DOES A DAY LOST EQUAL DOLLARS SAVED? THE EFFECTS OF FOUR-DAY SCHOOL WEEKS ON SCHOOL DISTRICT EXPENDITURES

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Although four-day school weeks often have financial justifications, researchers know little about whether they save school districts money. This study examines the dynamics of school district expenditures surrounding the adoption of four-day school weeks using a self-collected nationwide panel of four-day school week use from 1999 to 2017 combined with disaggregated school district expenditure data. The study finds that districts use the four-day school week in conjunction with preexisting instructional expenditure reduction policies and that the four-day school week reduces support services expenditures due to decreased educational service provision.

I. INTRODUCTION

School funding in the United States fell by around $1,025 per student between 2008 and 2013 (Leachman, Masterson, and Figueroa, 2017), representing an average spending reduction of 8.4 percent. These declines in revenue have been exacerbated by rising input costs that have outpaced inflation. Most notably, employee benefit costs increased by 22 percent between 2005 and 2014 (Marchitello, 2018), and pension/retirement costs have increased from 4.8 percent of total per pupil expenditures in 2004 to 10.6 percent of total per pupil expenditures in 2018 (Costrell, 2020). This financial climate has left many school districts attempting to find novel ways to balance budgets.

Although school districts have two recourses to balance budgets—increasing revenue and/or reducing expenditures—increasing revenue has been very difficult

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since the Great Recession. First, state aid has been slow to recover, as 25 states during the 2015–2016 school year had general formula aid that was still below 2008 levels (Leachman, Masterson, and Figueroa, 2017). Second, many states have tax limitation policies that restrict local jurisdictions' ability to increase local property taxes, and voters must approve any such increases. Although some school districts find other ways to increase revenue (e.g., instituting student activity fees), expenditure reductions are a primary way school districts alleviate financial problems in the short run. Traditional expenditure reduction policies include teacher and staff layoffs, class size increases, and school site closures. Some states have also developed financial intervention systems to monitor school district financial health and intervene in school districts to help alleviate financial problems.[1] A recent growing trend of school districts switching to four-day school weeks (typically Tuesday–Friday or Monday–Thursday) as a way to reduce expenditures has emerged. Most school districts that adopt this alternative to the traditional five-day school week are rural. Most lengthen the school day on the remaining four days. As of the 2018–2019 school year, approximately 1,607 schools in 662 school districts operated on a four-day school week schedule (Thompson et al., 2020).

 Research on four-day school weeks has generally focused on the effects of these alternative school schedules for students and families, including impacts on student achievement (Anderson and Walker, 2015; Morton, 2020; Thompson, 2021), juvenile crime (Fischer and Argyle, 2018), maternal labor supply (Ward, 2019), and housing prices (Nowak, Perrone, and Smith, 2019).[2] However, given that districts generally adopt these four-day school weeks to lower expenditures (Thompson et al., 2020), researchers should be investigating whether they do. Such investigations have addressed only a small number of school districts or a single state context and have shown small reductions in expenditures. Griffith (2011) projected that the switch to a four-day school week could produce a maximum cost savings of up to 5.4 percent, but his investigation of school districts' actual savings, which indicated savings of between 0.4 and 2.5 percent, addressed only six districts in four states. Similarly, Morton (2020) found cost savings of 1.36 percent in Oklahoma school districts that adopted the schedule.

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[1] Although these approaches have helped these school districts become more financially sustainable, some evidence suggests such interventions can harm student achievement (de la Torre and Gwynne, 2009; Engberg et al., 2012; Brummet, 2014; Larsen, 2020, regarding school closures; Angrist and Lavy, 1999; Krueger, 1999, regarding class size; Thompson, 2016, regarding financial intervention systems), although findings can be contrary (Carlson and Lavertu, 2016, regarding positive impacts of school closures; Hoxby, 2000; Chingos, 2012, regarding null impacts of class size changes).

[2] With the notable exception of Anderson and Walker (2015), which finds positive impacts of four-day school weeks on achievement in Colorado, these studies generally find detrimental impacts of four-day school week adoption. These include lower test scores (Morton, 2020; Thompson, 2021), reduced maternal employment and income (Ward, 2019), increased juvenile crime (Fischer and Argyle, 2018), and lowered housing prices (Nowak, Perrone, and Smith, 2019).

Building off of this literature, this study seems to be the first to examine the dynamics of school district expenditures surrounding the adoption of four-day school weeks using a national data set of all US school districts. I examine expenditure changes and event study estimates that draw on National Center for Education Statistics school district expenditures data from 1999 to 2017 and a unique, self-collected nationwide panel data set of four-day school week usage. Findings indicate minimal reductions, of 1–2 percent, in overall expenditures following four-day school week adoption. Much of this reflects a lack of statistically significant direct impacts of the four-day school week on instructional expenditures. However, the data show notable reductions in instructional expenditures prior to four-day school week adoption, suggesting that districts use four-day school weeks in conjunction with more traditional cost-savings approaches targeting reductions in instructional expenditures. The adoption of the four-day school week reduces support service expenditures by around 4 percent, reflecting reductions in personnel expenditures, including salaries and benefits of employees, and nonpersonnel expenditures, for supplies and materials.

II. BACKGROUND

A. Four-Day School Weeks

The four-day school week, predominantly used in rural contexts, eliminates one required school day per week—a Friday or Monday. Nationally, the school year under a four-day school week model is an average of 148 school days long, which is well below the 175–180 school days typically seen in a traditional five-day school week schedule. Schools adhere to state-mandated minimum yearly instructional hours requirements by providing longer school hours on the remaining four school days. The average school day lasts 7 hours and 45 minutes under a four-day school week model and 6 hours and 54 minutes under a five-day school week model (Thompson et al., 2020). Many school districts offer remedial or enrichment services for students, teacher professional development, and/or student extracurricular events on the off-day.

A recent survey by Thompson et al. (2020) found that nearly two-thirds of districts that adopt these four-day school schedules cite financial reasons; other key reasons they cite include teacher retention, student attendance, and rural-related issues (e.g., commuting time, farming/ranching). A majority of four-day school week districts (92.7 percent) implement these school schedules districtwide. Others ("select school" districts) typically adopt the four-day school week for a handful of remote, rural public schools or individual charter/specialized schools within the school district only. Of the 627 districts that eventually adopted the four-day school week districtwide, 612 (97.6 percent) initially adopted these school schedules districtwide, and the remaining 15 began the four-day school week in select schools before moving to districtwide implementation within two to five years.

Although the use of the four-day school week dates back to the 1970s or earlier, over the past two decades the number of school districts with at least one school operating on a four-day school week schedule has grown significantly. In 1999, 108 US public school districts had at least one school operating on a four-day school week; by 2017 there were 586 (see Figure 1a).[3] As noted in Figures 1b and 1c, this expansion has been geographic. In 1999, 10 US states had four-day school weeks, and the majority were in Arizona, Colorado, New Mexico, or Oregon; by 2017, 24 states had them. Four-day school weeks remain largely a rural phenomenon, but adoption has grown in nonrural school districts. The number of school districts operating the four-day school week in select schools has also risen (see Figure 1a). Despite this growth, only 1.56 percent of students in the 24 four-day school week states attended school four days per week during the 2016–2017 school year.

B. School District Budgets

School districts depend on a mix of local, state, and federal revenues. Local revenue primarily consists of local property or income tax revenue, with activity fees and parental contributions providing additional revenue. Most state revenue comes in the form of state formula aid through the state's school funding equalization system, but transportation reimbursements, restricted funds for special and vocational education, and state building aid programs to subsidize capital projects provide additional state revenue. State governments distribute most federal revenue, which covers, among other things, school meal programs and bilingual, special education, Title I, and vocational education programs.

Some revenue sources (e.g., state formula aid, local tax revenue for current expenditures) contribute to the unrestricted general fund, which school district officials can allocate at their discretion. As Table 1 indicates, these fungible expenditures account for roughly 80 percent of total expenditures per pupil ($12,319 average). Restricted funds (e.g., local tax revenue for capital bond projects, federal/state lunch program revenues) cover expenses such as food service for school meal programs, extracurricular student activities, and large-scale capital infrastructure investments. As Table 1 indicates, these items account for around 20 percent of total expenditures per pupil.

Districts primarily use general funds to pay for instructional and support services expenditures. Instructional expenditures include salaries and benefits for teachers and instructional aides as well as classroom-related materials. Support service expenditures include salaries and benefits for support staff as well as materials costs related to a host of auxiliary school services, including (1) pupil support, which includes

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[3] Although the sample period of this study ends in 2017, the number of four-day school week districts has continued to grow in the past few years. In fact, by 2019, there were more than 660 school districts across the country with at least one four-day school week school (Thompson et al., 2020).
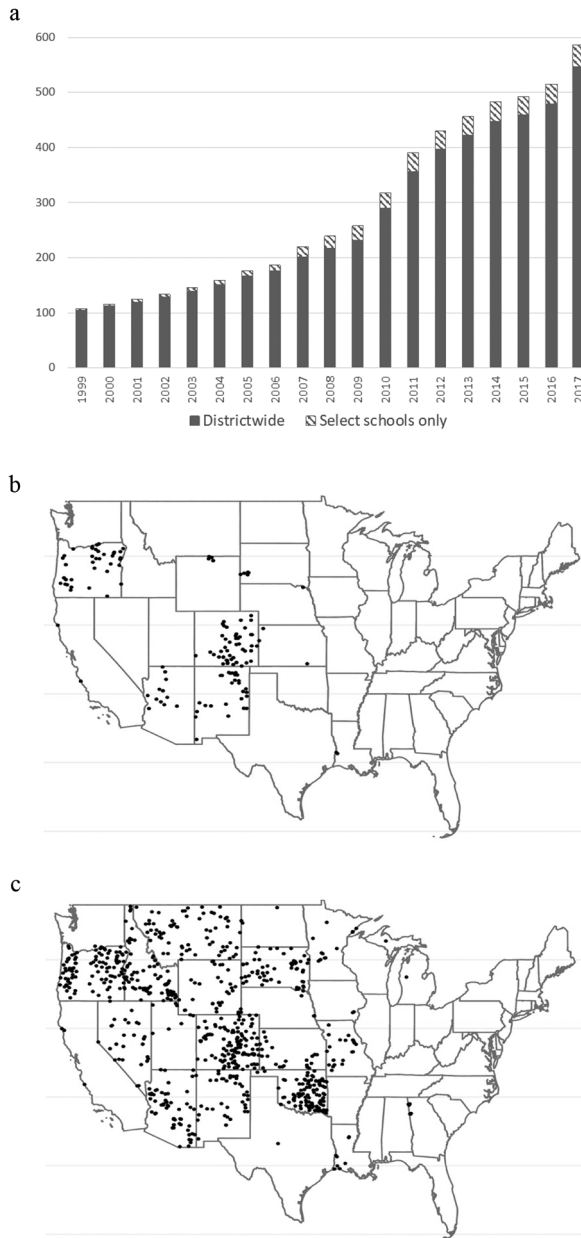
Figure 1. Four-day school week policy variation. (a) Growth in four-day school week districts, 1999–2017. (b) Four-day school week districts, 1999. (c) Four-day school week districts, 2017.

