Rev PP	(8) Instruct Expend PP	(9) Gen Admin Expend PP	(10) Sch Admin Expend PP	(11) Stu Services Expend PP	(12) Food Service Expend PP	(13) Ops and Maint Expend PP	(14) Transp Expend PP
Sensitivity to Changes in Analytic Sample														
Panel A: States with FDSW Only														
Four-day	0.008	-0.013	-0.026***	0.08	-0.006	0.043**	-0.040**	-0.011	-0.046**	-0.035	-0.043***	-0.066***	-0.044***	-0.073***
	(0.012)	(0.012)	(0.009)	(0.067)	(0.011)	(0.017)	(0.017)	(0.009)	(0.021)	(0.024)	(0.012)	(0.014)	(0.014)	(0.016)
Observations	111,216	111,186	111,186	106,846	111,185	111,177	111,110	111,185	108,977	104,158	111,185	106,641	109,625	107,239
R-squared	0.996	0.796	0.901	0.421	0.860	0.929	0.875	0.883	0.931	0.804	0.898	0.912	0.859	0.936
Panel B: FDSW Districts Only														
Four-day	0.005	-0.012	-0.021**	0.08	-0.003	0.018	-0.008	-0.008	-0.042**	-0.021	-0.034***	-0.067***	-0.035**	-0.063***
	(0.012)	(0.013)	(0.009)	(0.071)	(0.011)	(0.018)	(0.018)	(0.010)	(0.020)	(0.023)	(0.011)	(0.014)	(0.014)	(0.016)
Observations	8,481	8,481	8,481	7,859	8,481	8,481	8,479	8,481	8,348	7,395	8,481	7,809	8,475	8,357
R-squared	0.990	0.786	0.881	0.441	0.828	0.896	0.855	0.863	0.901	0.774	0.878	0.865	0.840	0.910
Panel C: Rural Districts Only														
Four-day	0.008	-0.015	-0.024**	0.064	-0.006	0.061***	-0.039**	-0.01	-0.031	-0.025	-0.042***	-0.056***	-0.038**	-0.071***
	(0.014)	(0.014)	(0.011)	(0.073)	(0.012)	(0.020)	(0.018)	(0.011)	(0.022)	(0.028)	(0.013)	(0.016)	(0.017)	(0.018)
Observations	114,453	114,401	114,401	109,624	114,400	114,389	114,329	114,389	113,124	107,869	114,385	109,813	113,710	111,532
R-squared	0.995	0.826	0.913	0.434	0.885	0.938	0.880	0.900	0.917	0.819	0.909	0.902	0.862	0.931
Panel D: Low Enrollment Districts Only														
Four-day	0.011	-0.023*	-0.033***	0.027	-0.011	0.046**	-0.042**	-0.018*	-0.048**	-0.042	-0.049***	-0.072***	-0.046***	-0.074***
	(0.013)	(0.013)	(0.011)	(0.071)	(0.012)	(0.019)	(0.017)	(0.010)	(0.022)	(0.027)	(0.013)	(0.016)	(0.016)	(0.017)
Observations	137,701	137,607	137,607	132,327	137,606	137,595	137,519	137,579	135,903	130,012	137,591	131,827	136,532	133,635
R-squared	0.992	0.831	0.919	0.402	0.890	0.943	0.880	0.905	0.898	0.815	0.914	0.910	0.860	0.927
Sensitivity to Changes in Empirical Specification														
Panel E: Time-varying district covariates included														
Four-day	0.010	-0.018	-0.030***	0.054	-0.008	0.031*	-0.033**	-0.014	-0.030	-0.021	-0.051***	-0.058***	-0.048***	-0.081***
	(0.010)	(0.012)	(0.008)	(0.080)	(0.010)	(0.018)	(0.016)	(0.009)	(0.019)	(0.028)	(0.011)	(0.015)	(0.014)	(0.015)
Observations	107,691	107,632	107,632	103,918	107,631	107,625	107,581	107,631	106,271	102,513	107,621	104,292	106,628	104,805
R-squared	0.994	0.850	0.937	0.449	0.911	0.951	0.896	0.927	0.912	0.822	0.929	0.921	0.879	0.936
Panel F: Dependent Variable in Levels														
Four-day	3.605	-187.734	-433.265	197.242	-186.655	283.634	-436.752*	-95.576	-6.786	-32.458**	-293.031*	-39.754***	-57.170	-55.180**
	(3.005)	(379.038)	(306.791)	(222.565)	(394.160)	(213.490)	(263.033)	(157.789)	(41.919)	(16.319)	(156.492)	(10.180)	(61.955)	(26.929)
Observations	137,701	137,607	137,607	137,607	137,607	137,607	137,607	137,607	137,607	137,607	137,607	137,607	137,607	137,607
R-squared	0.994	0.734	0.750	0.346	0.742	0.781	0.759	0.770	0.808	0.755	0.737	0.816	0.625	0.751

