Some New Evidence on the Relationship Between School Provision

and Parental Labor Supply

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THESIS

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LIST OF ABBREVIATIONS

4DW	Four-day school week
ACS	American Community Survey
ATUS	American Time Use Survey
CPS	Current Population Survey
CYA	Child and Young Adult Supplement
DD	Difference-in-differences
DDD	Difference-in-difference-in-differences
EITC	Earned Income Tax Credit
GLM	Generalized linear model
IV	Instrumental variables
NLS	National Longitudinal Surveys
NLSY79	National Longitudinal Survey of Youth 1979
OLS	Ordinary least squares
PIAT	Peabody Individual Achievement Test
PSID	Panel Study of Income Dynamics
PUMA	Public Use Microdata Area
SES	Socioeconomic status
SIPP	Study of Income and Program Participation
TANF	Temporary Assistance to Needy Families
WLS	Weighted Least Squares

SUMMARY

This dissertation explores numerous aspects of the relationship between parental employment and the implicit child care subsidy represented by the provision of public schooling. with a particular focus on the way that the provision of public schooling affects the labor supply decisions of parents. To provide evidence on the nature of this potentially complex relationship, I study the theoretical and empirical implications of two different sources of variation in school provision. The first chapter studies the negative shock to schooling represented by the four-day school week schedule. The four-day week is a one-day per week reduction in the days of schooling provided throughout the school year that is typically adopted to accommodate fiscal constraints or to attract and retain teachers in school districts with thinner labor markets. The number of students affected by this once-rare scheduling policy has grown by more than 400 percent in less than two decades. I use the plausibly quasi-experimental nature of decentralized adoption of the four-day school week to provide novel evidence on the labor supply responsiveness of both married parents and single-female-headed households.

I estimate the effects of the four-day school week policy in four states—Colorado, Idaho, Oklahoma, and Oregon—that have significant numbers of school districts using this schedule. Using a difference-in-differences identification strategy, I find that married mothers with children all of grade-school ages (6 to 13) reduce their employment by 7.6 percentage points (11 percent relative to baseline employment levels), and that married fathers do not exhibit a measurable employment response, though they do exhibit some responsiveness along the intensive labor supply margin, reducing hours in areas with the highest levels of four-day school week policy adoption. In contrast, I find no evidence of employment reductions among single mothers. Instead, I estimate economically large and statistically significant *increases* in the weeks worked throughout the year by single mothers in response to the four-day school week policy. I test the plausibility of a causal interpretation of these estimates by estimating identical regression models using multiple groups with labor supply that should remain unaffected by this policy, parents with all preschool-aged children, parents with all high-school-aged children, and childless married adults, and find no similar pattern of labor supply responses to the four-day school week. These findings suggest that the reduction in schooling represented by the four-day week may be a significant hindrance to dual-earner employment and suggest that policymakers should consider these potentially important and economically large household responses in setting school funding levels.

The second chapter focuses on the persistent, annual interruption in schooling represented by the 11- to 12-week summer break in the school schedule. Despite the fact that the summer break represents a cessation of school-based child care provision across a span nearly a quarter of the year, the small amount of existing social science work on the summer break in schooling has focused almost solely on the effects of this break on knowledge retention and the attenuation of academic skills (the so-called "summer slide"). To the best of my knowledge, there has not been a comprehensive assessment of the effects of this significant annual shock to child care on parental labor supply and associated labor market outcomes.

In this study I provide evidence that the summer break is associated with significant changes in the labor supply of married mothers of school-aged children along both the extensive and intensive margins, with a decrease in employment of around 4 percent and a relative reduction in reporting being employed and present at work of around 10 percent over the months of June through August, relative to childless married women. I find no employment reductions among married fathers and much smaller declines in being present on the job in the prior week. Among single-mothers, I find no employment reductions and reductions in being present on the job in the prior week among the employed that are less than half the magnitude of the decreases among married mothers. I also explore differences in these patterns of labor supply responsiveness across maternal education levels and changes in these patterns over time and across birth cohorts.

I provide evidence on the extent to which occupational choice and maternal labor supply responses over the summer contribute to the overall experience gap between mothers and fathers and differences in earnings. This analysis suggests that, while the additional gap in experience accrual related to summer differences in labor supply is not trivial, the additional decrease in hours worked among mothers only accounts for a small proportion of the overall gap in experience that accrues to married mothers, relative to married fathers, over the early years of the life of their eldest child. In estimating the effects of summer employment interruptions on earnings, I find substantial differences between the way these employment gaps affect the earnings of mothers and fathers that are consistent with findings in the existing literature of a "motherhood penalty" and a simultaneous "fatherhood premium."

I also investigate how maternal shifts away from market employment relate to changes in time spent in home production tasks and for both married parents and single-female-headed households. I show that the summer months are characterized by a reduction in market hours worked and by a similarly sized reduction in "primary" child care activities among married mothers of school-aged children, which may be related to the relaxation of direct school-related demands on children that require parental involvement. However, these reductions together are more than offset by an increase in “secondary” child care time, which includes a large array of both passive and active child interactions. I find that, despite no statistically significant work hour reductions among single mothers, their “secondary” child care time increases by around 70 percent of the increase observed among married mothers, suggesting that, in terms of child time inputs over the summer, these mothers respond similarly to married mothers on average despite a more binding time constraint.

I conclude by providing some suggestive evidence that parental time away from market work over the summer is correlated with beneficial changes in child cognitive and non-cognitive skill measures. In particular, when holding constant total hours worked, family income, and a variety of demographic and socioeconomic characteristics in a panel data set of linked mothers and children, I estimate a negative association between maternal summer work hours and child scores on the Peabody Individual Achievement Test and a positive relationship between maternal summer work hours and an index that measures a variety of behavioral problems. This relationship is more pronounced for mothers with lower educational attainment. Though this evidence is only descriptive, if it reflects a causal link, it suggests that differences in child time inputs over the summer may be an important factor in the intergenerational transmission of human capital.

In total, this dissertation lays out new evidence on the historical and contemporary relationship between school-based child care and parental labor market behaviors. Both chapters motivate a number of future research paths for further exploring this important nexus of labor and education economics with implications for both parental labor market outcomes and child welfare.

1. THE FOUR-DAY SCHOOL WEEK AND PARENTAL LABOR SUPPLY[1]

1.1 Introduction

> *"I just asked one of the moms in our office what she thought of the idea, and she said, 'Oh my gosh, no; I'm already paying enough in child care.' You're pushing the most expensive burden back on the parents. We want them to have more school, not less school,"*
>
> Patty Neuwirth, spokesperson for the Lawton-Fort Sill (OK) Chamber of Commerce (Denwalt, 2016)

The increase in married maternal employment in the decades since the end of World War II is one of the most notable social and economic changes of the 20th century. Between 1960 and the present, the labor force participation rate of married mothers more than tripled from around 20 percent to nearly 70 percent (Greenwood, Guner, & Vandenbroucke, 2017; Bureau of Labor Statistics, 2018). This rise in mother's employment has been accompanied by a commensurate increase in the use of non-maternal child care.

In this paper, I provide new evidence on the relationship between parental labor supply and the provision of public schooling, the primary source of non-maternal child care for over 90 percent of grade-school-aged children (Laughlin, 2013). I estimate causal effects using a difference-in-differences (DD) identification strategy to estimate the effects of school districts adopting the four-day school week—a permanent reduction in the annual days of schooling—on parental employment, hours/weeks of work, and earnings, as well as residential location choice captured in district enrollment.[2] Use of the four-day school week has increased significantly in the wake of state-level cuts to education funding following the Great Recession (Bryce, 2010;

[1] In addition to help from those in the acknowledgements at the beginning of this thesis, I am also grateful to Yana Gallen, Erik Hembre, Adam Smith, and audience members at the UIC Economics Active Research Lunch Seminar for helpful suggestions with this chapter.

[2] The linear weighted least squares regression models in this analysis are identified using the now-standard common trends assumption. Non-linear regression estimates are identified by a related but more restrictive common trends assumption (Lechner, 2011) or, alternately, by a more traditional conditional independence assumption, as discussed in more detail below.

Irish, 2015; Layton, 2016; Brown, 2017). More than 560 districts currently use the four-day school week, and the majority of this growth has occurred within the last decade (National Conference of State Legislatures, 2018). Yet, despite this rapid growth in the adoption of the four-day school week, which significantly reduces the overlap between the typical work week and the time that children are in school, there have been no studies to date of its effect on parental labor supply.

I focus on four states that have experienced large increases in utilization of the four-day week schedule: Colorado, Idaho, Oklahoma, and Oregon. Data on outcomes are from 1-year American Community Survey (ACS) population estimates from 2005 to 2016. This empirical strategy regresses an outcome on the proportion of students in an area—specifically, a Public Use Microdata Area, or PUMA, the smallest geographical area for which public microdata are made available—enrolled in districts using the four-day school week. Estimates focus on a group of parents most likely to be fully "exposed" to the reduction in school-based child care represented by the four-day school week—those with children all between 5 and 13 years of age. Dual-earner parents in this group are likely to depend either primarily or completely on school for weekday child care, as are single-female-headed households. I test the plausibility of these estimates by generating estimates for parents with children in neighboring age groups—those with all pre-school aged children and those with children between the ages of 14 and 18—who should be largely or totally unaffected by the four-day school week, as well as childless married adults.

I use both weighted least squares (WLS) linear regression models and non-linear regression models (GLM) to develop a multi-dimensional picture of these effects and to test the consistency of the estimates. The main estimates I present represent the effect of a PUMA moving from zero students enrolled in four-day school week districts to an average of 24 percent of students enrolled under the four-day week. Multinomial logit estimates using grouped categories of usual hours per week and weeks worked per year indicate that such an increase in four-day week enrollment causes a 7 to 8 percentage point (12 to 16 percent) shift from working full-time hours to working zero hours, and from working 50-52 weeks per year to working zero weeks per year, respectively, among married mothers with children all ages 5-13. Similarly, WLS regression estimates indicate this increase in four-day week enrollment causes a 7.6 percentage point decrease (an 11 percent decrease from a baseline of 70 percent) in employment at the time a respondent is surveyed, and robust Poisson estimates indicate an 11 percent decrease in annual hours worked (the product of usual hours worked per week and weeks worked per year over the prior 12-month period). Additionally, I estimate a statistically significant 5.5 percentage point (8 percent from the baseline mean) decrease in the incidence of any wage or salary earnings in the last year. Among fathers in these couples, I find no statistically significant evidence of a labor supply response to the policy, but some marginal evidence of an hours decrease in areas with the highest levels of four-day week enrollment. Among both married mothers and fathers, I find evidence of increases in alternate sources of income that may partially offset the maternal earnings decrease.

In contrast to the results for married mothers, for single mothers with children all ages 5-13, I estimate no significant effect on employment at the time of survey or usual hours worked, but an 11 percentage point (18 percent) increase in the probability of working 50-52 weeks per year, relative to working fewer weeks. Event study results of enrollment changes at the district level indicate that the four-day school week causes statistically significant declines in district enrollment of around 3 to 5 percent per year, but I find no evidence of moves across PUMAs, which could bias the estimated labor supply responses upward in magnitude if parents who desire to remain working move to an untreated PUMA.