Table 1

Average Expenditures and Definitions, by Expenditure Category

	All Schools	Four-Day	Description
Panel A: Overall Expenditures			
Total expenditures	12,318.96	13,022.74	Total school district spending
	(12,397.38)	(8,946.37)	
Personnel	8,055.93	8,118.72	
	(6,064.15)	(4,357.32)	
Nonpersonnel	4,263.03	4,904.01	
	(8,407.86)	(6,012.15)	
Fungible expenditures	9,966.78	10,976.82	Total school district spending on
	(9,235.61)	(6,764.00)	instruction and support services
Personnel	7,867.84	7,888.40	
	(6,026.55)	(4,293.09)	
Nonpersonnel	2,098.93	3,088.42	
	(4,472.80)	(3,001.17)	
Nonfungible expenditures	1,580.53	1,699.62	Total school district spending on
	(3,056.82)	(4,620.82)	capital and debt service projects,
			food services, and other restricted
			fund services
Instructional	6,199.06	6,456.43	Total spending on instruction;
	(5,093.32)	(3,646.76)	includes activities directly associated
Personnel	5,515.25	5,452.43	with the interaction between
	(3,684.09)	(2,909.36)	teachers and students, including
Nonpersonnel	683.81	1,004.00	teacher salaries and benefits,
	(2,994.21)	(1,127.44)	supplies (such as textbooks), and
			purchased instructional services
Support services	3,700.71	4,433.22	Total spending on support services;
	(4,877.81)	(3,437.19)	includes school and school district
Personnel	2,352.59	2,435.97	administration, student and
	(2,746.40)	(1,754.73)	instructional staff support, school
Nonpersonnel	1,348.12	1,997.25	facility operations and maintenance,
	(2,710.87)	(2,286.47)	student transportation, and fiscal
			and school district business
			services
Panel B: Disaggregated Support Services Expenditures			
Pupil support	462.10	358.35	Expenditure for attendance record
	(732.90)	(420.15)	keeping, social work, student
Personnel	386.58	218.58	accounting, counseling, student
	(560.28)	(232.49)	appraisal, record maintenance,

Table 1 (Continued) Average Expenditures and Definitions,
by Expenditure Category

	All Schools	Four-Day	Description
Nonpersonnel	75.52	139.78	and placement services; this
	(387.24)	(336.88)	category also includes medical,
			dental, nursing, psychological,
			and speech services
Instructional staff support	371.32	293.84	Expenditure for supervision and
	(784.74)	(347.49)	instruction service improvements;
Personnel	275.93	180.56	curriculum development; instructional
	(577.92)	(179.95)	staff training; and instructional
Nonpersonnel	95.39	113.28	support services, such as libraries,
	(300.20)	(269.14)	multimedia centers, and computer
			stations for students who are
			outside of the classroom
School district administration	424.29	705.25	Expenditure for board of education
	(846.65)	(844.12)	and executive administration
Personnel	279.73	483.20	(office of the superintendent)
	(522.25)	(611.43)	services
Nonpersonnel	144.56	222.05	
	(456.14)	(421.26)	
School administration	534.28	486.80	Expenditure for the office of the
	(397.06)	(402.32)	principal services
Personnel	503.37	451.03	
	(364.31)	(363.02)	
Nonpersonnel	30.91	35.77	
	(88.46)	(87.05)	
Operations and maintenance	1,037.75	1,372.38	Expenditure for building services
	(972.47)	(1,356.44)	(heating, electricity, air conditioning,
Personnel	454.38	486.28	property insurance), care and
	(401.25)	(454.80)	upkeep of grounds and equipment,
Nonpersonnel	583.37	886.10	nonstudent transportation vehicle
	(690.66)	(1,087.59)	operation and maintenance, and
			security services
Student transportation	516.84	690.68	Expenditure for the transportation of
	(2,479.14)	(933.68)	public school students, including
Personnel	234.01	308.26	vehicle operation, monitoring
	(1,093.54)	(614.82)	riders, and vehicle servicing and
Nonpersonnel	282.84	382.42	maintenance
	(1,886.56)	(551.00)	

Note: Each cell contains the average expenditure per pupil across all public schools in the United States, given in 2015 dollars. Standard deviations are given in parentheses. Descriptions are based on NCES F-33 documentation.

guidance counseling, school-based health services, and other student services provided outside the classroom; (2) instructional staff support, which includes curriculum support, professional development services, and library, media, and technology services; (3) school district administration, which consists of the school board and the office of the superintendent; (4) school administration, which consists of the various principals' offices in the district; (5) operations and maintenance, which includes school facility heating and cooling, electricity, maintenance, and security services; (6) student transportation, which consists of bus operations and maintenance; and (7) business services, which consists of fiscal services, purchasing, printing, and other miscellaneous services.

As shown in Table 1, the amount of expenditures per student varies across these services, as does the distribution of personnel and nonpersonnel expenditures within these categories. Around 62 percent of fungible expenditures come from instructional expenditures, which are heavily (~85 percent) associated with personnel expenditures. Overall, personnel expenses account for about two-thirds of support services expenditures, and nonpersonnel expenses account for the rest, but the various subgroups of spending show a great deal of variation in this distribution. As with instructional expenditures, personnel expenditures account for much of the expenditures related to pupil support services, instructional staff support services, and school administration. In contrast, nonpersonnel expenditures drive a majority of student transportation services and facility operations and maintenance expenditures.

C. Conceptual Framework: Why Might Four-Day School Weeks Affect School District Expenditures?

As financial savings often motivate the adoption of four-day school weeks, research must explore how the four-day school week may affect school district expenditures. Districts that look to the four-day school week as a way to save money most likely have three avenues of savings in mind. First, staffing reduction, through layoffs or attrition, in response to the introduction of the four-day school week could save money. Second, the reduced cumulative school hours could save money in personnel-related expenditures, directly with respect to hourly employees and through reduced salaries among salaried employees. Finally, nonpersonnel expenditures, especially in spending areas that have a high degree of variable nonpersonnel costs (e.g., transportation services), could fall as well.

In the absence of revenue increases, school districts can balance their budgets only by reducing fungible expenditures that they pay out through the general fund. Although reduced educational service provision may also reduce expenditures in nonfungible funds (e.g., food services), these reductions matter little to overall budgetary savings as districts cannot use them to offset budget deficits in the general fund or help increase spending in other areas. Thus, this subsection discusses how instructional and support services expenditures from the general fund may change in the years leading up to and after the adoption of the four-day school week.

1. Instructional Expenditures

Given that teachers are often on fixed, collectively bargained salary schedules with a set number of contract days, regardless of the number of student days, it is unlikely that the switch to the four-day school week alone will affect instructional expenditures much. Thus, it is unlikely the four-day school week directly affects instructional expenditures.

However, school districts may adopt the four-day school week in conjunction with or in response to more traditional cost-savings methods targeting instructional expenditures (e.g., furloughs, early retirement packages, temporary pay decreases, or renegotiated lower pay scales). Many school districts cite teacher retention and recruitment as a key consideration in four-day school week adoption (Thompson et al., 2020), often in addition to the financial savings rationale. In this case, the four-day school week would not provide any tangible instructional expenditure reductions on its own; instead, it would provide a nonmonetary benefit to teachers, a three-day weekend, to offset the lower salary that the more traditional cost-savings approaches set. Research has shown that teachers generally like the four-day school week (Turner, Finch, and Ximena, 2017), and thus these school schedules may lessen the impact of traditional instructional cost-cutting methods on the quality of the teaching pool.

School districts more concerned about providing competitive wages and recruiting or retaining teachers than they are about cost savings may choose to transfer some or all of the realized expenditure reductions from the various support services, described in the next subsection, toward greater instructional spending. Such a reallocation of spending would increase instructional expenditures in the years following the initial adoption of the four-day school week.

2. Support Services

The decreased provision of educational services due to the four-day school week should directly affect support services. The resulting reductions should occur immediately following four-day school week adoption and persist in the years following. Due to the structures of these school schedules (e.g., use of off-day activities for students and/or teachers), the four-day school week should affect some expenditure types within the support services category more than others. This subsection explains these differences.

Pupil and instructional staff support services. Similar to teachers and instructional staff, many pupil and instructional staff support services employees are salaried workers (e.g., nurses, guidance counselors, librarians). Thus, the four-day school week should not have much direct effect on personnel expenditures in these categories. However, as with teaching staff, the changed schedule may compensate these employees for lowered salaries. If this occurs, expenditures in these categories will fall concurrently or in anticipation of four-day school week adoption. Reductions in the provision of

these services in conjunction with or as a result of the four-day school week should also result in reductions of nonpersonnel expenditures. However, greater use of teacher professional development on the off-day—services that are provided by instructional support staff—may yield increases in expenditures for these services following the adoption of the four-day school week.