Each column of the table presents results from a separate regression containing the natural log of the specified dependent variable. Each specification contains school year fixed effects, school district fixed effects, and school district-specific time trends. Robust standard errors, clustered at the school district-level are given in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

baseline results, a concurrent statistically insignificant rise in capital expenditures appears to mitigate the overall financial savings for these school districts. Among only four-day school week districts, I find a statistically insignificant reduction in total expenditures per pupil of 1.2 percent following the switch to the four-day school week. The greatest expenditure reductions (in percentage terms) still are found to occur in areas where service provision is likely to be reduced the most. While I find no statistically significant impacts on instructional expenditures, I do find statistically significant reductions among per-pupil expenditures for general district administration (4.2 percent), student services (3.4 percent), food service (6.7 percent), operations and maintenance (3.5 percent), and transportation (6.3 percent).

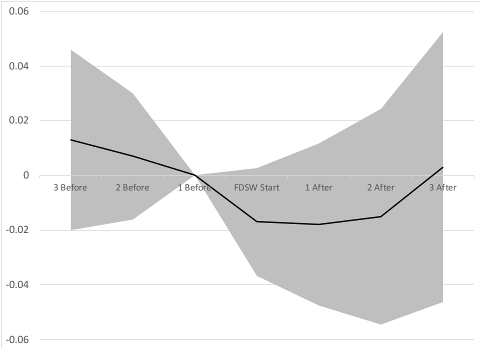
I also test the sensitivity of the main results to changes in the empirical specification. I change the specification in the following ways: (a) including time-varying school district characteristics into the model, which, recall, were omitted in the baseline regression specification due to potential endogeneity issues.; and (b) changing the dependent variable from the log of revenues and expenditures per pupil to levels. When including the time-varying school district characteristics as covariates (Panel E), I find little change from the baseline estimates suggesting that the choice of which time-varying characteristics to include matters little to the overall results and conclusion of these analyses after fixed effects and school district-specific time trends are included.

When using the levels of revenues and expenditures per pupil as dependent variables (Panel F), I find statistically insignificant results for the reductions in total expenditures per pupil and total operating expenditures per pupil. The point estimates suggest a total savings of around \$187 per student and a reduction in operating expenditures of \$433 per student. Even in the levels specification, I continue to find statistically significant impacts of four-day school weeks on food service and transportation expenditures, but the magnitudes highlight the small monetary savings school districts actually realize from reductions these services. Following the switch to a four-day school week, school districts see a reduction in food services expenditures of about \$40 per student and reduction in transportation expenditures of about \$55 per student. Larger savings (in dollar terms) are found in student support services expenditures, which fall by around \$293 per student following the switch to the four-day school week.

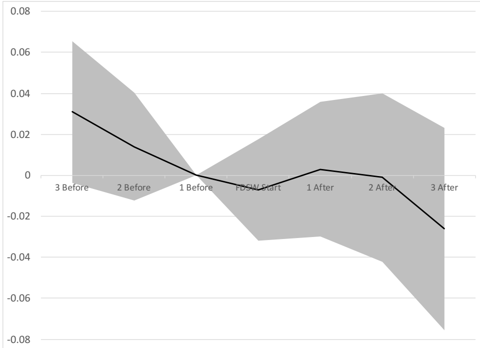
4.3. Event Study Results

The above results find some cost savings as a result of the switch to a four-day school week, but tell very little about the dynamics of these savings. To answer questions regarding how quickly these cost savings are realized and whether they accumulate or ameliorate over time, I estimate the event study specification outlined in equation (2). These results are presented in Figure 2 and show that the parallel