This study is the first to use the four-day school week policy to estimate the relationship between parental labor supply and school provision. This setting differs from past work in multiple ways that extend the literature on the relationship between school provision and household labor supply. Most importantly, the four-day school week represents a large, permanent reduction in the total annual days of school provision that affects parents of children of a wide range of ages. As mentioned above, studies using kindergarten and pre-k settings identify the labor supply effects of a one-year expansion of school-based child care.[3] The four-day school week also breaks the alignment between the school week and the traditional five-day work week throughout the school year, requiring that a one parent in a dual-earner family secure either a part-time schedule or one day per week of child care to continue working. Thus, reduced form estimates on the effects of the four-day school week incorporate the potential effects of scheduling inflexibility in the workplace and the relative scarcity of part-time jobs. Additionally, this study is set in a contemporary period of high, stable maternal labor force participation, where the margins of responsiveness may differ from past work due to higher baseline levels of overall maternal labor force participation (and, hence, dual-earner households), differences in the composition of the labor force along dimensions such as maternal age and education, and changes in employment policy (e.g., welfare reform policies such as TANF, the introduction and scaling up of the Federal Earned Income Tax Credit and various state EITC programs). Finally, the four-day school week is currently being adopted at an increasing rate around the U.S. making

[3] Additionally, as recently as the late 1990s, around half of public schools only offered half-day kindergarten. See https://nces.ed.gov/pubs2004/2004078.pdf. This variation in the length of the kindergarten day may also contribute to the large differences in estimates across studies using kindergarten expansions.

these estimates highly relevant for policymakers considering policy decisions that may lead to further expansion in the use of the four-day school week.

1.2 Background of the Four-day School Week

The four-day school week involves dropping Friday or Monday from the school week and adding 60 to 90 minutes of instruction time to the remaining four days to meet minimum instruction time requirements.[4] The recent increase in use of the four-day school week is typically associated with state cuts to education funding (Bowen, 2011; Brown, 2017; Bryce, 2010; Irish, 2015; Layton, 2016). A number of districts report first considering the schedule after failed ballot measures to raise needed revenue (Richert, 2016; Scoville, 2018). Due to the predominance of fixed costs such as teacher and administrator salaries and benefits, the schedule typically reduces a district's overall budget by less than 2.5 percent (Griffith, 2011; Donis-Keller & Silvernail, 2009). Beyond responding to fiscal constraints directly by adopting the policy, many administrators have suggested that the four-day week also provides an important job amenity for use in hiring and retention efforts amid flat or declining teacher salaries (Moored & Frank, 2013; Brown, 2017; Cummings, 2015; Levin, 2016; Hardiman, 2018; Tennent, 2018).

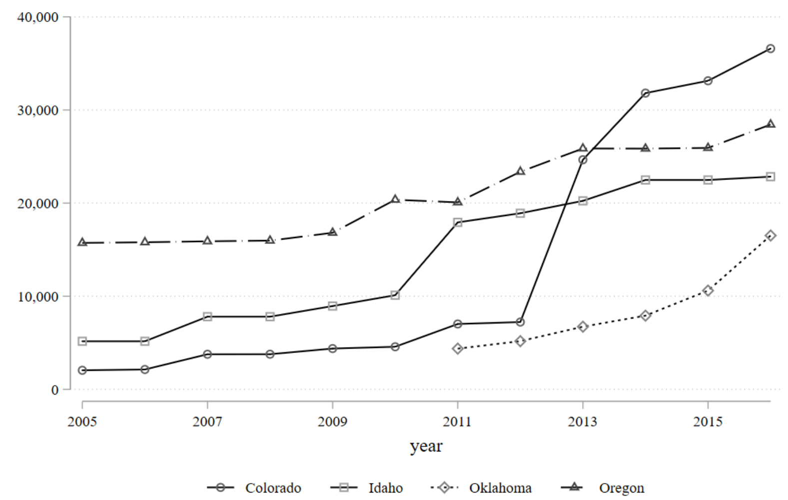
Some smaller districts have reported taking measures to cope with the child care needs induced by the four-day schedule, such as pairing high school students with younger students for child care (Herring, 2010; Doyle, 2017). In larger districts, the potential impact on employment has been a key focus of stakeholders (Irish, 2015; Simpson, 2012; Vanek, 2016). A large metropolitan district in Denver, CO that recently switched to the four-day week announced a $30

[4] Use of the four-day week is enabled by legislation defining required annual instruction time in hours rather than days, but several states with no four-day school week districts have such a statute on the books (Simpson, 2012).

per child fifth-day child care program after encountering significant opposition to the proposed schedule change from working parents (Scoville, 2018).

The four states in this study have among the highest four-day week enrollment levels in the country.[5] Figure 1 plots annual enrollment of students under the four-day school week for each state (appendix A, table XX presents these changes numerically). Enrollment in Colorado increased eighteenfold over 12 years. In Idaho, enrollment increased from around 5,000 to over 24,000. In Oregon, enrollment more than doubled from 15,000 to over 34,000. Finally, Oklahoma, which has only recently seen widespread adoption of the four-day week, saw enrollment increase eightfold in six years, from 4,000 students in 2011 to over 32,000 in 2016.[6]

Figure 1: Four-day Week Enrollment by State and Year



Source: Colorado, Idaho, Oklahoma, and Oregon Departments of Education

[5] Arizona is also among the states with the highest enrollment on the four-day school week, but the state does not make enrollment and calendar data uniformly available. The Arizona School Finance Analyst Team denied a custom data request for school calendar information, citing resource limitations (email to author, August 2018).
[6] School calendar information prior to 2011 is not available from the Oklahoma Department of Education (email to author, June 2018).

1.3 Existing Literature on School Provision and Maternal Labor Supply

Estimates of the relationship between child care and maternal labor supply have been accruing for at least 25 years, yet the results of this research have been surprisingly inconclusive. A large body of work using structural models to estimate maternal labor supply elasticities including Connelly (1992), Connelly and Kimmel (2001), Kimmel (1998), and Ribar (1992) reported estimates of the employment elasticity of child care that range from -0.2 to -1.4. Blau and Currie (2006) summarize 20 studies across more than a decade and report estimates ranging from 0.06 to -3.60. This large variation in estimated elasticities has been attributed to differences in the methods used to construct child care costs, in harmonizing survey instruments across time and, more generally, from omitted variables such as quality measures (Kimmel, 1998).

More recent studies have estimated the relationship between child care provision and maternal labor supply using expansions of the provision of kindergarten and prekindergarten or, in other cases, simply the process of children aging into eligibility for these programs. Examples of the latter approach include Gelbach (2002), who used quarter of birth as an instrumental variable (IV) for kindergarten enrollment with 1980 decennial census data. He reported a positive employment effect of kindergarten availability of 6 to 8 percent and an increase of 9 to 10 percent in usual hours worked per week among both single and married mothers whose youngest child is 5. Two studies by Fitzpatrick (2010, 2012) extend this IV approach to a regression discontinuity framework using exact dates of birth to study the employment effects of pre-kindergarten. Unlike Gelbach, she generally finds small to zero effects that are imprecisely estimated and are sensitive to bandwidth choices around date of birth.

Examples of studies that use kindergarten and prekindergarten expansions include Cascio (2009), who studied the expansion of kindergarten programs across the U.S. between 1950 and

1990 using a difference-in-differences-in-differences (DDD) identification strategy. She found a 12 percent increase in employment and an 11 percent increase in hours worked among single mothers with a youngest child of age 5, but an imprecise zero effect for both married mothers with a youngest child of age 5 and for all mothers with children younger than 5, noting that her research design likely biased the estimates towards zero. Baker, Gruber, and Milligan (2008) and Lefebvre and Merrigan (2008) estimated the effects of a province-wide, $5/day, universal child care program in Quebec that represented a large, permanent, positive shock to child care costs (a program with greater similarity to the four-day week). Both studies reported large, positive labor supply effects. Among mothers with at least one child aged 1-5, the former study estimated a 14 percent positive employment effect, while the latter study estimated that employment increased 12 percent and annual hours worked increased 20 percent. Sall (2014) estimated the effect of district-level pre-kindergarten expansions on employment among eligible mothers of around 8.5 percent.

Multiple factors may contribute to the considerable differences in results across these studies. First, the research cited above used data spanning the 1960s to the early 2000s. Over this time the labor force participation of married women with children increased from less than 20 percent to around 65 percent and the raw gender wage gap decreased by nearly 50 percent (Greenwood, Guner, & Vandenbroucke, 2017). This suggests that the relative return to employment versus child rearing may have been quite different across these studies. Additionally, the composition of mothers in terms of age and education has changed dramatically over this time (Rindfuss, Morgan, & Offutt, 1996; Buckles, Guldi, & Schmidt, 2019), which could be expected to change maternal labor supply even holding constant the relative availability of child care and employment opportunities. Finally, the availability of affordable substitutes for direct maternal care may have varied across both time and geography for studies using only one or a few states or provinces (Baker, Gruber, & Milligan, 2008; Lefebvre & Merrigan, 2008; Fitzpatrick, 2010) versus other studies using national samples (Cascio, 2009; Gelbach, 2002; Sall, 2014).

In a pair of recent studies more closely related to the four-day week policy, Graves (2013a) and Graves (2013b) estimated the effect on maternal employment of adopting a year-round school calendar, which spreads the school year evenly across the calendar year, creating more frequent multi-week breaks in schooling. While the year-round calendar is not an absolute reduction in the days of schooling, it spreads relatively large school breaks evenly across the year, a situation that may be more likely to disrupt employment, particularly without the sorts of paid child care options associated with the traditional 11- to 12-week summer break. Graves (2013a) utilizes data at the census track level from the 2000 decennial Census to create a dependent variable comprising differenced measures of employment among those in the labor force comparing, for instance, mothers with school-aged children only (ages 6 to 17) and mothers with pre-school aged children only. She then uses a DD estimation strategy on this differenced dependent variable—an implicit difference-in-difference-in-differences approach—and finds that increasing year-round-calendar enrollment by one percentage point is associated with a .042 percentage point decrease in the employment rates of mothers with only school-aged children relative to mothers with only pre-school aged children. In Graves (2013b) she stratified the analysis by racial/ethnic makeup of the schools in the sample. Using this approach, she estimates that, among schools in the highest tercile of white enrollment, a one percentage point increase in year-round-calendar enrollment is associated with a much larger .21 percentage point decrease in the employment rate of mothers with at least one school-aged child relative to mothers of only pre-school aged children.