School and school district administration. Although the school district superintendent and school principals largely receive fixed salaries, districts that close central offices one day a week—which seems likely only in districts that adopt the schedule districtwide—should decrease school and school district administration costs. Reduced weekly hours will tend to decrease administrative staff pay. Reductions in expenditures are expected to be smaller for school district administration, as the switch to the four-day school week is unlikely to change some services the school district administration provides—most notably the school board and central office fiscal services.

Operation and maintenance of school facilities. Closing school buildings one additional day per week would yield immediate and persistent expenditure reductions on heating and cooling, electricity, and security and could potentially reduce the amount of maintenance and upkeep school facilities require over time. The school district could also see reductions in personnel costs among hourly maintenance and janitorial staff. However, many school and district facilities remain open in some capacity, which may limit the amount of expenditure reductions that school districts realize in this category. A majority of four-day school week school districts open for student remedial and enrichment off-day programs, teacher professional development, and/or extracurricular events and practices within their facilities at least some weeks out of the school year.[4] Thus, I expect expenditure reductions in this category to be minimal.

Student transportation. Eliminating the need for student transportation to and from school one additional day per week would yield expenditure reductions on bus operations (e.g., fuel costs) and reductions in personnel costs among hourly bus drivers. The bus route lengths would remain the same, and thus longer school days are unlikely to increase bus drivers' work hours on the remaining four school days. Thus, personnel

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[4] As Thompson et al. (2020) note, more than 80 percent of four-day school week districts take Fridays off. As most school districts hold football games and other athletic and extracurricular events on Fridays, the Friday-off model may yield lower cost savings than those using the Monday-off model. Supplementary analyses presented in Table A5 provide suggested evidence to support this hypothesis. As shown in Panel B of Table A5, school districts choosing a Monday off-day see a 3.3 percent greater reduction in operating expenditures than those using a Friday off-day. In light of the results presented in Panel C of Table A5, however, the fact that a significantly greater proportion of the group using a Monday off-day cite financial motivations for the switch to four-day school weeks may drive this result (Thompson et al., 2020). As noted in Panel C of Table A5, school districts that choose the four-day school week for financial reasons have more pronounced cost savings. These results suggest that the four-day school week may not intrinsically be a cost-savings policy, and schools that have these financial motivations may need to put in additional effort or other cost-savings measures beyond just switching the school calendar to realize savings.

cost savings are likely larger among this group. However, if bus drivers drive students to extracurricular activities on the off-day, this would negate the savings.

In summary, the adoption of the four-day school week likely reduces some school district expenditures—primarily support services—due to the reduction of educational services one additional day per week. The four-day school week may complement other policies that reduce instructional expenditures by making lowered salaries more palatable, but direct effects of the four-day school week on spending on instruction are unlikely. As instructional expenditures make up more than 50 percent of all per pupil expenditures in these school districts (see Table 1), this may severely dampen the overall expenditure reductions that districts can achieve solely by switching to the four-day school week. Therefore, I expect to find that the switch to the four-day school week generates only small overall expenditure reductions.

III. DATA

This study uses the National Center of Education Statistics (NCES) F-33 financial database, which contains detailed yearly financial data by expenditure type for all public K–12 school districts in the United States from 1999 to 2017. In addition to total expenditures, I use disaggregated totals for fungible and nonfungible expenditures.[5] I also examine the following fungible expenditure subcategories: (1) instructional, (2) support services, (3) school district administration, (4) school administration, (5) pupil support services, (6) instructional staff support services, (7) operations and maintenance, and (8) student transportation.[6] The NCES F-33 database also provides disaggregated data on salaries and benefits for employees in each of these categories. To create the total personnel 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 nonpersonnel costs. Personnel expenditures relate only to salaries and benefits for employees that the school district hired directly. In some cases, school districts contract out these services to private firms (e.g., contracting out student transportation to private bus companies). These school districts make contract payments to these private firms, who in turn pay the wages and benefits to the contracted employees. The NCES data classify these contract payments as

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[5] Fungible expenditures include instructional and support services expenditures, as measured by the NCES F-33 files. In an actual budget, however, a small percentage of these expenditures would be classified as nonfungible expenditures. For example, districts use special education funds, nonfungible funds from state and federal levels, to pay for special education instructional expenditures. The NCES F-33 files classify this expenditure under instructional expenditures. Thus, the categories I used in this analysis are only an approximation of fungible versus nonfungible funds.

[6] In addition to these expenditure categories used in the main analysis, I collected disaggregated revenue measures and included them in analyses presented in Panel D of Table A4. I collect revenue information on total revenue and the following disaggregated categories: (1) total local revenue, (2) local property tax revenue, (3) other local tax revenue, (4) other local revenue, (5) total state revenue, (6) state general formula aid, (7) transportation reimbursement, (8) other state revenue, and (9) total federal revenue.

nonpersonnel expenditures. To control for differences in student composition across these districts, I use NCES Common Core of Data variables such as the percentage of students eligible for free and reduced lunch, percentage of white students, pupil-teacher ratios, and percentage of English-language learners and those with individualized education plans.

To augment the NCES data, I assembled a nationwide, school district–level panel data set of four-day school week use dating back to 1999 — seemingly the first of its kind. To identify which school districts operated on a four-day school week schedule, I collected lists of four-day school week districts from state department of education websites.[7] Although some states maintained historical lists of four-day school week use, many had lists for only the most recent year. To find out when each school district started its four-day school week in those states, research assistants and I emailed and telephoned the districts on the current-year lists. Archived newspaper reports and school websites provided additional information on four-day school week adoption.[8] The analytic sample contains all 8,193 public school districts in the 24 states that ever had a school district operate on a four-day school week between 1999 and 2017, of which 675 had at least one school operate on a four-day school week for at least one year during that time period.[9]

Table 2 provides descriptive statistics for the expenditure types and demographic characteristics across the different categories of four-day school week use. Expenditures per pupil are larger, on average, postadoption of the four-day school week. Although this may reflect rising costs over time, it may also be that the switch to these school schedules prevents costs from increasing even more.[10] Other factors (e.g., fixed factors about these districts, changes in enrollment, regional economic

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

[8] In total, the four-day school week data set contains full historical four-day school week use for 2,006 out of the 2,081 (96.4 percent) schools that have ever had a four-day school week. I collected partial historical data (e.g., missing a few years of data) for the remaining 75 schools. Reasons for missing data include lack of sufficient past records and lack of response from districts regarding historical four-day school week use. Given the retrospective nature of the historical data, I may have misclassified some years (e.g., coded them as a four-day when actually a five-day). Although the rate of misclassification is likely small, these types of misclassification errors would bias the results against finding an effect of four-day school weeks on school district expenditures.

[9] Restricting the sample to this group of states yields the population of interest in this study (i.e., the universe of states where four-day school weeks are currently possible). However, the results are robust to the inclusion of five-day school week districts from the other 26 states. As noted in Panel A of Table A4, the general conclusions are the same with these other districts included in the analysis, although the magnitudes are generally larger than in the baseline case.

[10] Variation in national per pupil expenditure growth rate during this period and the fact that these pre- and postsamples encompass different years may drive some of this. In fact, according to data from the NCES, national per pupil expenditure rose by almost 2 percent per year between 2003 and 2009, fell by about 1.3 percent per year between 2009 and 2013, and then rose by around 2 percent per year again between 2013 and 2016.

Table 2

Summary Statistics, by Four-Day School Week Type

	Panel A:	Panel B: Districtwide		Panel C: Select Schools Only	
	No 4DSW	Pre-4DSW	4DSW	Pre-4DSW	4DSW
School district expenditures					
Total expenditures pp	14,881	13,347	15,027	11,637	13,307
	(22,616)	(6,258)	(8,204)	(3,342)	(5,326)
Fungible expenditures pp	11,927	11,408	12,770	9,569	10,349
	(17,803)	(5,410)	(7,065)	(2,698)	(3,691)
Nonfungible expenditures pp	1,815	1,595	1,863	1,656	2,470
	(3,121)	(1,430)	(2,473)	(999)	(2,165)
Instructional expenditures pp	7,316	6,838	7,515	5,669	6,046
	(8,645)	(2,892)	(3,939)	(1,458)	(2,042)
Support services expenditures pp	4,527	4,446	5,189	3,797	4,234
	(10,884)	(2,678)	(3,436)	(1,321)	(1,775)
District administrative expenditures pp	532	677	867	238	246
	(1,430)	(590)	(1,092)	(181)	(215)
School administrative expenditures pp	619	516	546	634	701
	(507)	(334)	(384)	(207)	(270)
Student support services expenditures pp	554	361	419	487	607
	(1,165)	(243)	(335)	(270)	(364)
Instructional staff support services expenditures pp	464	328	342	401	481
	(1,624)	(254)	(438)	(235)	(308)
Operations and maintenance expenditures pp	1,187	1,375	1,649	1,100	1,150
	(1,038)	(947)	(1,434)	(418)	(582)
Transportation expenditures pp	727	719	759	474	550
	(7,743)	(883)	(877)	(199)	(251)
School district demographics					
Total enrollment	3,573	580	527	21,027	15,710
	(12,006)	(933)	(976)	(63,390)	(50,858)
Fraction white	0.77	0.77	0.72	0.74	0.69
	(0.92)	(0.24)	(0.24)	(0.17)	(0.18)
Fraction female	0.47	0.43	0.48	0.45	0.48
	(0.56)	(0.13)	(0.07)	(0.07)	(0.01)
Fraction free/reduced lunch	0.42	0.48	0.53	0.43	0.45
	(0.44)	(0.22)	(0.24)	(0.15)	(0.13)
Fraction rural	0.52	0.87	0.89	0.28	0.25
	(0.45)	(0.29)	(0.30)	(0.38)	(0.38)
Observations	14,072	509	509	42	42

Note: Per-pupil (pp) expenditure variables are given in 2015 dollars. Standard deviations are given in parentheses. The "No 4DSW" column provides the average expenditures and demographics for only school districts that never had a four-day school week between 1999 and 2017. The "Pre-4DSW" columns provide 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 2017. The "4DSW" columns provide the average expenditures and demographics after the switch to the four-day school week for this same set of districts. The "Districtwide" category includes all four-day school week districts that eventually adopt the policy districtwide. The "Select Schools Only" category includes all four-day school week districts that adopted the four-day school week schedule only in select schools.

trends) also confound this simple comparison of means. Due to these issues, researchers should be cautious in drawing conclusions from differences in these raw means before and after four-day school week adoption. The empirical analyses described in the following section, which attempt to control for these other factors, will provide more meaningful conclusions in regard to the changes in expenditures resulting from adoption of the four-day school week.