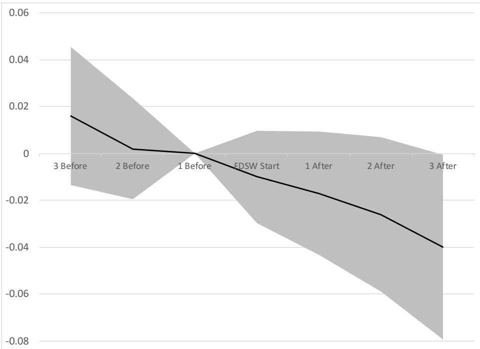
Figure 2: Event Study Results



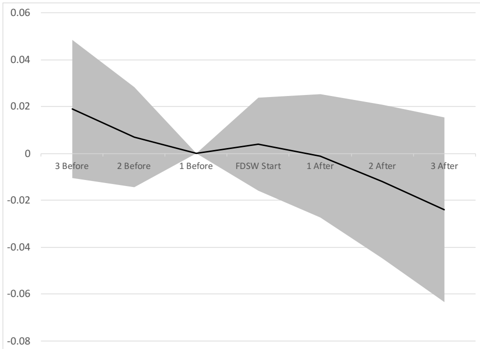
(a) Total Enrollment



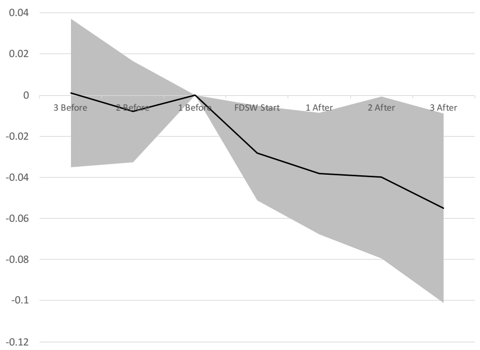
(b) Total Expenditures PP



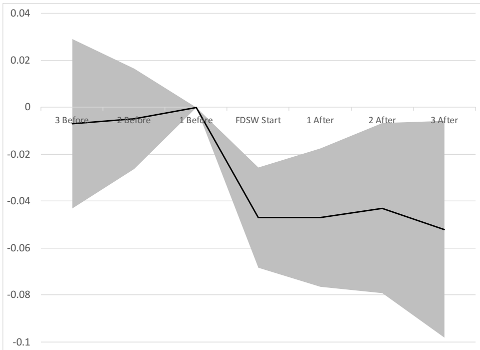
(c) Operating Expenditures PP



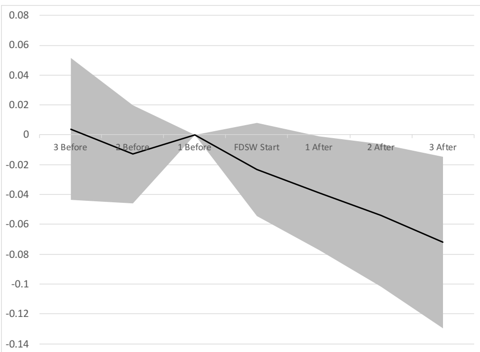
(d) Instructional Expenditures PP



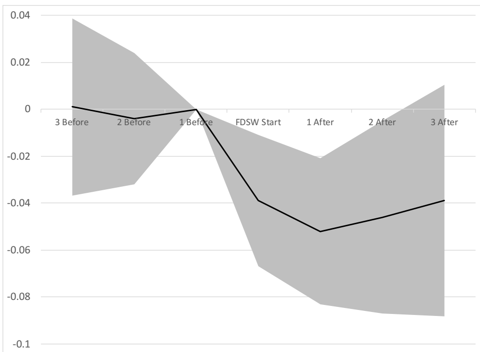
(e) Student Services Expenditures PP



(f) Food Services Expenditures PP



(g) Operations and Maintenance Expenditures PP



(h) Transportation Expenditures PP

Note: The black line in the subfigures denotes the point estimates across the different years relative to implementation. The gray shaded region in each subfigure denotes the 90% confidence interval around each of these point estimates.

trends assumption generally holds after controlling for school district-specific time trends, as evidenced by the lack of statistically significant pre-trend in these outcome variables.[9] Therefore, these findings lend further validity to the results presented in Panel B of Table 2 that included school district-specific time trends.

As observed in Figure 2b, there appears to be minimal impacts on overall expenditures per pupil as a result of the switch to a four-day school week. The effects on total expenditures per pupil in the first few years after four-day school week implementation are statistically insignificant and the point estimates suggest a negligible impact on overall expenditures. Operating expenditures appear to fall monotonically following the implementation of the four-day school week, but the results are generally insignificant. The lack of a stark change in either total expenditures or operating expenditures at implementation may be attributed to the lack of a change in the biggest expenditure subcategory – instructional expenditures.