1.4 A Model of Parental Labor Supply

I motivate the empirical analysis by considering a theoretical model of household labor supply choice under the four-day school week and the five-day school week. Because instruction time is held constant under the four-day school week but the "child care" component of schooling is reduced by one day per week, I model the utility from schooling as two additively-separable components: a constant instruction time component and a variable child care time component. The decrease in child care time requires parents working full-time to either purchase child care or to substitute away from market work to care for children directly.[7]

The utility of a household (mother, m, and father, f) depends on consumption, c, child quality, q, and leisure, l. The utility function is

$$U(c,q,l) = \alpha \ln(c) + \beta ln(q) + (1-\alpha-\beta)\left[\ln(l_m) + \ln\left(l_f\right)\right]. \tag{1}$$

Child quality comprises the instruction-time benefit of schooling, t_s^i, the child care benefit from schooling, t_s^c, and non-school child care time, t_{-s}^c, which can be provided by parents (t_m^c, t_f^c) or by an outside provider (t_o^c). I normalize the productivity of child care from an outside provider and from a child's school to be equal to one and allow parental child care productivity to differ from these sources. Thus, $q = \ln(t_s^i) + \ln(t_s^c + t_{-s}^c = t_s^c + \lambda_m t_m^c + \lambda_f t_f^c + t_o^c)$. λ_i is the relative

[7] Though the four-day school week lengthens the remaining school days by around an hour and a half, I assume that work schedules revolve around days of work and cannot be reshaped in a similar fashion. This shift does suggest that there may be money savings associated with various aftercare expenditures for the lengthened school days, though the use of formal aftercare programs in rural districts is only around 15 percent (Afterschool Alliance, 2014).

productivity of each parent's child care time and I assume $\lambda_i \geq 0$.[8] I make the following additional assumptions on λ_i: it is an increasing function of parental education, e, a decreasing function of child age, a, and $\lambda_m \geq \lambda_f$ (mothers are at least as productive as fathers at providing child care).

Parent $i \in \{m, f\}$ allocates 1 unit of time between market work, t_i^w, child care, t_i^c, and leisure, $l_i = 1 - t_i^w - t_i^c$ (with $t_i^w + t_i^c < 1$). Market work time is a choice between no work, part-time work, P (a schedule I assume does not conflict with the four-day school week), and full-time work, F ($0 < P < F < 1$). The budget constraint is $c = w_m t_m^w + w_f t_f^w - k - p_c(n, a) t_o^c$. The wage is $w_i \in \{m, f\}$, and I assume that $w_f > w_m$.[9] Combined with the assumption that $\lambda_m \geq \lambda_f$, the mother's labor supply will be unambiguously more responsive than the father's labor supply to a reduction in school-based child care. The price of outside child care, $p_c > 0$, is increasing in the number of children, n, and decreasing in child age, a. Finally, there is a minimum consumption level, k, that each household must earn. Plugging all this into the utility function in (1) expresses household utility as a function of parental time allocation.

$$\begin{aligned} U(c, q, l) = \alpha \ln\left[w_m t_m^w + w_f t_f^w - k - p_c(n, a) t_o^c\right] \\ + \beta\left[\ln(t_s^i) + \ln\left(t_s^c + \lambda_m(e_m, a) t_m^c + \lambda_f\left(e_f, a\right) t_f^c + t_o^c\right)\right] \\ +(1 - \alpha - \beta)\left[\ln(1 - t_m^w - t_m^c) + \ln\left(1 - t_f^w - t_f^c\right)\right]. \quad (2) \end{aligned}$$

[8] This assumption rules out the notion that any parents are so unproductive that they are made explicitly worse off by providing child care *per se*. However, a parent receiving no utility is still explicitly worse off overall, since leisure will decrease by the amount of the increase in child care time.

[9] This assumption rationalizes the empirical fact that mothers disproportionately provide child care irrespective of employment status (Laughlin, 2013; Guryan, Hurst, & Kearney, 2008; Ramey & Ramey, 2010), makes the model tractable, and is broadly consistent with the data, though it does ignore a non-trivial subset of households with higher earning mothers.

The four-day week is an exogenous decrease in school time from "full-time," $t_s^c = S(F)$, to "part-time," $t_s^c = S(P)$, increasing t_{-s}^c from 0 to $(F - P) = P'$. Since I take differences in the analysis below, I assume that other child care time allocations (e.g., evenings, weekends) are constant and I normalize them to zero.

1.4.1 Exogenous Paternal Labor Supply

I first analyze the effect of the four-day school week holding constant the father's labor supply at full-time ($w_f t_f = w_f F = Y$) and omitting arguments for parental education and child characteristics. To establish a basic result of the model, consider the difference in utility under the five-day school week, U_0^{5DW}, and under the four-day school week, U_0^{4DW}, for a household with a non-working mother:

$$U_0^{4DW} - U_0^{5DW} = \beta \ln\left(\frac{S(P) + \lambda_m P'}{S(F)}\right) + (1 - \alpha - \beta) \ln\left(\frac{T_f - P'}{T_f}\right) \qquad (3)$$

The difference in utility from leisure (the second term) is unambiguously negative; if $\lambda_m > 1$, the difference in utility from child care is positive, attenuating the loss of leisure utility. If $\lambda_m >> 1$ (i.e., a mother's child care time is very productive), overall household utility may increase under the four-day school week. Since, under the five-day school week, the marginal utility of leisure was higher than the marginal utility of consumption, and the marginal utility of leisure has increased under the four-day school week, no non-working mother will enter employment in response to the four-day week.

Now compare the utility differences for married mothers initially working full-time. There are three possible choices after the four-day week is adopted: no work, part-time work and full-time work. These differences in utility are:

$$U_F^{4DW} - U_F^{5DW} = \alpha \ln\left(\frac{Y + w_m F - k - p_c P'}{Y + w_m F - k}\right). \tag{4}$$

$$U_P^{4DW} - U_F^{5DW} = \alpha \ln\left(\frac{Y + w_f P - k}{Y + w_f F - k}\right) + \beta \ln\left(\frac{S(P) + \lambda_m P'}{S(F)}\right) \tag{5}$$

$$U_0^{4DW} - U_F^{5DW} = \alpha \ln\left(\frac{Y - k}{Y + w_f F - k}\right) + \beta \ln\left(\frac{S(P) + \lambda_m P'}{S(F)}\right) + (1 - \alpha - \beta) \ln\left(\frac{1}{1 - F}\right) \tag{6}$$

The difference in (4) is strictly negative. Therefore, any mother working full-time is made worse off under the four-day school week. If child care costs are sufficiently high, a mother may reduce work hours to P and provide care directly. In (5), the consumption term is strictly negative, but now there is a potential change in utility from child quality and, as above, if λ_m is greater than one, a positive change in utility from child quality will attenuate the magnitude of the consumption utility loss or even make the change in overall utility positive. Leisure is unchanged in (5). Finally, consider the utility difference in (6). The consumption term is strictly more negative than in (5) and, if $w_m F > p_c P'$, it is also more negative than in (4). The change in child quality utility is equal to (5) and there is a positive change in the utility of leisure. However, the mother’s choice to work full-time under the five-day school week means that the ratio of the marginal utilities of leisure and consumption was optimal at full-time hours. This implies that (6) can’t be optimal. Thus, a mother working full-time under the five-day school week would always prefer part-time work to exit under the four-day school week.

However, labor demand-side factors may also play a role. Employers may use a full-time hours requirement to sort workers according to unobservable productivity (Rebitzer & Taylor, 1995; Landers, Rebitzer, & Taylor, 1996; Sousa-Poza & Ziegler, 2003). Additionally, changes in worker preferences over hours have been found to have a much larger effect on labor supply when associated with a job transition, suggesting that within-job hours flexibility is scarce (Altonji & Paxson, 1992). Empirically, part-time jobs represent around 20 percent of all jobs and are typically held for "non-economic reasons," meaning they are preferred to full-time work by those holding them (Valleta & Bengali, 2013).[10] Taken together, these factors suggests that a labor market in equilibrium may be characterized by an inefficient number of part-time jobs. If suitable part-time work is unavailable when a household is faced with the four-day school week, the utility loss from exiting employment may be smaller than the utility loss from continuing to work and paying for outside child care suggesting that there will be exit from employment under the four-day school week.

1.4.2 Child Characteristics

Younger children require greater levels of supervision. Higher associated costs induce a negative relationship between the price of child care and child age.[11] Higher prices will disproportionately lower the net-of-child-care wage for mothers of younger children relative to mothers of older children. This relationship between child age and the required intensity of care also implies that, for young children, maternal care will tend to be more productive than care delivered in a non-

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[10] Additionally, Peters, Jackofsky and Salter (1981) find that a set of characteristics reflecting workplace involvement, job search expectations / behavior and related characteristics has predictive power with respect to turnover among full-time employees but not among part-time employees. Part-time employees in their sample also live closer to their jobs, a potentially important non-pecuniary benefit.

[11] See, e.g., http://usa.childcareaware.org/wp-content/uploads/2016/05/Parents-and-the-High-Cost-of-Child-Care-2015-FINAL.pdf for evidence of this price relationship across several states. See https://www.opm.gov/policy-data-oversight/worklife/reference-materials/child-care-resources-handbook/ for recommended and maximum child to caregiver ratios that decrease with age.

maternal group setting. This difference in productivity will have an effect on employment, as a mother's reservation wage will decline with child age (Lubotsky & Qureshi, 2018). These factors will make mothers of younger children more likely to reduce hours or exit employment in response to the four-day school week.

The price of child care, p_c, is also increasing in the number of children (see, again, footnote 11) implying that the loss of consumption utility associated with paying for outside child care is increasing in family size. Thus, mothers with a greater number of children will be more likely to reduce hours or exit employment in response to the four-day school week.

1.4.3 Parental Education

A growing descriptive literature across the social sciences has highlighted a strong, positive association between parental education and time spent with children (Craig, 2006; Guryan, Hurst, & Kearney, 2008; Kalil, Ryan, & Corey, 2012; Ramey & Ramey, 2010). Other studies using plausibly causal research designs estimate relationships suggesting that parental education is associated with higher returns to a given level of investment in children (Currie & Moretti, 2003; Oreopoulos, Page, & Huff Stevens, 2003). These factors motivate the model's assumption that child care productivity is increasing in parental education, which implies that, all else equal, more-educated mothers will decrease labor supply more under the four-day week than less-educated mothers.[12]

[12] One factor I hold constant across the change in school provision and, thus, omit from the model is the positive relationship between education and wages. Across adoption of the four-day week, only a change in the time allocation of a parent affects earnings. While the change in the level of family income will be larger among families with higher educated mothers on average, positive assortative mating (which I find strong evidence of in the data) suggests that fathers in these families will also earn more and, thus, such families will have a lower marginal utility of consumption on average. Consistent with this observation, the positive association between parental education and child rearing time documented in Guryan, Hurst, and Kearney (2008), Ramey and Ramey (2010) and elsewhere appears to dominate the alternative of increased labor supply (at presumably high wages) among parents of both genders.

1.4.4 Endogenous Paternal Labor Supply

Next, I relax the assumption that fathers are non-responsive to the four-day school week. Suppose that, upon learning of the adoption of the four-day school week, both parents assess their ability to reduce hours. If both are equally constrained or unconstrained to reduce hours, then the model would reduce to the results above since $w_f > w_m$ and $\lambda_m \geq \lambda_f$. However, if the mother cannot adjust hours and must exit employment if she cannot continue working full-time, but the father can reduce hours, the optimal response may be a reduction in the father's hours. This difference in utility (where subscripts on utility denote, first, the labor supply of the father and, second, the labor supply of the mother) is

$$U_{P,F}^{4DW} - U_{F,F}^{5DW} = \alpha \ln\left(\frac{w_f P + w_m F - k}{w_f F + w_m F - k}\right) + \beta \ln\left(\frac{S(P) + \lambda_f P'}{S(F)}\right) + (1-\alpha-\beta)\ln\left(\frac{1-P}{1-F}\right). \qquad (7)$$

The utility difference in consumption is negative and the utility difference in leisure is positive. If $\lambda_f > 1$, then the utility difference in child quality is also positive. Under the assumptions on wages ($w_f > w_m$) and child care productivity ($\lambda_m \geq \lambda_f$), a household would always prefer (5) to (7), but (7) may be optimal if the utility loss associated with it is smaller in magnitude than the losses associated with the mother either continuing to work full-time while using market child care, (4), or exiting employment, (6). Thus, fathers may decrease hours but will not exit employment in response to the four-day school week.