The data show key differences between the districtwide four-day school week adopters and those that adopt the school schedule only in select schools. Most notably, four-day school week school districts that adopt the four-day school week districtwide are smaller, on average, than those implementing the four-day school week for only a select number of schools. As noted in Table 2, those implementing districtwide have average enrollments of 580 prior to four-day school week adoption compared with 21,027 for school districts adopting the four-day school week in select schools.[11] Districtwide four-day school week adopters are also much more frequently from rural areas. In fact, 77.2 percent of the 627 districtwide adopters are rural districts, whereas only 28.6 percent of the 49 districts implementing the four-day school week in select schools and 52 percent of the 14,072 districtwide five-day school week districts are rural.[12]

IV. EMPIRICAL STRATEGY

To more formally analyze the relationship between four-day school week adoption and school district expenditures, I estimate the following regression equation.

$$\ln(Y_{dt}) = \alpha + \beta_1 Fourday_{dt} + \gamma_1 \ln(enroll_{dt}) + \lambda_d + \phi_t + \epsilon_{dt}, \qquad (1)$$

where Y_{dt} is a per-pupil expenditure variable of the various disaggregated types described in the data subsection;[13] $\ln(enroll_{dt})$ is the natural log of school district enrollment; λ_d is a set of school district fixed effects; ϕ_t is a set of school-year fixed effects; and ϵ_{dt} is an idiosyncratic error term.[14] The key variable of interest, $Fourday_{dt}$, is a

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[11]   In addition to smaller enrollments, districtwide four-day school week districts have fewer numbers of schools than the other two groups of districts (see Table A2). Among districtwide four-day school week districts, 25 percent have only one school, 80 percent have three or fewer schools, and only 8 percent have six or more schools. Districts implementing in select schools all have more than one school and only 6 percent have three or fewer schools, whereas 78 percent have six or more schools. Among districtwide five-day school week districts, 14 percent have only one school, 49 percent have three or fewer schools, and 31 percent have six or more schools.

[12]   These numbers vary slightly with the numbers in Table 2, which only includes four-day school weeks where the pre- and post-four-day school week periods are observed. Here, 87–89 percent of the 509 districtwide four-day school week adopters are rural and 25–28 percent of the 42 select school districts are rural.

[13]   I also include a supplementary analysis that uses per pupil expenditure levels measured in dollars as the dependent variable. These results appear in Table A3.

[14]   As the switch to the four-day school week may endogenously determine many of the time-varying observable characteristics (e.g., the fraction of district enrollment that is white, the fraction that is

continuous treatment measure equal to the fraction of district enrollment that attends school on a four-day school week in school year t.[15] Although I expect this analysis to find $\beta_1 < 0$ for the various expenditure types, I also expect the overall effects to be small in magnitude due to the reasons outlined in Subsection II.C. The variable β_1 will likely be larger in magnitude for services, such as transportation, that are likely to see the greatest amount of service reduction.

To examine the dynamic changes in these expenditures around the timing of four-day school week adoption, I also estimate the following event study specification

$$\ln(Y_{dt}) = \alpha + \sum_{k=-4}^{4} \beta_k Fourday_{dtk} + \gamma_1 \ln(enroll_{dt}) + \lambda_d + \phi_t + \epsilon_{dt}, \qquad (2)$$

where $Fourday_{dtk}$ 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 all schools in the district.[16] For expenditures 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 student transportation is no longer needed one day per week. Instructional expenditures 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 the district and the teachers negotiate new contracts in the future.

As Subsection II.C notes, three different mechanisms may drive cost reductions: (1) staffing layoffs or voluntary employee departures, (2) reductions in personnel-related costs, and (3) reductions in nonpersonnel expenditures. To examine these three aspects, I also use as dependent variables (1) the number of employees for

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female, the fraction that is English-language learners, the fraction with an individualized education plan, and the fraction that receives free and reduced lunch), the main analyses omit these characteristics. Thus, this specification relies solely on the fixed effects for identification. Although this likely reduces the precision of the estimate of the four-day school week effect, it will avoid introducing potential endogeneity bias into the model. I include these time-varying factors as a sensitivity analysis, and the results appear in Panel C of Table A4. When including the time-varying school district characteristics as covariates, I find that the magnitudes of the effects are generally larger than the baseline estimates.

15 A common approach is to use a dummy variable indicating whether a school district has at least one school in the district operating on a four-day school week schedule. I prefer the continuous measure to the dummy variable version in this case because the continuous measure more accurately captures the treatment intensity. Given that only a small fraction of students in "select school" districts attend a four-day school week, the dummy variable version overstates treatment intensity for these districts. This is likely to lead to understating the impact of the four-day school week on expenditures. Supplementary analyses, the results of which appear in Panel B of Table A4, show that using the dummy variable version generates similar magnitude effects as the continuous case.

16 For simplicity, this treatment assignment classifies school districts with less than districtwide adoption of the four-day school week in the control group. Given the results presented in Panel A of Table 3 and Panel B of Table A4, this choice should not have a noticeable impact on the estimated effects. As those two tables reflect, the results from (1) give similar results regardless of whether we use the continuous treatment measure or this districtwide treatment criterion.

each expenditure subcategory, (2) the total personnel costs within each expenditure subcategory, and (3) the nonpersonnel costs within each expenditure subcategory.

Noticeable pretrends in school district enrollment (see Figure A1a) drove the decision to control for enrollment in this proposed empirical strategy. Thus, estimates using per-pupil dependent variables likely include changes in per-pupil expenditures resulting from four-day school week adoption and those mechanically related to enrollment changes in these districts. As set contracts essentially fix some school district expenditures in the short run, they may be sluggish to adjust to shocks (e.g., enrollment declines, funding shortfalls). In this case, a decrease in the number of students will mechanically yield an increase in expenditures per pupil, which may mask any potential savings from the four-day school week. Conditioning on enrollment (or the natural log of enrollment in this case), however, allows the model to disentangle these two effects and isolate the impact of four-day school weeks on school district expenditures.

The baseline analyses I described earlier use the full analytic sample consisting of all school districts in the 24 states with four-day school week schools. One concern with using this full sample, however, is that because four-day school week districts are generally smaller and more rural than their five-day school week counterparts (see Table 2), using all school districts in the analytic sample does not create a representative comparison group in these analyses. Although the inclusion of the enrollment variable and the school district fixed effects largely controls for fixed differences across these various types of districts, as noted in Figures A1b and A1c, total per-pupil expenditures also appear to trend differentially across time—particularly after the Great Recession—for rural and urban school districts and small and medium/large enrollment school districts. To account for these differences in trends, I conduct a couple of sensitivity analyses. First, I restrict the sample to include only rural districts. Second, to account for differential trends, I conduct a specification that includes school district–specific time trends.

V. RESULTS

For ease of interpretation and discussion, I have organized the results of these analyses into separate subsections for each expenditure category type. Within each of these subsections, I discuss the following: (1) Equation (1) results on the overall changes in spending from pre- to postadoption and those stratified by personnel versus nonpersonnel expenditures that appear in Table 3, (2) results of sensitivity analyses including school district–specific time trends or only rural schools that appear in Table 4, (3) Equation (2) results of the event study specification that appear in Figures 2 and 3, and (4) results of the event study specification stratified by personnel versus nonpersonnel expenditures that appear in Table 5.[17]

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[17] 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 95 percent confidence interval around each of these point estimates.

A. Total and Fungible Expenditures

Generally, the results suggest that school district expenditures are lower than preadoption levels following four-day school week adoption. Most notably, total expenditures are 2.9 percent lower than preadoption spending levels following the switch to the four-day school week. Total expenditures among fungible spending categories are 3.4 percent lower than preadoption spending levels following the switch to the four-day school week. I find similar postadoption differences—2.5–2.9 percent lower total expenditures and 3 percent lower fungible expenditures—when restricting the sample to rural school districts or including school district–specific time trends. As noted in Panels B and C of Table 3, lower personnel expenditures primarily drive these changes in spending. Overall, total personnel expenditures are 4.4 percent lower than preadoption levels following the switch to the four-day school week. Personnel expenditures in fungible spending categories decrease by 4.3 percent compared with preadoption spending levels following the switch to the four-day school week. There are negligible and statistically insignificant differences for total nonpersonnel and fungible nonpersonnel expenditures.

The results in Figures 2a and 2b suggest that the bulk of the declines in spending occur in the years prior to four-day school week adoption. As evidenced in Figure 2a, total expenditures fall by around 2.6 percent in the years before four-day school week adoption. The years following four-day school week adoption show no statistically significant changes to total expenditures. Total expenditures among fungible spending categories (Figure 2b) show a similar trend, with fungible expenditures falling by 2.6 percent in the years before four-day school week adoption. The years following four-day school week adoption show additional declines in fungible expenditures—up to 2.3 percent.

B. Instructional Expenditures

As noted in Column 3 of Table 3, instructional expenditures are 3.2 percent lower than preadoption spending levels following the switch to the four-day school week. These expenditure changes are slightly lower among rural school districts (see Column 3 of Table 4, Panel A): the dip is only 2.6 percent. The inclusion of school district–specific time trends shows an even smaller estimated magnitude, 1.8 percent. Lower spending on both personnel and nonpersonnel drives these changes in instructional spending. Instructional personnel expenditures are 3.1 percent lower, whereas instructional nonpersonnel expenditures are 6.4 percent lower than preadoption levels.