Despite the lack of an overall change in expenditures, I do find statistically significant expenditure reductions in some of the subcategories most likely to have service provision impacted by the four-day school week (e.g., student support services, food services, operations and maintenance, transportation). Many of these expenditure subcategories see reductions immediately after the implementation of the four-day school week. In the year the four-day school week was first implemented per pupil expenditures for student support services fall by 2.8 percent, food service fall by 4.7 percent, operations and maintenance fall by 2.3 percent, and transportation fall by 3.9 percent. These reductions persist or continue to grow in subsequent years after initial implementation. By three years after the year of initial implementation of the four-day school week, reductions in per-pupil expenditures relative to the year before implementation are 5.5 percent for student support services, 5.2 for food services, 7.2 percent for operations and maintenance, and 3.9 percent for transportation. The growth in expenditure reductions in operations and maintenance and student support services may reflect the fact that some school districts that initially may have tried to incorporate fifth-day remedial and enrichment activities for students often reduce the use of these services over time due to the cost of operating the programs and/or lack of student participation.

5. Heterogeneous impacts on personnel and non-personnel costs

The above analysis finds overall reductions in expenditures related to student support services, food services, transportation, and operations and maintenance, but to better understand the potential welfare

[9]The black line in the subfigures denotes the point estimates across the different years relative to implementation. The gray shaded region in each subfigure denotes the 90% confidence interval around each of these point estimates.

effects of these changes, it is important to decompose these expenditure reductions. Cost reductions could be driven by three different mechanisms. First, staffing layoffs or voluntary employee departures in response to the introduction of the four-day school week could be a contributing factor. Second, even in the absence of a change in the number of school employees, the loss of one full day of work for hourly employees may lead to reductions in personnel-related costs (i.e., salaries and benefits). This is likely to be the case in many of the spending areas where overall reductions in expenditures were found, as the bulk of food service workers, bus drivers, and maintenance and janitorial staff are hourly employees. Finally, the reduction in services one day a week may also lead to reductions in non-personnel expenditures, especially in spending areas that have a high degree of variable non-personnel costs, such as transportation (e.g., less fuel for busing) and food services (e.g., less food purchased).

To test these different avenues of cost savings, I use as dependent variables in equation (1): (a) the number of employees for each expenditure sub-category, (b) the total compensation costs within each expenditure subcategory, and (c) the non-compensation costs within each expenditure subcategory. To create the total compensation costs, I aggregate expenditures on salaries and benefits within the expenditure subcategory and then net that out of the total expenditure of the subcategory to obtain the non-compensation costs. The results of this analysis are presented in Table 4. As shown in column (1) of Table 4, I find very little evidence that staffing was reduced as a result of the switch to the four-day school week and, in fact, may have slightly increased staffing levels. There is some evidence that the nearly nine full-time equivalent increase in instructional staff is due to an increase in instructional aides and other non-full time teachers. Thus, it may be the case that some schools are substituting some lower cost instructional employees instead of hiring more teachers. However, the results here suggest that staffing changes likely explain little of the reduction in expenditures across these subcategories.

Despite the lack of a reduction in staffing, all of the expenditure subcategories, with the exception of instructional spending, see a substantial reduction in personnel costs. The lack of a change in personnel costs for instructional personnel is in line with what was hypothesized in the conceptual framework, as many instructional personnel (primarily teachers) are largely on fixed salary schedules and paid the same regardless the composition of the weekly school schedule. For non-instructional subcategories of spending, it appears that hourly workers may be facing a reduction in the compensation they receive. Personnel costs fall by between 4.8 percent and 5.7 percent for personnel in administration, support services, and operations and maintenance. Larger reductions are seen for personnel in food service (6.1 percent reduction) and transportation (8.2 percent reduction). This larger percentage reduction in

Table 4: Effects of Four-Day School Weeks on Personnel and Non-Personnel Costs

	Personnel Employed	Personnel Costs	Non-Personnel Costs
Instructional	8.890***	-0.011	-0.022
	(2.347)	(0.010)	(0.020)
Support Services	0.493*	-0.053***	-0.053***
	(0.254)	(0.020)	(0.012)
District Administration	1.975*	-0.048**	0.005
	(1.072)	(0.020)	(0.026)
School Administration	0.922**	-0.057***	0.001
	(0.427)	(0.019)	(0.037)
Other Support Staff (Ops/Maint; Transp.; Food Serv.)	4.722		
	(5.363)		
Operations and Maintenance		-0.048***	-0.040**
		(0.017)	(0.017)
Transportation		-0.082***	-0.078***
		(0.027)	(0.021)
Food Service		-0.061***	-0.085***
		(0.019)	(0.015)

Each cell of the table presents coefficient results for the FDSW indicator variable from a separate regression containing the specified dependent variable for the given expenditure category. Each specification contains school year fixed effects, school district fixed effects, and school district-specific time trends. Robust standard errors, clustered at the school district-level are given in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

personnel costs in these two spending areas may not be all that surprising as they are the two areas where staff may be less able to offset some of the hours lost on the off day with longer hours on the other four school days each week. For example, while hourly office staff may lose less than a day of work in aggregate due to working longer hours on the four days of school in session each week, the length of the bus route or the lunch hour is going to be the same regardless of when the school day starts or ends and, therefore, bus drivers and food service workers are essentially losing one full day of work.