1.4.5 <u>Single-Female-Headed Households</u>

Another important group affected by the four-day school week is single-female-headed households. Single-female-headed households have one source of income and, thus, less flexibility to respond to the four-day school week.[13] Consider utility for a single mother,

$$U(c,q,l) = \alpha \ln(w_m t_m^w - k - p_c(n,a)t_o^c) + \beta\lambda(e_m,a)\ \ln t_m^c + (1-\alpha-\beta)\ln(1-t_m^w-t_m^c)\,. \quad (8)$$

This household has only one source of earnings, so the requirement that $w_f t_f^w - k > 0$ means that she must remain employed. Therefore, among single-female-headed households, mothers may decrease hours, but will not exit employment in response to the four-day school week.

The response of single-female-headed households along the intensive labor supply margin is theoretically ambiguous. If a mother's own wage net of child care costs exceeds the opportunity cost of working (in terms of her child-rearing productivity), then she may reduce hours and provide needed child care directly, if scheduling flexibility exists. If, on the other hand, child care costs are low, and her own wage net of these costs exceeds the opportunity cost of forgoing additional child care time, *or* if the scheduling flexibility to reduce hours while maintaining employment doesn't exist, then a mother may increase hours to attempt to hold consumption (approximately) constant in the household. The direction of this empirical relationship is estimated below.

[13] There are, of course government transfer programs allow for non-work, and around 25-30 percent of such households consistently have non-working mothers (see, e.g., https://www.bls.gov/news.release/pdf/famee.pdf). Female-headed households also may receive contributions from fathers or other family members. However, since I show that no mothers will enter employment due to the four-day week, I abstract away from non-working single mothers in the analysis.

1.5 Data

Information on families comes from ACS 1-year estimates from 2005 to 2016 for Colorado, Idaho and Oregon, and from 2011-2016 for Oklahoma (Ruggles, Genadek, Goeken, Grover, & Sobek, 2015).[14] These microdata are geographically aggregated into Public Use Microdata Areas (PUMAs), which are contiguous, within-state collections of census tracts comprising 100,000 or more persons.[15] PUMA definitions between 2005 and 2011 are based on the 2000 Census population. In 2012, PUMA definitions were updated to reflect population growth and migration measured by the 2010 Census. I harmonize this geography by generating constant Census 2000 PUMA definitions for sample years 2012-2016 using a PUMA crosswalk from the Missouri Census Data Center. I restrict the ACS sample to adults aged 25 to 54. The primary estimates use a sample of married parents with children who are all between the ages of 5 and 13, as this group is likely to depend either primarily or entirely on school-based child care.[16] There are around 3,500 such parents in the sample per year. The sample of female-headed households is around 740 mothers per year.[17]

I construct labor supply outcomes from the ACS data in the following way. Employment is a dummy variable equal to one for those currently employed at the time of survey and zero for anyone else with a valid employment status, including those not in the labor force. Weeks

[14] Earlier data on four-day week adoption and enrollment are not available for Oklahoma. But the fewer than 4,000 students were enrolled under the four-day week in the state before 2011.
[15] See https://www.census.gov/geo/reference/puma.html for more details.
[16] I use age 13 as the high age because the incidence of "self-care" increases significantly among children 14 and older (Blau & Currie, 2006; Laughlin, 2013).
[17] Calculating the number of families in the sample is not straightforward for years 2012-2016 since, to hold PUMA geography constant, I duplicate respondents into all 2000 PUMAs for which the 2000 PUMA to 2012 PUMA crosswalk uses a positive allocation factor. In other words, the same family may appear in two or more PUMAs. I then generate hybrid sample weights that are the product of the given ACS person weight and this allocation factor, so that persons appearing in multiple PUMAs are weighted downward (on the interval (0,1)) according to their allocated probability of being in each PUMA using the PUMA 2000 crosswalk, with the sum of all weighted appearances of these respondents summing to the original ACS person weight. For years 2005-2011, the given ACS sample weights are used. Due to this hybrid weighting procedure, sample sizes in the regression results are overstated by around 11 percent.

worked per year refers to a respondent's answer when asked to recall the number of weeks during which she worked over the 12 months prior to being surveyed. These responses are grouped into seven mutually exclusive categories: 0 weeks, 1-13 weeks, 14-26 weeks, 27-39 weeks, 40-47 weeks, 48-49 weeks, and 50-52 weeks. In the usual hours worked measure, respondents are asked to estimate how many hours per week they typically worked during the weeks they worked over the past 12 months, and if their hours varied considerably, they are asked to give an approximate average.

Both weeks worked per year and usual hours worked per week are strongly bimodal. For usual hours worked per week among mothers with children ages 5 to 13 at baseline, 23 percent reported no work and 52 percent reported working 35 or more hours per week for the weeks in which they worked. For weeks worked in the past 12 months, around 22 percent reported no weeks of work during the past year and 52 percent worked 50 to 52 weeks. Among fathers, around 91 percent worked 35 or more hours per week and 78 percent worked 50-52 weeks in the past year. I use a categorical version of each of these variables in multinomial logit regression models as described below. For weeks worked in the past 12 months, I group the seven categories above into four: 0 weeks, 1-26 weeks, 27-49 weeks, 50-52 weeks. For usual hours worked per week, I use four categories: 0 hours, 1-19 hours, 20-34 hours, 35 or more hours. I also generate a continuous measure of annual hours worked in the past 12 months by setting each observation in the weeks worked measure to the middle value of the category's range (6.5, 20, 33, 43.5, 48.5, 51) and generating the product of weeks worked in the past 12 months and usual hours worked per week for weeks of positive work.

Estimating effects of the four-day week using ACS data is complicated by the time aggregation of survey responses into calendar years, which do not coincide with school years.

For example, I match a district that adopts the four-day school week in September of 2012 to 2013 ACS respondents. Conditional on the sampling weights, these responses are equally distributed across the year. This means that January respondents have been exposed to the four-day school week for four months and December respondents have been exposed for 16 months. But in the initial year of adoption, 2012, September through December respondents (who are part of the *t-1* sample in my estimation strategy) have been exposed to the four-day school week for between 1 and 4 months. Appendix A, figure 20 provides a graphical example of these overlapping time periods. The net effect of this temporal mismatch (which occurs throughout the sample as districts adopt the four-day week in any given PUMA-year) will be to bias estimates toward zero since, for each district adopting in a PUMA, both "treated" families will be present in the pre-period and, for the variables that use a 12-month "look back" approach—in particular weeks worked per year and earnings measures (the usual hours question asks respondents to estimate usual hours for the weeks they did work), respondents in period t_0 may be incorporating as many as eight months before the four-day school week began into their calculations.

Table I presents summary statistics in each state's baseline year (2005 for CO, ID, OR and 2011 for OK) for families with children all between the ages of 5 and 13 in PUMAs containing districts with "high" levels of four-day week enrollment (defined as .125 or more of enrollment in a PUMA-year in four-day school week districts), "low" levels of four-day week enrollment (up to .125 of PUMA-year enrollment under the four-day week), and no four-day week enrollment. This grouping approach is discussed in detail below. Panel A displays means and standard deviations for employment and usual hours of work along with income, education, and race for married mothers in these families. Panel B summarizes the number and age distribution of the children in these families. Panel C provides measures of the same

Table I: Baseline Characteristics of Parents of Grade School Aged Children

	(1) High 4DW Enrollment		(2) Low 4DW Enrollment		(3) No 4DW Enrollment	
	Mean	SD	Mean	SD	Mean	SD
Panel A: Married Mothers						
Employment	0.71	[0.45]	0.69	[0.46]	0.69	[0.46]
Wage/salary Income	16,114	[21,593]	21,141	[23,814]	20,441	[27,446]
Proportion HS Dropouts	0.10	[0.30]	0.06	[0.24]	0.07	[0.25]
Proportion Bacc Degr +	0.21	[0.41]	0.35	[0.48]	0.41	[0.49]
Proportion Non-White	0.17	[0.38]	0.12	[0.33]	0.19	[0.39]
Usual Hours Work / Week	27.88	[16.76]	27.34	[17.95]	27.11	[18.56]
Weeks Worked per Year	34.11	[21.28]	34.17	[21.71]	33.84	[21.70]
Annual Hours Worked/Year	1,197	[882]	1,256	[928]	1,231	[956]
Panel B: Household Children of Married Mothers						
Number of Own Children	1.69	[0.72]	1.80	[0.77]	1.77	[0.75]
Eldest Own Child Age	10.18	[2.28]	10.04	[2.36]	9.96	[2.40]
Youngest Own Child Age	8.39	[2.52]	7.98	[2.37]	7.98	[2.36]
Observations	389		1,366		1,024	
Panel C: Married Fathers						
Employment	0.89	[0.31]	0.93	[0.26]	0.92	[0.28]
Wage/salary Income	34,537	[28,575]	45,900	[41,252]	54,709	[62,247]
Proportion HS Dropouts	0.14	[0.35]	0.09	[0.28]	0.10	[0.30]
Proportion Bacc Degr +	0.20	[0.40]	0.31	[0.46]	0.43	[0.49]
Proportion Non-White	0.18	[0.38]	0.12	[0.32]	0.20	[0.40]
Usual Hours Work / Week	43.87	[16.85]	43.73	[13.66]	43.07	[13.65]
Weeks Worked per Year	44.97	[14.05]	46.46	[12.54]	46.00	[12.91]
Annual Hours Worked/Year	2,087	[874]	2,131	[771]	2,081	[773]
Observations	369		1,321		991	
Panel D: Single Mothers						
Employment	0.73	[0.45]	0.77	[0.42]	0.76	[0.43]
Wage/salary Income	12,758	[11,970]	26,058	[37,496]	20,713	[23,734]
Proportion HS Dropouts	0.09	[0.29]	0.08	[0.27]	0.11	[0.31]
Proportion Bacc Degr +	0.13	[0.33]	0.22	[0.41]	0.21	[0.41]
Proportion Non-White	0.12	[0.33]	0.21	[0.41]	0.22	[0.41]
Usual Hours Work / Week	31.62	[18.08]	33.67	[17.02]	33.28	[16.37]
Weeks Worked per Year	33.88	[21.54]	38.61	[19.49]	38.63	[18.41]
Annual Hours Worked/Year	1,331	[984]	1,540	[912]	1,484	[894]
Panel E: Household Children of Single Mothers						
Number of Own Children	1.74	[0.90]	1.59	[0.79]	1.45	[0.65]
Eldest Own Child Age	10.17	[2.49]	9.94	[2.52]	9.79	[2.58]
Youngest Own Child Age	8.39	[2.52]	8.40	[2.56]	8.50	[2.59]
Observations	114		387		362	

Source: American Community Survey 1-year estimates (2005 for CO, ID, OR, and 2011 for OK). Hybrid PUMA crosswalk / ACS person weights as described in text used to calculate means. Observations reflect actual respondent counts.

characteristics for married fathers. Panels D and E provide analogous means for single mothers and their children. Overall, married parents in PUMAs with "high" four-day week enrollment earn less, are more likely to have dropped out of high school, and are less likely to have completed a college degree. However, they do not differ meaningfully in terms of employment level, usual hours worked per week, weeks worked per year, family size or average child ages. These differences are similar for single mothers, however, single mothers in "high" four-day week enrollment PUMAs also worked about 11 percent fewer weeks at baseline and about 8 percent fewer usual hours per week.