As noted in Figure 2c, instructional expenditures appear to be falling prior to four-day school week adoption. Specifically, instructional expenditures fall by 4.4 percent in the years before four-day school week adoption. As expected, the four-day school week shows little, if any, direct effects on instructional expenditures, as the lack of any statistically significant effects following four-day school week adoption reflects.

Table 3

Effects of Four-Day School Weeks on School District Expenditures

	Total Expend.	Fungible Expend.	Instruct. Expend.	Support Services Expend.	District Admin. Expend.	School Admin. Expend.	Student Support Expend.	Instruct. Support Expend.	Operations and Maintenance Expend.	Transp. Expend.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Overall Expenditures										
Four-day	−0.029***	−0.034***	−0.032***	−0.036***	−0.011	−0.068***	−0.063**	−0.141***	−0.009	−0.107***
	(0.009)	(0.007)	(0.008)	(0.009)	(0.018)	(0.022)	(0.029)	(0.032)	(0.011)	(0.014)
Observations	143,429	143,429	143,428	143,428	141,172	135,873	134,671	137,670	141,863	139,001
R^2	0.988	0.996	0.995	0.993	0.945	0.971	0.954	0.944	0.985	0.972
Panel B: Personnel Expenditures										
Four-day	−0.044***	−0.043***	−0.031***	−0.039***	−0.009	−0.081***	−0.131***	−0.108***	−0.046**	−0.059*
	(0.008)	(0.008)	(0.008)	(0.011)	(0.016)	(0.020)	(0.030)	(0.033)	(0.018)	(0.030)
Observations	143,424	143,424	143,407	141,549	137,909	134,969	128,188	131,667	139,685	126,383
R^2	0.995	0.995	0.995	0.992	0.907	0.975	0.953	0.938	0.970	0.945
Panel C: Nonpersonnel Expenditures										
Four-day	−0.007	−0.019*	−0.064***	−0.004	−0.010	−0.041	−0.029	−0.119***	0.004	−0.158***
	(0.016)	(0.012)	(0.020)	(0.012)	(0.023)	(0.038)	(0.042)	(0.041)	(0.014)	(0.022)
Observations	143,466	143,466	143,318	143,464	140,751	127,463	129,522	136,024	141,889	138,611
R^2	0.942	0.968	0.938	0.965	0.879	0.855	0.845	0.872	0.958	0.920

Note: Each column of the table presents results from a separate regression containing the natural log of the specified dependent variable. Each specification controls for the natural log of enrollment, school-year fixed effects, and school district fixed effects. Robust standard errors clustered at the school district level are given in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

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Table 4

Sensitivity Analyses

	Total Expend.	Fungible Expend.	Instruct. Expend.	Support Services Expend.	District Admin. Expend.	School Admin. Expend.	Student Support Expend.	Instruct. Support Expend.	Operations and Maintenance Expend.	Transp. Expend.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Rural School Districts Only										
Four-day	−0.029***	−0.030***	−0.026***	−0.035***	−0.008	−0.068***	−0.063*	−0.126***	−0.011	−0.102***
	(0.009)	(0.007)	(0.008)	(0.009)	(0.019)	(0.025)	(0.033)	(0.035)	(0.011)	(0.015)
Observations	89,051	89,051	89,050	89,051	87,751	82,780	81,718	84,476	88,399	86,193
R^2	0.979	0.991	0.990	0.986	0.927	0.935	0.907	0.889	0.971	0.962
Panel B: School District Specific Time Trends Included										
Four-day	−0.025***	−0.030***	−0.018***	−0.047***	−0.052***	−0.055**	−0.088***	−0.051	−0.035***	−0.082***
	(0.009)	(0.006)	(0.006)	(0.008)	(0.017)	(0.022)	(0.028)	(0.032)	(0.010)	(0.012)
Observations	143,429	143,429	143,428	143,428	141,172	135,873	134,671	137,670	141,863	139,001
R^2	0.992	0.998	0.997	0.996	0.966	0.981	0.972	0.966	0.991	0.984

Note: Each column of the table presents results from a separate regression containing the natural log of the specified dependent variable. Each specification controls for the natural log of enrollment, school-year fixed effects, and school district fixed effects. Robust standard errors clustered at the school district level are given in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.
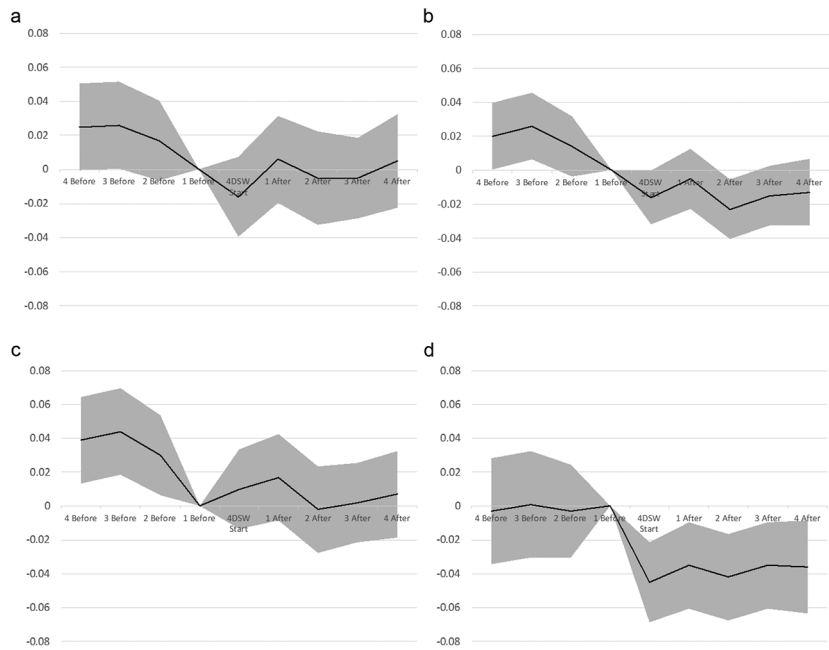
Figure 2. Event study results: overall expenditures. (a) Total expenditures. (b) Fungible expenditures. (c) Instructional expenditures. (d) Support services expenditures.

The instructional expenditure reductions prior to four-day school week adoption result from a mix of reductions to personnel and nonpersonnel expenditures. A majority of these reductions come from personnel expenditures, which fall by 4.1 percent in the years before four-day school week adoption. This is despite the fact that the number of instructional personnel rises (although the effects are statistically insignificant) in the year before four-day school week adoption (see Column 1 of Table 5). Nonpersonnel expenditures fall by 9.8 percent in the years before four-day school week adoption. Following four-day school week adoption, instructional personnel expenditures show no statistically significant changes, but instructional nonpersonnel expenditures show some statistically significant increases. Specifically, instructional nonpersonnel expenditures increase by 6.3–7.9 percent in the first few years of four-day school week adoption.

C. Support Services Expenditures

1. Total Support Services Expenditures

Total expenditures on support services are 3.6 percent lower than preadoption spending levels following the switch to the four-day school week. I find similar
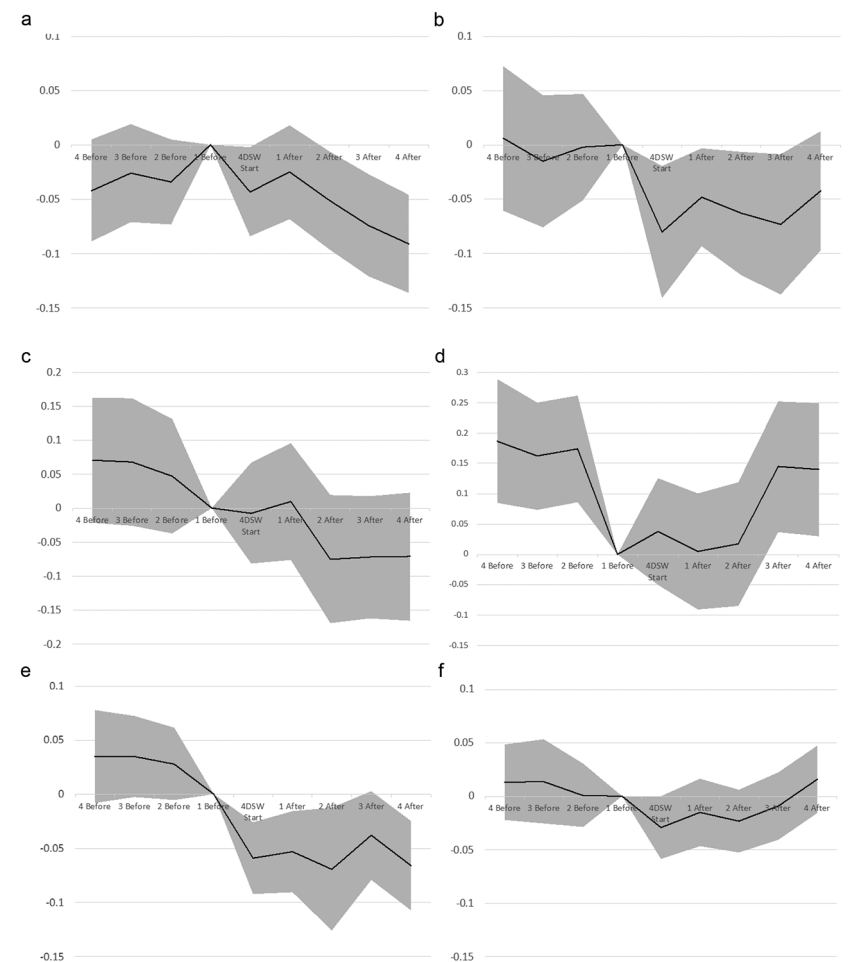
Figure 3. Event study results: disaggregated support services expenditures. (a) District administrative expenditures. (b) School administrative expenditures. (c) Student support expenditures. (d) Instructional staff support expenditures. (e) Transportation expenditures. (f) Operations and maintenance expenditures.