Finally, I find that for expenditure types that have a high degree of variable costs that are linked more to number of school days compared to number of total school hours see reductions in non-personnel costs as well. I find no change in non-personnel costs for instructional or administrative expenditures. For these expenditure subcategories, much of the non-personnel costs (e.g., instructional materials, printing) are largely unrelated to the choice of school calendar, so it may not be all that surprising to see very little change in non-personnel spending. I find some statistically significant reductions in non-personnel costs for support services (5.3 percent) and operations and maintenance (4 percent) and again find larger percentage reductions for food services (8.5 percent) and transportation (7.8 percent). The fact that some schools remain open on the off day for other events (e.g., athletic contests, teacher professional development) may help explain the difference in the sizes of the effects between these expenditure types. For example, a school that remains open on the off day for a sporting event would still need heating/cooling and electricity – thereby reducing savings in non-personnel operations and maintenance – but since there are no student services offered there would be no need to spend money for bus fuel and food for school lunches.

6. Conclusion

This paper used a difference-in-differences analysis to conduct a nationwide study on the effects of four-day school week use on school district expenditures. As this study covered all public school districts in the United States, it has provided the most comprehensive four-day school week cost study to date. The study finds that overall cost savings are small, albeit imprecise, and fall in the range of 1.2-1.8%. Much of the expenditures reduction comes from the areas of spending that see a high degree of service reduction as a result of the four-day school week, including student support services, operations and maintenance, food services, and transportation. It appears that school districts may be using some of the savings from these services to offset rising costs in other areas, particularly capital expenditures, suggesting that these school schedule changes may not be fully related to reducing costs in aggregate, but instead providing school districts with the financial flexibility to adjust their input mix.

As the four-day school week is just one of many cost-saving policy options, what do these results suggest about the effectiveness of four-day school weeks relative to more traditional cost-saving strategies? The results presented in this study suggest that the four-day school week amounts to a total savings of at most $200 per pupil, on average. Alternatively, a class size increase of one student per class, yields a savings of around $250 per pupil. One important consideration is the tradeoff between this level of cost savings and educational impacts of these cost reduction policies. Previous work on the impacts of four-day school weeks suggests that the achievement impacts of four-day school weeks may be comparable to (Thompson, 2019), or potentially better than (Anderson and Walker, 2015), those observed from increasing class sizes (Whitehurst and Chingos, 2011).Thus, the four-day school week may be a viable option in the array of cost cutting choices, particular for those school districts with a high degree of variable costs (e.g., long busing commutes, high degree of hourly staff).

Cost savings and achievement, however, are just a few metrics on which to assess the effectiveness policies and thus additional future work is warranted. To better assess the full costs and benefits of these school schedules more consideration must be paid to other potential ramifications of four-day school weeks for students, families, and communities. In particular, the loss of one day per week of the supportive school environment (e.g., access to physical education, healthy school meals) may have implications for child diet, physical activity, and overall health. The addition of one more non-school day per week also may have implications for family relationships and routines and the incidence of juvenile risky behaviors, such as crime (Fischer and Argyle, 2018), drug use, and sexual behavior. The results here suggest that the cost savings in certain spending areas may come at a financial cost to hourly employees that may have ramifications for the distribution of household resources and food security – especially in light of the potential loss of subsidized school meals one day per week. Financial burden may also be placed on families who work outside of the school district, as the day off imposes child care conundrum for many families of young school-aged children, which may lead to reductions in labor supply among parents (Ward, 2019) and/or increased childcare costs. Analyzing revealed preference for these school schedules through changes in housing prices may also help capture the overall community-level welfare changes these four-day school weeks impose. Analyzing these important outcomes and others will help school district decision-makers go beyond the simple cost savings vs. achievement tradeoff calculation and provide them with a better sense of the true tradeoffs that exist regarding the decision to use a four-day school week for cost-saving purposes.

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