District-level data on total enrollment and four-day week schedule adoption were provided by each state's department of education. I aggregate these data to match the ACS data using a school district to PUMA crosswalk from the Missouri Census Data Center. Figure 2 shows the distribution of PUMA-year four-day school week enrollment levels in the sample. The density of this distribution is right-skewed, with most of the mass at enrollment levels below .06 and then a long tail of enrollment levels ranging from .12 to .45. To decrease the likelihood that my results are affected by this nonlinearity in the distribution of four-day week adoption, my main estimation approach divides PUMA-years into "zero," "low," and "high" levels of four-day week enrollment (as used in Table 2 above). PUMA-years with positive four-day week enrollment are grouped according to whether they are above or below a cutoff value of .125, the dashed red line in Figure 2.[18]

Table II shows the mean and dispersion of four-day week enrollment in each category as a proportion of total PUMA-year enrollment and in terms of student counts. 371 of 996 PUMA-years in the sample have positive four-day week enrollment. Of these, 285 PUMA-years are

[18] Appendix A, Figure 10 shows a set of alternate cutoffs that form three categories of positive enrollment PUMA-years using other thresholds in the distribution. Estimates using these cutoffs (Appendix Table A3) have lower statistical power but are consistent with the main results using two categories.

categorized as “Low 4DW Enrollment” and 86 PUMA-years are categorized as “High 4DW Enrollment.” The are 92 unique PUMAs in the sample, 13 have years of high four-day week enrollment, 42 have only years of low four-day week enrollment, and 37 PUMAs have no positive four-day week enrollment across the sample period.

Figure 2**:** Distribution of Four-Day Week Enrollment at the Puma-Year Level

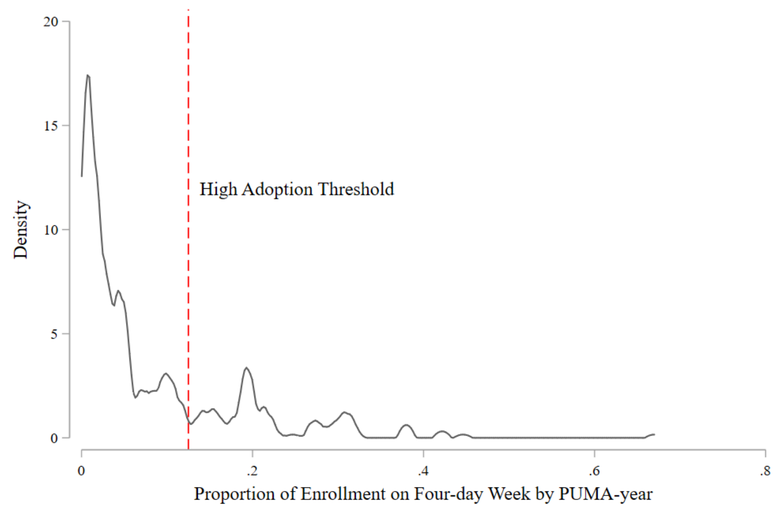

Figure presents a kernel density plot showing different levels of PUMA-by-year enrollment among PUMAs with positive four-day week enrollment. Dashed red line indicates cutoff between “low adoption” and “high adoption” used in empirical analyses.

Table II: Characteristics of Puma-Years with Positive Four-Day Week Enrollment

	Mean	SD	Min	Max
Panel A: PUMAs with Low Four-day Week Enrollment Levels				
Proportion of PUMA Enrollment Under 4DW	0.03	[0.03]	0.00	0.12
Number of 4DW Students in PUMA	842	[764]	10	4,228
Observations		335		
Panel B: PUMAs with High Four-day Week Enrollment Levels				
Proportion of PUMA Enrollment Under 4DW	0.23	[0.09]	0.13	0.67
Number of 4DW Students in PUMA	4,695	[1,972]	2,064	10,042
Observations		95		

Source: Colorado, Idaho, Oklahoma, Oregon Departments of Education. Assignment of four-day week enrollment to PUMA (2000) geography uses a school district to PUMA crosswalk from the Missouri Census Data Center. Observations are PUMA-years. Cutoff enrollment proportion between "Low" and "High" levels of positive 4DW enrollment is .125.

1.6 Empirical Strategy

I use difference-in-differences to estimate the effect of the four-day week in “low” and “high” enrollment PUMAs (relative to PUMAs with no four-day week enrollment) for each outcome. The basic estimating equation is the following two-way fixed-effects model:

$$y_{ijt} = \beta_0 + \beta_1\, low\ 4DW_{jt} + \beta_2\, high\ 4DW_{jt} + \boldsymbol{X_{ijt}}\boldsymbol{\Gamma} + \theta_j + \delta_t + \varepsilon_{jt}. \qquad (9)$$

y_{ijt} is the outcome for individual *i* in PUMA *j* in year *t*. The parameters θ_j and δ_t are, respectively, PUMA and year fixed effects and $\boldsymbol{\Gamma}$ is a vector of coefficients for controls $\boldsymbol{X}_{ijt}$, that include race, ethnicity and educational attainment dummy variables, indicators for three-year age groupings, and interactions between the educational attainment dummies and the grouped age indicators.[19] I also include variables to control for potential confounding from time-varying factors correlated with each outcome (employment, usual hours worked per week, weeks worked per year, annual hours worked per year) and adoption of the four-day week. Specifically, in each regression I include the PUMA-level baseline mean outcome of each labor supply measure (for both men and women) interacted with a full set of year dummies.[20] This control allows for the effect of annual shocks to employment, hours worked, or weeks worked among parents (or a placebo group) to differ according to initial level differences across PUMAs and across genders within PUMA. I also include the annual PUMA-level employment rate of men and women aged 18-24 (who are not the estimation samples), to control for unobservable annual economic

[19] Race is coded as black, Asian, Pacific Islander, Native American and other, and the Hispanic ethnicity is a binary dummy variable. Non-Hispanic whites are the omitted group. Dummies for educational attainment are less than high school, some college, and Baccalaureate degree or greater, with high school graduate omitted. Age is binned in three-year age groups with cuts at 25, 28, 31, 34, 37, 40, 43, 46, 49, 52.
[20] Each of these controls is generated for the particular estimation group of interest’s mean level at baseline.

conditions at the PUMA-by-year level.[21]

In equation (9) above, β_2 is the parameter of interest, since it identifies the effect of high levels of four-day week enrollment (defined as PUMA-years with more than .125 of total enrollment using the four-day week schedule). For β_1, the coefficient on low four-day week enrollment (PUMA-years with non-zero four-day week enrollment that is below .125 of total enrollment), the mean of the proportion of enrollment using the four-day week is sufficiently low (0.03) that the 1 percent ACS sample is, ex-ante, unlikely to have statistical power to detect a plausible effect. Therefore, I do not expect to find consistent statistically significant non-zero estimates for the low four-day week enrollment coefficient.

For the categorical variables, usual hours worked per week and weeks worked per year, I use a multinomial logit version of model (9).[22] I present the results of this method using figures showing predicted probabilities of being in each category in areas with no four-day week enrollment, low four-day week enrollment, and high four-day week enrollment. This approach has two main virtues. First, it generates an exhaustive choice set, yielding complete distributions of the (grouped) outcomes under different levels of four-day school week enrollment. Second, it shows the relative distribution of these labor supply choices in the data. In addition to these results, I generate estimates of employment at the time of survey using a linear probability OLS model and estimates of annual hours worked using a robust Poisson model. All regressions are

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[21] The regression-adjusted correlations (net of year and PUMA fixed effects) between the employment rates of young adults aged18-24 and potentially affected parents are .33 (t=5.13) for men and .15 (t=3.32) for women.
[22] If we let $\mathrm{Z} = \beta_1\ low\ 4DW_{jt}^0 + \boldsymbol{X_{ijt}}\boldsymbol{\Gamma} + \theta_j + \delta_t$ with the value of $low\ 4DW_{jt}$ held constant at 0, then the multinomial logit model to estimate the effect of "high" four-day week enrollment levels for outcome y_{ijt} is

$$P\left(y_{ijt} = k \middle| high\ 4DW_{jt}, low\ 4DW_{jt}^0, \boldsymbol{X_{ijt}}, \theta_j, \delta_t\right) = \frac{exp\left(\beta_2 high\ 4DW_{jt}^1 + \mathrm{Z}\right)}{1 + exp\left(\beta_2 high\ 4DW_{jt}^1 + \mathrm{Z}\right) + exp\left(\beta_2 high\ 4DW_{jt}^0 + \mathrm{Z}\right)}\ k \neq B.$$

The respective model for variation in the "low" four-day week enrollment level is analogous. Due to an excess of empty cells when using non-parametric age bins and the interaction with education levels for categorical labor supply outcomes (as is done in the estimates using continuous outcome measures), a cubic term in age and non-parametric education groups (without interactions) were used in these estimates.

weighted using hybrid PUMA crosswalk / ACS sampling weights (discussed in footnote 17 above). Standard errors are clustered at the PUMA level.

1.6.1 Validity of the Difference-in-Differences Approach

The highly decentralized nature of adoption of the four-day school week makes it prohibitively difficult to collect detailed information on the determinants of adoption (even sample statistics at the school district level are not readily available for most of the districts in this study), so I rely primarily on empirical evidence and multiple attempts at falsifying the results to support the research design. Conceptually, though, the validity of the DD approach hinges on the assumption of a common trend in conditional outcomes between areas containing districts with different levels of four-day week enrollment absent the four-day week policy.[23] A possible concern about this assumption is that districts adopting the schedule may have unobservable characteristics, such as weaker maternal labor force attachment, that would lead to disproportionate adoption of the four-day week. If such characteristics make these communities less affected by the policy change relative to comparison areas, then any bias arising from this situation would be in the direction of finding no effect on labor supply. The opposite conjecture, that the four-day school week is disproportionately adopted among districts where it would have a particularly large effect on labor supply, seems unlikely ex-ante, and less plausible than an assumption of quasi-random adoption with respect to potential labor supply outcomes. Table I shows that, though

[23] Though many DD studies using non-linear regression models implicitly rely on the common trends assumption (Eissa & Liebman, 1996; Evans & Garthwaite, 2014; Myers & Ladd, 2017), the now-standard linear common trends assumption (Angrist & Pischke, 2009) cannot be recovered from models with a non-linear link function (such as Poisson and multinomial logit regression) that include group and time fixed-effects, since the necessary differencing relies on the linearity of the expectation operator (Lechner, 2011). Lechner (2011) shows that a modified common trend assumption using a latent dependent variable framework allows for identification in regression models using non-linear link functions. This alternate assumption is not necessarily less plausible than either the linear common trends assumption or the alternate "common slopes" assumptions used in many DD studies with linear group trends. As to the plausibility of the non-linear regression estimates in this study, appendix A, figures 14 and 15 present results for two main outcomes estimated with non-linear regression models, hours and weeks worked per year, using an analogous linear regression approach. These results do not differ meaningfully from the estimates from the non-linear models.

families differ at baseline along some observable characteristics such as education, income, and race across PUMAs with varying levels of four-day week enrollment, they do not differ meaningfully by average labor supply or the presence and composition of children at baseline (with the exception of week worked among single mothers, as mentioned previously). But to address the possibility that unobservable labor market differences remain, I control for baseline labor supply outcomes interacted with year fixed-effects for each group analyzed, allowing initial labor supply characteristics in an area to interact differently with common economic shocks.