results when restricting the sample to only rural schools (see Column 4 of Table 4, Panel A), finding that total expenditures on support services are 3.5 percent lower than preadoption spending levels following the switch to the four-day school week in these rural districts. The magnitude is larger when the analysis includes school district–specific time trends: total expenditures on support services are 4.7 percent lower relative to preadoption spending levels. Personnel spending, which is 3.9 percent lower, primarily drives these lower spending levels, as nonpersonnel expenditures

Table 5

Event Study Results: Personnel versus Nonpersonnel Costs

	Instruction			Support Services			District Administration			School Administration		
	Personnel Employed	Personnel Costs	Other Costs	Personnel Employed	Personnel Costs	Other Costs	Personnel Employed	Personnel Costs	Other Costs	Personnel Employed	Personnel Costs	Other Costs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Four years before	-4.495	0.034**	0.098***	-3.209	0.011	-0.021	0.532	-0.035	-0.015	-0.698	0.005	-0.006
	(3.134)	(0.013)	(0.036)	(2.166)	(0.017)	(0.020)	(0.375)	(0.022)	(0.035)	(0.448)	(0.029)	(0.062)
Three years before	-4.458	0.041***	0.088***	-1.297	0.016	-0.024	0.411	-0.045*	0.014	-0.117	0.020	-0.083
	(2.895)	(0.013)	(0.034)	(1.901)	(0.016)	(0.021)	(0.327)	(0.025)	(0.033)	(0.393)	(0.027)	(0.053)
Two years before	-4.890*	0.024**	0.076***	-2.513	0.023	-0.030*	0.409	-0.036*	-0.029	-0.272	0.022	-0.053
	(2.596)	(0.012)	(0.027)	(1.756)	(0.015)	(0.018)	(0.284)	(0.020)	(0.034)	(0.341)	(0.024)	(0.047)
Four-day start	-0.059	-0.001	0.079***	-0.834	-0.019	-0.058***	0.310	-0.034*	0.014	0.296	-0.062***	-0.087*
	(2.424)	(0.013)	(0.028)	(1.565)	(0.014)	(0.017)	(0.229)	(0.019)	(0.034)	(0.353)	(0.022)	(0.046)
One year after	2.047	0.012	0.063**	-0.980	-0.013	-0.050***	0.222	-0.032	0.027	0.303	-0.068***	-0.067
	(2.678)	(0.013)	(0.032)	(1.575)	(0.015)	(0.019)	(0.286)	(0.021)	(0.035)	(0.493)	(0.023)	(0.054)
Two years after	2.003	-0.001	-0.007	-0.554	-0.023	-0.051***	0.210	-0.050**	0.002	0.334	-0.078***	-0.120**
	(2.821)	(0.014)	(0.031)	(1.679)	(0.016)	(0.018)	(0.301)	(0.023)	(0.036)	(0.518)	(0.026)	(0.058)
Three years after	0.518	0.000	0.002	0.138	-0.027*	-0.030	0.223	-0.072***	-0.055	0.273	-0.086***	-0.072
	(2.661)	(0.014)	(0.029)	(1.583)	(0.015)	(0.019)	(0.260)	(0.027)	(0.036)	(0.496)	(0.028)	(0.061)
Four years after	1.811	0.006	0.009	0.517	-0.027*	-0.026	0.022	-0.077***	-0.077**	0.213	-0.062**	-0.104*
	(2.802)	(0.014)	(0.032)	(1.648)	(0.016)	(0.019)	(0.249)	(0.025)	(0.038)	(0.546)	(0.025)	(0.061)
Observations	134,288	134,229	134,115	134,288	132,400	134,248	134,288	129,212	131,703	134,288	126,947	120,427
R^2	0.983	0.995	0.951	0.963	0.992	0.975	0.779	0.907	0.891	0.903	0.976	0.862

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	Student Support Services			Instruct. Support Services			Other Support Services	Operations and Maint.		Transportation	
	Personnel Employed	Personnel Costs	Other Costs	Personnel Employed	Personnel Costs	Other Costs	Personnel Employed	Personnel Costs	Other Costs	Personnel Costs	Other Costs
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
Four years before	3.827***	0.139***	0.003	−0.391***	0.041	0.300***	−6.478***	0.025	0.003	−0.002	0.075**
	(0.484)	(0.048)	(0.076)	(0.134)	(0.051)	(0.061)	(1.491)	(0.021)	(0.022)	(0.045)	(0.032)
Three years before	3.113***	0.126***	0.035	−0.423***	0.054	0.211***	−4.280***	0.029	−0.005	−0.015	0.071**
	(0.452)	(0.043)	(0.070)	(0.124)	(0.042)	(0.056)	(1.321)	(0.020)	(0.023)	(0.040)	(0.028)
Two years before	2.529***	0.081*	0.030	−0.370***	0.079**	0.201***	−4.808***	0.035*	−0.018	−0.001	0.051*
	(0.404)	(0.043)	(0.069)	(0.107)	(0.037)	(0.052)	(1.219)	(0.018)	(0.018)	(0.034)	(0.027)
Four-day start	1.416***	0.019	−0.036	−0.287***	−0.024	0.096*	−2.568**	−0.021	−0.039**	−0.094***	−0.041*
	(0.354)	(0.040)	(0.065)	(0.075)	(0.038)	(0.052)	(1.088)	(0.018)	(0.018)	(0.034)	(0.025)
One year after	1.239***	0.041	−0.035	−0.279***	−0.034	0.066	−2.466*	0.004	−0.029	−0.124***	−0.043*
	(0.397)	(0.044)	(0.072)	(0.079)	(0.039)	(0.057)	(1.302)	(0.024)	(0.021)	(0.041)	(0.025)
Two years after	0.906**	−0.027	−0.120	−0.133	−0.067	0.108*	−1.871	−0.031	−0.025	−0.108**	−0.045*
	(0.443)	(0.049)	(0.074)	(0.089)	(0.047)	(0.057)	(1.303)	(0.024)	(0.020)	(0.044)	(0.027)
Three years after	0.355	−0.040	−0.044	0.039	0.009	0.251***	−0.752	−0.046*	0.006	−0.057	−0.042
	(0.428)	(0.045)	(0.073)	(0.086)	(0.051)	(0.062)	(1.176)	(0.026)	(0.021)	(0.040)	(0.030)
Four years after	0.434	−0.054	−0.069	0.147	−0.013	0.253***	−0.298	−0.046*	0.039*	−0.065	−0.069**
	(0.424)	(0.049)	(0.079)	(0.089)	(0.050)	(0.061)	(1.215)	(0.028)	(0.021)	(0.040)	(0.030)
Observations	134,288	120,662	121,543	134,288	123,667	127,383	134,288	130,767	132,680	118,418	129,510
R^2	0.898	0.955	0.852	0.869	0.940	0.881	0.940	0.970	0.971	0.945	0.931

Note: Each column of the table presents results from a separate regression containing the number of personnel or the natural log of the specified dependent variable. As the year before adoption is the omitted year in this event study specification, it is also omitted from the table, and all coefficients in the table are effects relative to this omitted year. The "Other Support Services Personnel Employed" category is the aggregate of all operations and maintenance, transportation, and other support services employees. Disaggregated totals for these categories are not collected by the National Center for Education Statistics. Each specification controls for the natural log of enrollment, school-year fixed effects, and school district fixed effects. Robust standard errors clustered at the school district level are given in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

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exhibit negligible and statistically insignificant changes (see Column 4 of Table 3, Panels B and C).

Unlike instructional expenditures, support services expenditures show no noticeable changes prior to four-day school week adoption, but the adoption of the four-day school week appears to directly affect these expenditures (Figure 2d). An immediate and statistically significant 4.5 percent reduction in support services expenditures occurs in the year of four-day school week adoption. This reduction persists in the years that follow, fluctuating between a reduction of 3.5–4.2 percent relative to the year before four-day school week adoption. As noted in Column 5 of Table 5, small, statistically insignificant reductions in personnel expenditures follow four-day school week adoption, but these grow to around a 2.7 percent reduction by three or four years after initial adoption. Nonpersonnel expenditures fall by 5.8 percent following four-day school week adoption, driving much of the initial reduction in support services expenditures (see Column 6 of Table 5). These expenditure reductions begin to fade out in the years that follow and become statistically insignificant by three years after initial adoption.

2. Disaggregated Support Services Expenditures

There are heterogenous changes to the various components of support service expenditures. Some components—primarily administration and transportation—appear to be driving these overall support services expenditure reductions, whereas the four-day school week has very little direct impact on others (e.g., pupil and staff support, operations and maintenance).

School and school district administration. Both school and school district administration expenditures see decreases following four-day school week adoption. As expected, however, school administration expenditures fall more than school district administration expenditures. School administration expenditures are 6.8 percent lower than preadoption spending levels following the switch to the four-day school week. I find an identically sized difference when restricting the sample to rural school districts only and a slightly smaller-magnitude (5.5 percent lower spending level) difference with the inclusion of school district–specific time trends. Reductions in personnel expenditures, at 8.1 percent lower than preadoption spending levels, primarily drive these differences. Although school district administration expenditures show no statistically significant change in the baseline specification, statistically significant differences emerge when the model includes school district–specific time trends. In this case, I find that school district administration expenditures are 5.2 percent lower than preadoption spending levels following the switch to the four-day school week.

As Figure 3b reflects, reductions in school administration expenditures immediately follow four-day school week adoption with an 8 percent decline in these expenditures in the year of adoption. In the years that follow, declines in school administration expenditures fluctuate between 4.2 and 7.3 percent relative to the year

before adoption. Declines in personnel expenditures drive declines in school administration expenditures, as they fall by between 6.2 and 8.6 percent relative to the year before four-day school week adoption. As Figure 3a reflects, school district administration expenditures rise by 3.4 percent in the year before four-day school week adoption, before declining by 4.3 percent in the initial year of adoption. These declines in school district administration expenditures continue in the years that follow. In fact, by four years after initial adoption of the four-day school week, school district administration expenditures have fallen by 9.1 percent compared with the year before four-day school week adoption. Similar to school administration, reductions in personnel expenditures primarily drive these reductions in school district administration expenditures, as they fall by between 3.4 and 7.7 percent relative to the year before four-day school week adoption.

Pupil and instructional staff support services. Expenditures for both pupil and instructional staff support services fall following the switch to the four-day school week. Pupil support services expenditures fall by 6.3 percent, and instructional staff support services fall by 14.1 percent. For pupil support services, restricting the sample to rural school districts only reveals the same difference, and including school district–specific time trends reveals a slightly larger-magnitude (8.8 percent lower spending level) difference. For instructional staff support services, restricting the sample to rural school districts only reveals a slightly smaller magnitude (12.6 percent lower spending level), but including school district–specific time trends in the model reveals a statistically insignificant difference. Reductions in personnel expenditures primarily drive the differences in pupil support services, as they are 13.1 percent lower than preadoption spending levels. Reductions in both personnel and nonpersonnel expenditures drive the differences in instructional staff support services, as they are 10.8 and 11.9 percent lower than preadoption spending levels, respectively.

The event study results show no statistically significant changes in pupil support services before or after four-day school week adoption (see Figure 3c). However, the years before four-day school week adoption show notable declines, between 8.1 and 13.9 percent, in personnel expenditures for pupil support services. As Figure 3d reflects, as with instructional expenditures, instructional staff support services expenditures in the year before four-day school week adoption show large declines. Reductions in both personnel and nonpersonnel expenditures, which fall by 7.9 and 20.1 percent, respectively, drive this decline.

Operation and maintenance of school facilities. The baseline specification shows no statistically significant change in operations and maintenance expenditures pre- and postadoption; statistically significant differences emerge when the model includes school district–specific time trends. Specifically, school district administration expenditures are 3.5 percent lower than preadoption spending levels following the switch to the four-day school week. The initial year of adoption shows a statistically significant

2.9 percent reduction in expenditures, driven by nonpersonnel expenditures, which fall by 3.9 percent. But these effects become statistically insignificant in the subsequent years.

Student transportation. Transportation expenditures are 10.7 percent lower than preadoption spending levels following the switch to the four-day school week.[18] Restricting the sample to only rural school districts reveals a similar-magnitude difference (10.2 percent lower spending level) and a slightly lower-magnitude (8.2 percent lower spending level) difference when including school district–specific time trends. Both lowered personnel and nonpersonnel expenditures drive these differences. Personnel expenditures fall by 5.9 percent following the switch to the four-day school week, and nonpersonnel expenditures are 15.8 percent lower. Figure 3e indicates that an immediate and persistent statistically significant reduction in transportation expenditures of between 3.8 and 6.9 percent emerges in the years following four-day school week adoption. Personnel expenditures, which fall by 9.4–12.4 percent in the first few years of the four-day school week, account for much of these reductions, but nonpersonnel expenditures fall by a marginally significant and persistent amount (around 4.5 percent).

D. Discussion

Study findings largely align with the hypotheses laid out in the conceptual framework section. A majority of expenditure reductions occur prior to four-day school week adoption, which suggests that districts tend to use the four-day school week in conjunction with or as a way of supporting other cost-savings approaches. Instructional expenditures and, specifically, instructional personnel expenditures drive much of these preadoption expenditure reductions. These results suggest that cost-savings policies introduced prior to four-day school week adoption that reduce teacher salaries or benefits play a key role in these instructional expenditure reductions.

Reduced support services expenditures reflect direct impacts of the four-day school week. This includes the reduction in service provision from five days to four (e.g., for transportation) and reduced payments to hourly employees under a four-day school week model (e.g., administration, transportation). However, expenditures for pupil or instructional staff support notably lack significant direct impacts, which may be due to the fact that a higher proportion of personnel expenditures for these services are salaried compared with administration or transportation. The structure of the four-day school week schedule and use of the off-day may also play a role in these results. Most notably, the lack of persistent effects on operations and maintenance expenditures may suggest that wide-scale building closures occur in the initial year of adoption, which are then scaled back in subsequent years to better

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[18] Reductions in revenue generated by transportation offset some of the reductions in transportation expenditures. As Column 8 of Panel D of Table A4 indicates, this reduction is 11.3 percent. Given the mean sizes of transportation expenditures are around four times larger than the means of these revenue sources, these declines in revenue offset about one-third of the decline in transportation expenditures.

accommodate additional student and teacher off-day activities. Increased teacher professional development opportunities in the wake of the switch to the four-day school week could also explain the drastic shift in instructional staff support expenditures, which declined prior to adoption of the four-day school week but largely leveled off in the postadoption period.

VI. CONCLUSION

This paper examined the dynamics of school district expenditures surrounding the adoption of four-day school weeks. As this study covered all public school districts in the United States, it has provided the most comprehensive analysis of the relationship between four-day school weeks and school district expenditures to date. The results suggest that the direct impacts of the four-day school week on school district expenditures yield around a 1–2 percent reduction in expenditures. This magnitude aligns with previous estimates of four-day school week cost savings (Griffith, 2011; Morton, 2020). There are notable, larger reductions in instructional expenditures prior to four-day school week adoption, suggesting that districts use four-day school weeks in conjunction with more traditional cost-savings approaches targeting reductions in instructional expenditures. Although the four-day school week has no statistically significant direct impacts on instructional expenditures, the adoption of the four-day school week does directly reduce support service expenditures. These changes in expenditures result from a mix of reductions to both personnel and nonpersonnel expenditures.

The four-day school week is just one of many cost-savings policy options. Thus, districts facing cost-savings decisions should consider the trade-off between the cost savings and educational impacts of these expenditure reduction policies. Like many traditional cost-savings approaches, the four-day school week has generally negative impacts on student achievement (Morton, 2020; Thompson, 2021), although Anderson and Walker (2015) find the schedule change had positive impacts on achievement in the pre–Great Recession period in Colorado. Future work that more systematically reviews the cost savings–achievement trade-off across various cost-savings approaches will better inform school officials about the relative standing of the four-day school week in this regard.

Beyond achievement and cost savings, four-day school week policies may simply shift spending on children from public to private expenditure. Schools have traditionally served as an effective infrastructure for caring for and fostering desirable short- and long-run outcomes in children (Chetty, Friedman, and Rockoff, 2011; Chetty et al., 2011). Reductions in the intensity of exposure to this supportive school environment (e.g., access to physical education, healthy school meals) likely shifts some of the financial burden of childcare and food provision onto families and community/governmental organizations. For working families not providing their own childcare, children and adolescents may have large amounts of unsupervised

and unstructured time that may yield undesirable outcomes, including engagement in risky behaviors. Reduced exposure to the supportive school environment may also have implications for child diet, physical activity, and overall health. Analyzing these important outcomes and others will help school district decision makers go beyond simple cost savings and achievement metrics and provide them with a better sense of the true trade-offs of using a four-day school week for cost-savings purposes.

ACKNOWLEDGMENTS

DISCLOSURES

APPENDIX: SUPPLEMENTARY TABLES AND FIGURES

Table A1

Additional Variable Names and Definitions

Variable Name	Description
Four-day school week measures[†]	
Four-day (primary measure)	= total enrollment under a four-day school week schedule divided by total enrollment
Four-day (alternative measure)	= 1 if all schools in the district operate on a four-day school week schedule; 0 if otherwise
School district revenue[‡]	
Total revenue	Total revenue from all sources
Local revenue	Total revenue from local sources
Local property tax revenue	Revenue from local property taxes
Other local tax revenue	Revenue from local income and sales taxes
Other local revenue	Local revenue not related to local taxes (e.g., private contributions, student fees)
State revenue	Total revenue from state sources
State formula aid	Revenue from state general formula assistance
State transportation revenue	Revenue from state transportation programs
Other state revenue	State revenue not related to general formula assistance or transportation
Federal revenue	Total revenue from federal sources
School district demographics[*]	
Total enrollment	Total number of students in the district
White students	Total number of white students enrolled in the district
Free/reduced lunch students	Total number of students that are eligible for free or reduced-price lunch
Female students	Total number of female students in the district
Individualized education plan students	Total number of students with an individualized education plan
Limited English proficient students	Total number of students who are limited English proficient

Sources: Proprietary data collection; email/phone correspondence with school districts, news articles, state departments of education ([†]); National Center for Education Statistics F-33 Financial files ([‡]); National Center for Education Statistics Common Core of Data ([*]).

Table A2

Fraction of School Districts with Given Number of Schools

	All Four-Day	Districtwide Four-Day	Select Schools Four-Day	Districtwide Five-Day
1	0.23	0.25	0	0.14
2	0.3	0.32	0.05	0.18
3	0.22	0.23	0.01	0.17
4	0.08	0.08	0.07	0.11
5	0.05	0.04	0.08	0.08
6+	0.13	0.08	0.78	0.31

Note: Each cell gives the fraction of school districts within the given school group with the given number of schools.