Another potential concern is that areas may be heterogenous affected by macroeconomic conditions. If a macroeconomic shock leads to a relatively weaker fiscal position in some districts, making them simultaneously more likely to adopt the schedule and more likely to experience potentially unrelated employment declines, then my estimates may be biased upward in magnitude. To address this possibility in the regression models, I include PUMA-year level labor supply outcomes for workers ages 18 to 24. The employment of these young workers should be correlated with time-varying area-specific labor market conditions that may lead to adoption of the four-day week.

I also estimate year-over-year estimates of the change in employment and annual hours worked that can provide evidence on trends in these outcomes prior to crossing a threshold of four-day week adoption. This model is

$$\begin{aligned} y_{ijt} = \alpha_0 + \beta_{-5+}\, low4DW_{j,-5+} + \sum\nolimits_{t=-4}^{4} \beta_t\, low4DW_{jt} + \beta_{4+}\, low4DW_{j,4+} + \gamma_{-5+}\, high4DW_{j,-5+} \\ + \sum\nolimits_{t=-5}^{4} \gamma_t\, high4DW_{jt} + \gamma_{4+}\, high4DW_{j,4+} + \boldsymbol{\Gamma X}_{ijt} + \theta_j + \delta_t + \varepsilon_{jt}. \end{aligned} \tag{10}$$

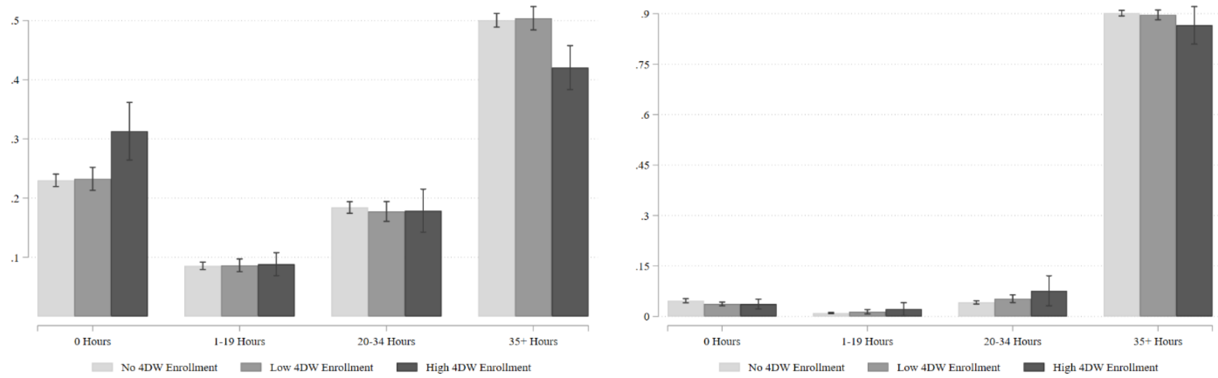
The terms subscripted by "$-5+$" and "$4+$" indicate that the change in four-day week enrollment status is, respectively, 5 or more years in the past or 4 or more years in the future. This model estimates of the effect of moving across the threshold into the "Low 4DW Enrollment" category relative to areas with no change in four-day week enrollment, generating pre-period estimates, β_{-5} to β_{-2}, and the effect of moving from low four-day week enrollment into the "High 4DW Enrollment" category, (γ_{-5} to γ_{-2}). Evidence consistent with the validity of the DD approach would be that the pre-period coefficients on "Low 4DW Enrollment" equal zero relative to *t-1*, the omitted reference period. The pre-period coefficients relative to crossing the "High 4DW Enrollment" threshold, on the other hand, are arbitrary with respect to estimating a "pre-trend," but this threshold does provide a useful landmark with which to consider the extent to which a "dose response" relationship between levels of four-day school week enrollment and labor supply outcomes is present.

1.7 <u>Results</u>

Figures 3 and 4 present predicted probabilities of being in different categories of usual hours worked per week and weeks worked per year from multinomial logit regression. Panels labeled A are estimates for married mothers of children between ages 5 and 13, and panels labeled B are estimates for fathers. Within each category of hours or weeks worked, the three bars (from left to right) represent predicted mean values of the indicated labor supply choice for areas with no four-day week enrollment, with "low" four-day week enrollment and "high" four-day week enrollment. Predicted values are constructed using the actual distribution of covariates and confidence intervals are estimated using delta-method standard errors.

Figure 3: Predicted Hours Worked Among Married Parents of Grade School Aged Children
Under Zero, Low, and High Four-Day Week Enrollment

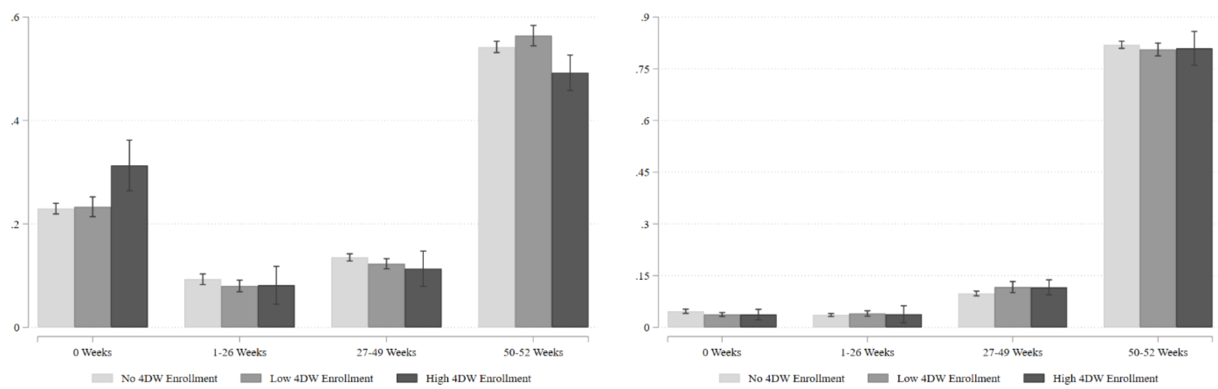
Panel A: Mothers with Children 5-13 Panel B: Fathers with Children 5-13



Bars show predicted values from multinomial logit regression of usual hours worked on indicator variables for high and low 4DW enrollment (and controls as described in text) for each outcome with both 4DW indicators at zero, low 4DW enrollment equal to one with high 4DW enrollment equal to zero and high 4DW enrollment equal to one with low 4DW enrollment equal to zero. Standard errors estimated using the delta method.

Figure 4: Predicted Weeks Worked Among Married Parents of Grade School Aged Children
Under Zero, Low, and High Four-Day Week Enrollment

Panel A: Mothers with Children 5-13 Panel B: Fathers with Children 5-13



Bars show predicted values from multinomial logit regression of annual weeks worked on indicator variables for high and low 4DW enrollment (and controls as described in text) for each outcome with both 4DW indicators at zero, low 4DW enrollment equal to one with high 4DW enrollment equal to zero and high 4DW enrollment equal to one with low 4DW enrollment equal to zero. Standard errors estimated using the delta method.

Estimates in panel A of figure 3 show that, under no four-day week enrollment, 23 percent of mothers report zero hours (not working in the past 12 months) and 50 percent of mothers work full-time hours, with 18.5 percent working 20-34 hours and 8.5 percent working 19 or less hours. Predicted means under “low” four-day week enrollment are statistically identical to these levels. However, under “high” four-day week enrollment the zero hours category is 8 percentage points higher than under no or low four-day week enrollment. The decrease in mothers working full-time usual hours over that period is of equal magnitude. The 95 percent confidence intervals for the predicted mean values of zero and high four-day week enrollment are distinct from one another. In contrast, there are no statistically distinguishable shifts in either of the part-time usual hours categories. In panel B of figure 3, estimates indicate that 90 percent of fathers work full-time hours under no four-day week enrollment, 4 percent work 20-34 hours per week, 1 percent work 1-19 hours per week, and 5 percent do not work. Under either level of four-day week enrollment, there is no statistically significant shift in predicted hours worked, but the means suggest a modest decline in the incidence of working 35+ hours per week under high four-day week enrollment (a 3.5 percentage point change) and small increases in working part-time hours.

Turning to weeks worked per year (panel A of figure 4), under no four-day week enrollment 54 percent of mothers work 50-52 weeks, 13.5 percent report working 27-49 weeks, 9 percent report working 1-26 weeks, and 23 percent did not work during any weeks in the prior 12 months. Under low four-day week enrollment, there is no statistically distinguishable change. However, moving from no four-day week enrollment to high four-day week enrollment is associated with a statistically significant 5 percentage point decrease in the predicted incidence of working 50-52 weeks in the past year and an 8 percentage point increase in working no weeks in the past year. The 3 percentage point difference between year-round work and no employment is divided between the 1-26 weeks and 27-49 weeks categories (though these estimated changes are not statistically significant). Appendix A, table XXI reports numerical results of these analyses.

1.7.1 <u>Weighted Least Squares and Robust Poisson Estimates</u>

Table III presents estimates for employment at the time of survey using a weighted least squares linear probability model, and for annual hours worked using robust Poisson regression. For each outcome and gender, there are results from three regression models that sequentially add the controls detailed above in the description of the model in equation (9). In the first specification (column (1) for mothers and column (4) for fathers), the model contains only PUMA and year fixed effects. The second specification (columns (2) and (5)) adds controls for race/ethnicity, age, educational attainment and the interaction between age and education as outlined above. The final specification, given in columns (3) and (6), adds the PUMA-level outcome of interest for mothers and fathers in the baseline year interacted with year fixed effects, and the PUMA-year average outcome for 18- to 24-year-olds. Because estimates are not particularly sensitive to the presence or absence of these controls, I will limit discussion to estimates from the third model with all controls included (columns (3) and (6)).