Table A3

Effects of Four-Day School Weeks on School District Expenditures—Per-Pupil Levels

	Total Expend.	Fungible Expend.	Instruct. Expend.	Support Services Expend.	District Admin. Expend.	School Admin. Expend.	Student Support Expend.	Instruct. Support Expend.	Operations and Maintenance Expend.	Transp. Expend.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Overall Expenditures										
Four-day	−276.711	−227.044	−134.994	−57.117	43.476	−79.430***	−18.792*	−50.797***	41.420	−48.805***
	(223.153)	(160.977)	(99.946)	(76.632)	(28.411)	(11.290)	(10.273)	(15.498)	(34.728)	(16.136)
Observations	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468
R^2	0.757	0.846	0.825	0.827	0.774	0.702	0.727	0.774	0.643	0.825
Panel B: Personnel Expenditures										
Four-day	−266.839**	−249.757**	−111.592	−138.165***	33.291	−73.722***	−30.382***	−38.022***	−13.965	−20.659*
	(112.761)	(111.546)	(80.779)	(45.846)	(23.964)	(10.447)	(7.301)	(7.827)	(12.182)	(12.101)
Observations	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468
R^2	0.843	0.844	0.838	0.807	0.737	0.700	0.871	0.738	0.723	0.751
Panel C: Nonpersonnel Expenditures										
Four-day	−9.873	22.713	−23.401	81.047*	10.185	−5.708**	11.590	−12.774	55.384*	−28.146**
	(165.146)	(67.958)	(39.719)	(44.155)	(10.469)	(2.795)	(7.188)	(13.386)	(28.454)	(11.443)
Observations	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468	143,468
R^2	0.665	0.830	0.814	0.755	0.673	0.495	0.611	0.761	0.552	0.859

Note: Each column of the table presents results from a separate regression containing the specified dependent variable measured in per-pupil dollars. Each specification controls for the natural log of enrollment, school-year fixed effects, and school district fixed effects. Robust standard errors clustered at the school district level are given in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

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Table A4
Additional Sensitivity Analyses

	Total Expend.	Fungible Expend.	Instruct. Expend.	Support Services Expend.	District Admin. Expend.	School Admin. Expend.	Student Support Expend.	Instruct. Support Expend.	Operations and Maintenance Expend.	Transp. Expend.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Districts from All States Included in the Sample										
Four-day	−0.037***	−0.049***	−0.045***	−0.052***	−0.032*	−0.078***	−0.111***	−0.170***	−0.014	−0.110***
	(0.008)	(0.007)	(0.008)	(0.009)	(0.017)	(0.022)	(0.029)	(0.032)	(0.010)	(0.014)
Observations	241,025	241,024	240,990	240,995	238,715	232,309	231,728	234,887	239,382	236,078
R^2	0.989	0.996	0.995	0.993	0.948	0.975	0.963	0.949	0.987	0.973
Panel B: Dummy Variable for Four-Day School Week Use										
Four-day	−0.029***	−0.034***	−0.033***	−0.036***	−0.009	−0.070***	−0.067**	−0.147***	−0.008	−0.107***
	(0.009)	(0.007)	(0.008)	(0.009)	(0.018)	(0.022)	(0.029)	(0.032)	(0.011)	(0.014)
Observations	142,567	142,567	142,566	142,566	140,310	135,011	133,809	136,808	141,001	138,139
R^2	0.988	0.995	0.995	0.993	0.945	0.970	0.954	0.944	0.985	0.972

Panel C: Time-Varying School District Controls Included

	Total Revenue	Local Revenue	Local Property Tax Revenue	Local Other Tax Revenue	Other Local Revenue
Four-day	−0.037***	−0.044***	−0.039***	−0.051***	−0.028*
	(0.009)	(0.007)	(0.007)	(0.008)	(0.015)
Observations	117,331	117,331	117,331	117,331	115,440
R^2	0.989	0.996	0.995	0.993	0.946

	State Revenue	State General Formula Aid	State Transp. Revenue	Other State Revenue	Federal Revenue
	−0.076***	−0.069**	−0.158***	−0.031***	−0.115***
	(0.023)	(0.033)	(0.033)	(0.011)	(0.014)
Observations	112,161	111,375	113,439	115,809	114,011
R^2	0.973	0.958	0.948	0.986	0.973

Panel D: Revenue Dependent Variables

	Total Revenue	Local Revenue	Local Property Tax Revenue	Local Other Tax Revenue	Other Local Revenue
Four-day	−0.026***	−0.023	−0.012	−0.042	−0.024
	(0.008)	(0.016)	(0.017)	(0.037)	(0.016)
Observations	143,428	143,419	141,213	41,509	139,463
R^2	0.993	0.984	0.980	0.940	0.958

	State Revenue	State General Formula Aid	State Transp. Revenue	Other State Revenue	Federal Revenue
Four-day	−0.068***	−0.054***	−0.113***	−0.095**	−0.043**
	(0.016)	(0.019)	(0.032)	(0.039)	(0.019)
Observations	143,351	142,972	58,320	142,741	142,717
R^2	0.980	0.958	0.955	0.907	0.966

Note: Each column of the table presents results from a separate regression containing the natural log of the specified dependent variable. Each specification controls for the natural log of enrollment, school-year fixed effects, and school district fixed effects. Robust standard errors clustered at the school district level are given in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

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Table A5

Heterogenous Impacts of Four-Day School Week Structure and Rationale

	Total Expend.	Fungible Expend.	Instruct. Expend.	Support Services Expend.	District Admin. Expend.	School Admin. Expend.	Student Support Expend.	Instruct. Support Expend.	Operations and Maintenance Expend.	Transp. Expend.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Off-Day Activities (No Academic Services vs. Some Academic Services)										
Four-day	−0.038***	−0.043***	−0.041***	−0.047***	−0.040	−0.053	−0.043	−0.097**	−0.023	−0.097***
	(0.013)	(0.010)	(0.010)	(0.012)	(0.027)	(0.038)	(0.045)	(0.041)	(0.015)	(0.018)
Four-day * no services	−0.009	−0.003	−0.007	−0.002	0.049	−0.035	−0.044	−0.041	−0.001	−0.036
	(0.019)	(0.015)	(0.016)	(0.018)	(0.040)	(0.049)	(0.066)	(0.070)	(0.023)	(0.031)
Observations	139,680	139,680	139,679	139,679	137,532	132,754	131,392	134,199	138,114	135,331
R^2	0.988	0.995	0.995	0.993	0.944	0.971	0.954	0.944	0.985	0.972
Panel B: Off-Day Choice (Monday vs. Friday)										
Four-day	−0.026***	−0.031***	−0.029***	−0.031***	−0.009	−0.070***	−0.055*	−0.126***	−0.008	−0.101***
	(0.009)	(0.008)	(0.008)	(0.009)	(0.019)	(0.024)	(0.032)	(0.035)	(0.011)	(0.014)
Four-day * monday	−0.020	−0.033**	−0.030*	−0.042*	−0.023	0.036	−0.058	−0.128	−0.011	−0.060
	(0.023)	(0.017)	(0.017)	(0.022)	(0.044)	(0.045)	(0.062)	(0.084)	(0.024)	(0.048)
Observations	143,406	143,406	143,405	143,405	141,151	135,866	134,651	137,649	141,840	138,978
R^2	0.988	0.996	0.995	0.993	0.945	0.971	0.954	0.944	0.985	0.972
Panel C: Rationale (Financial vs. Nonfinancial)										
Four-day	0.018	0.016	0.007	0.027	0.059	−0.054	−0.000	−0.054	0.057***	−0.076***
	(0.017)	(0.015)	(0.017)	(0.018)	(0.041)	(0.055)	(0.084)	(0.076)	(0.020)	(0.028)
Four-day * financial	−0.086***	−0.085***	−0.069***	−0.104***	−0.111**	−0.021	−0.090	−0.078	−0.113***	−0.051
	(0.020)	(0.017)	(0.019)	(0.020)	(0.047)	(0.061)	(0.091)	(0.085)	(0.024)	(0.033)
Observations	139,443	139,443	139,442	139,442	137,295	132,564	131,185	133,986	137,877	135,094
R^2	0.988	0.995	0.995	0.993	0.944	0.971	0.954	0.945	0.985	0.972

Note: Each column of the table presents results from a separate regression containing the natural log of the specified dependent variable. Each specification controls for the natural log of enrollment, school-year fixed effects, and school district fixed effects. Robust standard errors clustered at the school district level are given in parentheses. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.
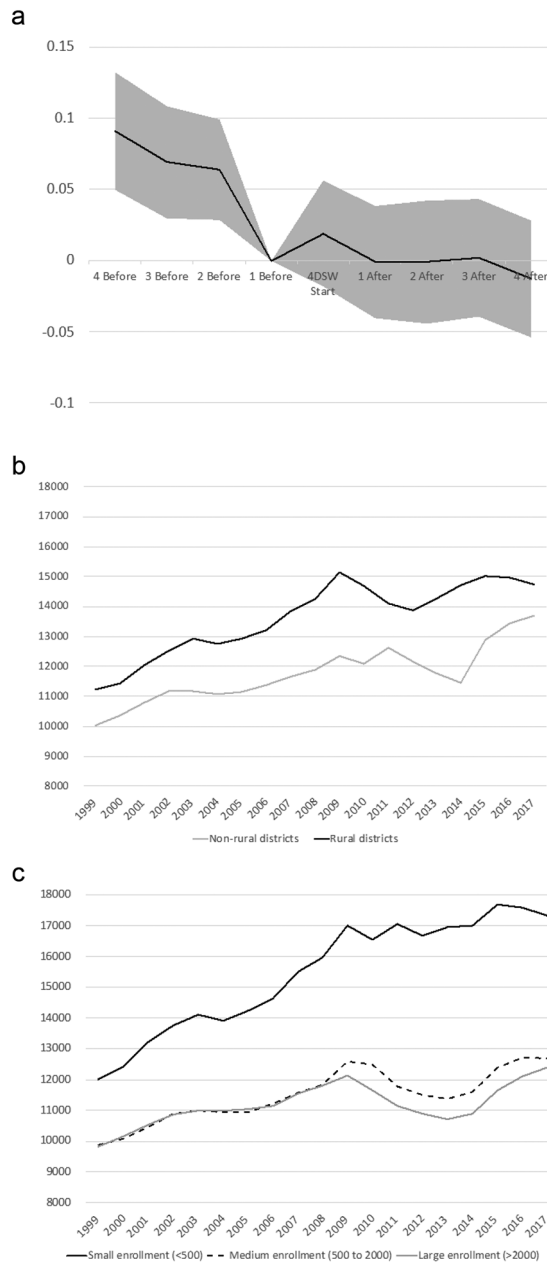
Figure A1. Trends in enrollment and expenditures. (a) Total enrollment — event study results. (b) Trends in expenditures per pupil, rural versus nonrural. (c) Trends in expenditures per pupil, by school district enrollment.

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