Panel A presents results for a linear probability model of employment at time of survey. Focusing on the "High 4DW Enrollment" coefficient, I estimate a decrease of 7.6 percentage points, equivalent to an 11 percent decline from a baseline of 70 percent. The estimated coefficients for "Low 4DW Enrollment" areas are all close to, and statistically indistinguishable from, zero. For fathers, the coefficients for both four-day week enrollment indicators are near

Table III: Effects of the Four-Day Week Among Married Parents of Grade School Aged Children

	(1)	(2)	(3)	(4)	(5)	(6)
		Mothers			Fathers	
Panel A: Employment						
Low 4DW Enrollment	0.007	0.006	0.004	0.002	0.000	0.002
	(0.017)	(0.017)	(0.016)	(0.008)	(0.008)	(0.008)
High 4DW Enrollment	-0.082**	-0.079**	-0.076**	-0.001	-0.004	-0.003
	(0.022)	(0.023)	(0.027)	(0.017)	(0.016)	(0.014)
Baseline Mean	.69	.69	.69	.92	.92	.92
Panel B: Annual Hours Worked						
Low 4DW Enrollment	0.009	0.010	0.004	-0.007	-0.009	-0.005
	(0.027)	(0.028)	(0.027)	(0.013)	(0.012)	(0.012)
High 4DW Enrollment	-0.113**	-0.104*	-0.114**	-0.017	-0.022	-0.019
	(0.040)	(0.041)	(0.042)	(0.031)	(0.030)	(0.029)
Baseline Mean	1,215	1,215	1,215	2,101	2,101	2,101
PUMA & year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Race, Age, Ed Controls	No	Yes	Yes	No	Yes	Yes
Outcome Controls	No	No	Yes	No	No	Yes
Observations	37,149	37,149	37,149	35,642	35,642	35,642

Models (1) include year and PUMA fixed effects. Models (2) include race/ethnicity, age, educational attainment and interactions between age and education. Models (3) include baseline outcome interacted with year fixed effects and annual PUMA by year outcome of 18- to 24-year olds. Annual hours models use robust Poisson regression. Regressions weighted using hybrid PUMA crosswalk / ACS person weights as described in text. Standard errors clustered at the PUMA level. + p<0.10, * p<0.05, ** p<0.01.

zero. The standard errors on the "High 4DW Enrollment" coefficient rule out an effect of more than half the magnitude of the maternal effect at the 95 percent confidence level.

Panel B reports robust Poisson regression estimates of the effect of the four-day school week on annual hours worked. Estimates suggest that an average four-day week enrollment level of 25 percent is associated with an approximately 11 percent reduction in annual hours worked that is statistically significant at the 1 percent level. Estimates for fathers center around a statistically insignificant 2 percent reduction. The greater magnitude of these cumulative annual hours results relative to the component results in the multinomial logit estimates appears to be driven by hours decreases within the hours groupings used in the prior analysis.[24]

Alternative specifications suggest these results above are not sensitive to a particular specification. Appendix A, table XXII presents estimates for the employment at the time of survey and annual hours worked using two alternate regression specifications. The first approach uses alternate cutoffs to bin four-day week enrollment into three, rather than two, bins of positive enrollment. [25]The maternal results are confluent with the main results, and the point estimates show clear evidence of a dose response to higher levels of four-day week enrollment. For example, in the maternal employment regression specification with full controls, "Low 4DW Enrollment" has a value of .006 (p=0.68), "Mid 4DW Enrollment" has a value of -.034 (p=.11), and "High 4DW Enrollment" has a value of -.095 (p=.07). A similar relationship is observed for the annual hours worked estimates.

It is notable, too, that the magnitude of estimated effects for fathers under this definition of "High 4DW Enrollment" becomes significantly more negative and, while falling short of

[24] For example, in results not shown, I estimate a 7.5 percent decrease in the incidence of working 30 hours or more among mothers working between 20 and 34 hours usual hours per week (p=0.18).
[25] These "Low" "Mid" and "High" bins of positive four-day week enrollment have respective cutoff values of .065 (Low and Mid) and .33 (Mid and High). These cutoffs relative to the overall distribution of positive four-day week enrollment are presented graphically in appendix A, figure 10.

statistical significance at conventional levels, is considerably more precise than the "high" estimate from the main results using two groupings of four-day week enrollment. Here the annual hours worked estimates are around 60 percent of the magnitude of the estimates for mothers. These point estimates are consistent with the theoretical prediction that there may be some hours reductions among fathers in response to the four-day week.

Panels A2 and B2 present results from models using a continuous measure of four-day week enrollment. Given the highly non-linear density of PUMA-year enrollment values in the sample, the linear specification may be overly restrictive, but I include these results for completeness. In terms of sign and magnitude, they are confluent with the main results and, imputing the effect size by using the mean level of enrollment in "High 4DW Enrollment" areas in the main results, they agree quite closely with the estimates in table III.

The standard errors on these WLS regression estimates (e.g., table III and elsewhere) are derived by using a clustering adjustment that depends on a large number of treated and untreated units for the asymptotic result supporting its consistency. The sample used here supplies a relatively small number of units with high four-day week enrollment (13 PUMAs) that may not satisfy this large-N assumption. An alternative measure of statistical inference is randomization inference (Fisher, 1935; Rosenbaum, 2002; Kaestner, 2016). This method abstracts from making distributional assumptions about the underlying data generating process, instead using actual random assignment of "treatments" to "outcomes" to generate a distribution of coefficients to use for statistical inference. To implement this test, I randomly assign entire sequences of PUMA-by-year vectors of four-day week enrollment levels to PUMA-by-year outcomes and covariates (within-state) and re-estimate specification 3 of equation (9). This process is repeated 1000 times, creating a distribution of coefficients that yield exact p-values against which the inference of the main estimated results may be tested.

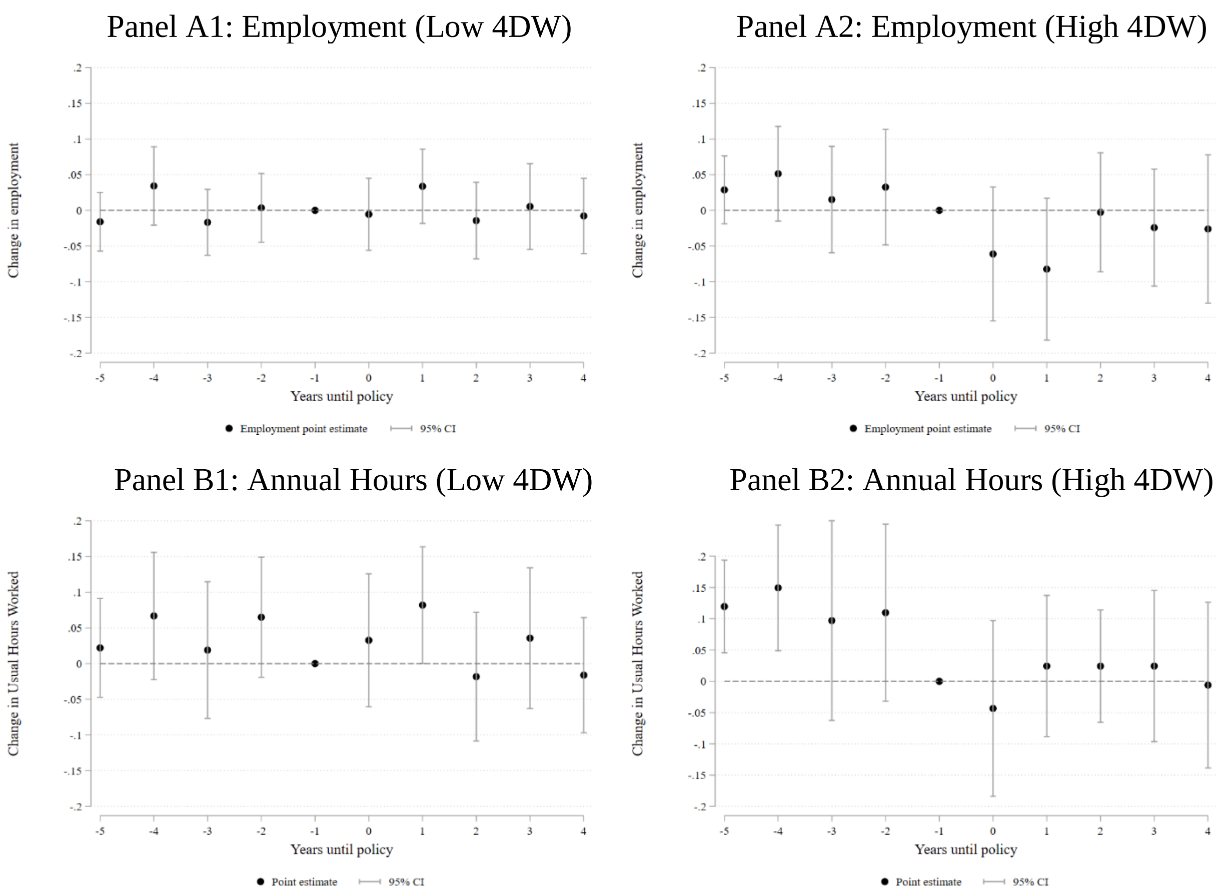
Appendix A, figure 22 presents the results of this exercise. Each panel plots the density of the distribution of placebo results for each outcome, with dashed lines representing the 95 percent confidence level bounds from a one-sided t-test (e.g. the 25th ranked estimate in the 1000-observation placebo distribution in terms of absolute value of the effect size). The solid red line is the main estimate from column (3) of Table III. The p-values from the placebo distribution for each outcome are, respectively, 0.006 for employment, 0.009 for usual hours worked, and 0.076 for weeks worked. Together, these results suggest that clustering standard errors at the PUMA level generates plausible inference.

1.7.2 Event Study Estimates

Figures 5 and 6 present event study estimates of the three main labor supply outcomes for, respectively, married mothers and fathers with children ages 5 to 13. In each figure are three pairs of graphs. Each pair is an outcome, with one graph showing year-over-year estimates for "Low 4DW Enrollment," and the other showing estimates for "High 4DW Enrollment." These results are on a common scale to facilitate comparison both across thresholds and across gender.

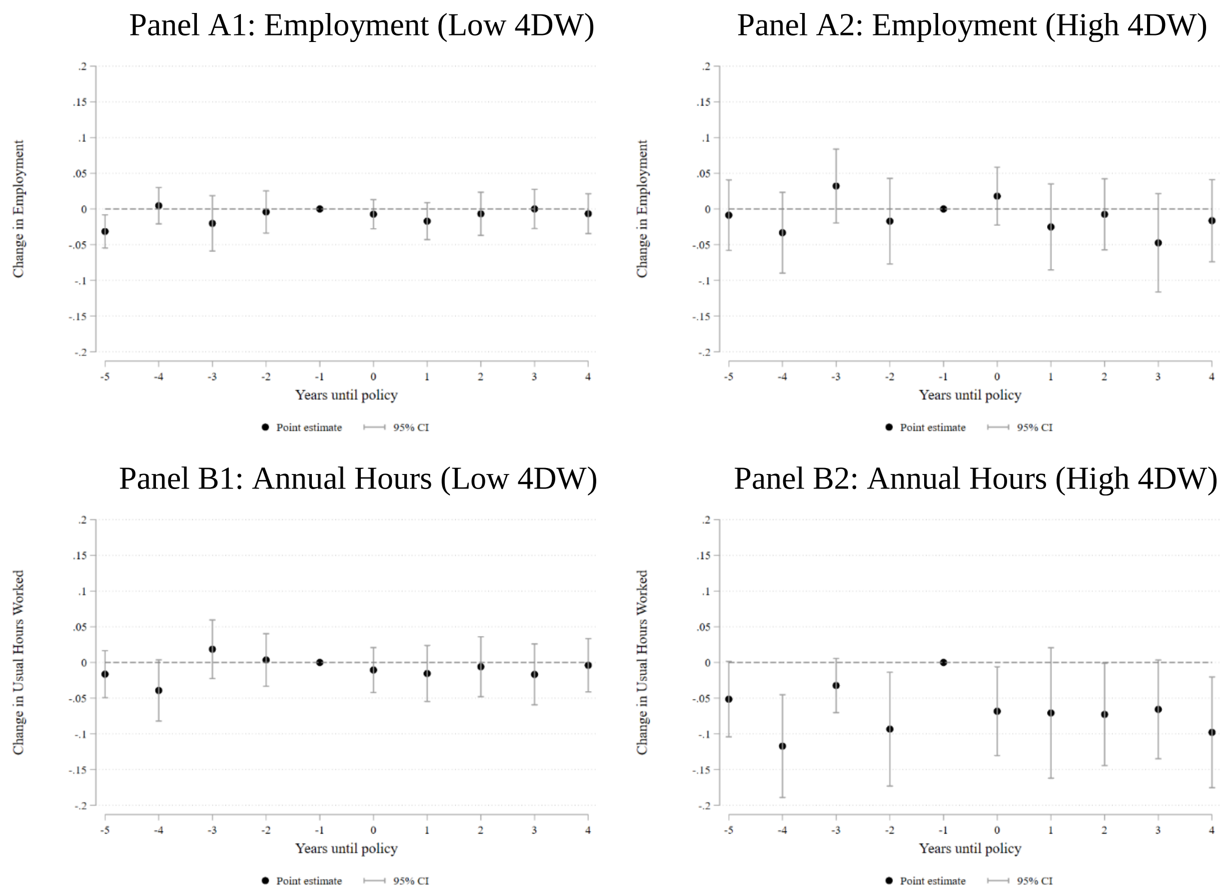
Figure 5, panels A1 and A2 show the results for employment. Under low four-day week enrollment, there is no evidence of a pre-trend and also no evidence of a negative effect in the post periods, consistent with estimates presented above. But panel A2 shows a sequential decrease in employment in years t_0 and $t+1$ of 6 and 8 percentage points (respectively, p=0.21 and p=0.11). The estimate in $t+2$ reverts to zero, but in $t+3$ and $t+4$ the point estimates are -2.5 percentage points. The annual hours worked estimates in panel B1 also indicate no pre-period or post-period effect under low four-day week enrollment. But the result for crossing the threshold into "high" four-day school week enrollment (in panel B2) shows clear evidence of a negative

Figure 5: Maternal Labor Supply Event Study Results



Result are from a regression of outcome on a pair of indicator variables for low and high four-day week enrollment. All models include year and PUMA fixed-effects, controls for race, ethnicity, age, education and interactions between the two, baseline outcome interacted with year fixed effects, and annual outcome level of 18- to 24-year-old workers. Regressions use hybrid PUMA crosswalk / ACS person weights as outlined in text. Confidence intervals are generated from standard errors clustered at the PUMA level.

Figure 6: Paternal Labor Supply Event Study Results



Result are from a regression of outcome on a pair of indicator variables for low and high four-day week enrollment. All models include year and PUMA fixed-effects, controls for race, ethnicity, age, education and interactions between the two, baseline outcome interacted with year fixed effects, and annual outcome level of 18- to 24-year-old workers. Regressions use hybrid PUMA crosswalk / ACS person weights as outlined in text. Confidence intervals are generated from standard errors clustered at the PUMA level.

hours response beginning before the threshold of "high" enrollment (0.125) has been crossed. An alternate interpretation of these results using *t-2* as the reference period is shown in appendix A, figure 23.

Figure 6 shows the same estimates for fathers. Panels A1 and A2 suggest no employment effect on fathers under either level of four-day week enrollment. Panel B1 shows no evidence of a pre-period trend in annual hours worked. The noisy results for annual hours worked in panel B2 do not suggest any clear relationship between increasing levels of four-day school week enrollment and this outcome. To further explore the plausibility of the pre-trend in panel B2 of figure 5 resulting from the time mismatch discussed above, appendix A, figure 24 presents analogous event study results for the effect of "high four-day week" enrollment on annual hours for three groups of plausibly unaffected women (parents of pre-school aged children, parents of children all aged 14-18 and childless married women). These results show no clear pattern of responsiveness across time to the four-day school week policy for any of these groups.

There are two important takeaways from these results. The first is that the pre-period outcomes when a PUMA moves from zero to low levels of four-day week utilization are supportive of the validity of the research design. The second is that as a PUMA moves into high four-day week enrollment, there is a marked decline in employment and annual hours that partially recovers over subsequent years. This pattern is consistent with labor market inflexibility generating more significant maternal exit from employment in the early years after the four-day school week adoption, but a portion of these mothers persisting in job search and reentering the labor market over a longer time period.

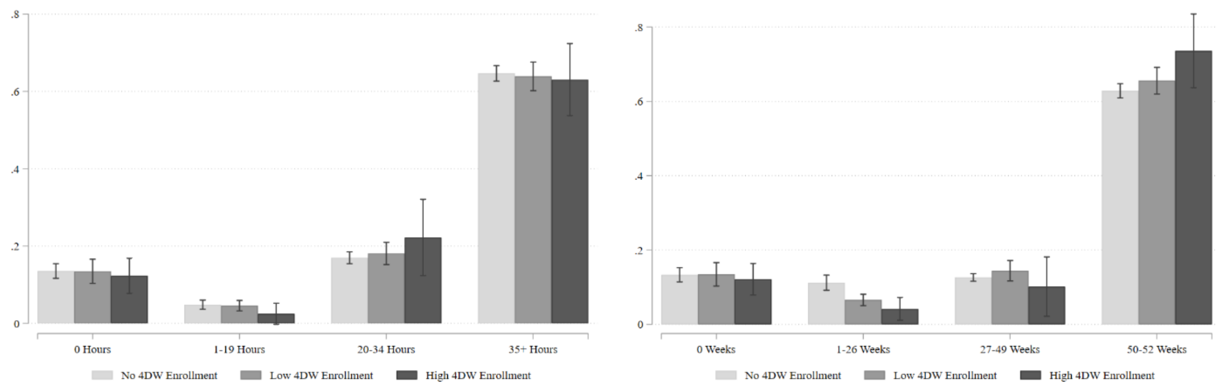
1.7.3 **Female-Headed Households**[26]

The model predicts that the labor supply of female-headed households will be less responsive to the four-day school week than that of married mothers. Multinomial logit results for the usual hours and weeks worked outcomes are shown in figure 7.

Figure 7: Predicted Hours and Weeks Worked Among Female-Headed Households of Grade School Aged Children

Panel A: Usual Hours Worked per Week

Panel B: Weeks Worked per Year



Bars show predicted values from multinomial logit regression of usual hours worked per week and weeks worked per year on indicator variables for high and low 4DW enrollment (and controls as described in text) for each outcome with both 4DW indicators at zero, low 4DW enrollment equal to one with high 4DW enrollment equal to zero and high 4DW enrollment equal to one with low 4DW enrollment equal to zero. Standard errors estimated using the delta method.

For usual hours worked (panel A) the predicted probabilities under zero, low, and high four-day week enrollment are statistically indistinguishable though there is a suggestive increase in the predicted probability of working 20-34 hours per week offset by modest decreases from the both the full-time hours category and 1-19 hours. The results for weeks worked in panel B, on the other hand, suggest that there is a meaningful increase in weeks worked per year in

[26] There are, of course, also households with single male parents with children. However, this is a small subset of single-parent-headed-households that is difficult to correctly identify within the ACS.

response to high four-day week enrollment (an 11 percentage point increase in the predicted probability of working 50-52 weeks per year). This increase in the incidence of working year-round would likely close the baseline gap in annual weeks of work observed between single mothers in "high" four-day week enrollment PUMAs and other PUMAs observed in table I. There is also a statistically significant decline in the incidence of working 1-26 weeks per year. This result is consistent with mothers in these households being more likely to rely on paid care to remain employed, increasing labor supply to compensate for the associated consumption loss.

The regression estimates in Table IV are consistent with a positive labor supply response, though they lack statistical significance at conventional levels. I estimate a 3 percentage point increase in employment at the time of survey and a 7.5 percent increase in annual hours worked.

Table IV: Effect of Four-Day Week Among Single Mothers of Grade School Aged Children

	(1)	(2)	(3)
Panel A: Employment			
Low 4DW Enrollment	0.022	0.025	0.020
	(0.024)	(0.024)	(0.023)
High 4DW Enrollment	0.045	0.040	0.034
	(0.046)	(0.040)	(0.031)
Baseline Mean	.77	.77	.77
Panel B: Annual Hours Worked			
Low 4DW Enrollment	0.010	0.019	0.013
	(0.032)	(0.032)	(0.033)
High 4DW Enrollment	0.087	0.081	0.075
	(0.067)	(0.061)	(0.061)
Baseline Mean	1,509	1,509	1,509
PUMA & Year FEs	Yes	Yes	Yes
Race, Age, Ed Controls	No	Yes	Yes
Usual Hours Controls	No	No	Yes
Observations	11,302	11,302	11,302

Model (1) includes year and PUMA fixed effects. Model (2) includes race/ethnicity, age, educational attainment and interactions between age and education. Model (3) includes baseline outcome interacted with year fixed effects and annual PUMA by year outcome of 18- to 24-year-olds. Annual hours worked model uses robust Poisson regression. Regressions weighted as described in text. Standard errors clustered at the PUMA level. + $p<0.10$, * $p<0.05$, ** $p<0.01$.

1.7.4 Falsification Analysis

Prior literature estimating the effects of increases in school provision, including Cascio (2009) and Graves (2013a), uses mothers with only pre-school aged children as a plausibly unaffected comparison group. I follow this practice and generate DD estimates for this group as a falsification exercise. However, in the four-day week setting there may some labor supply responsiveness among this group in anticipation of an impending reduction in school-based child care. To provide additional evidence that the four-day school week is the mechanism driving the results presented above, I also generate placebo estimates for married families with children all between the ages of 14 and 18, since these children should all be capable of self-care on average, as well as married adults aged 25-54 with no children in the home, since these parents shouldn't be affected at all by the change in child care provision represented by the four-day school week. Ex ante, I expect that employment outcomes among both these additional groups should be unaffected by the level of four-day week enrollment.

Appendix A, tables XXIII through XXV report regression results analogous to table III for these samples. In none of these results is there evidence of any pattern of labor supply responses similar to the findings for mothers with all children between 5 and 13. Most of these estimates are statistically indistinguishable from zero and the few statistically significant coefficients are generally sensitive to the specification in terms of precision and even sign.

1.7.5 Heterogeneity by Maternal Education, Child Age, and Number of Children

Below I test three propositions of the theoretical model. First, I divide the sample by the median age of the youngest child to test whether effects of the four-day week are a decreasing function of child age. Second, I split the sample by whether the mother has at least a baccalaureate (or higher) degree to test if the labor supply decrease in response to the four-day week is greater for more educated mothers. Third, I split the sample into parents with one child, two children, and three or more children to test the responsiveness of labor supply to higher child care costs.

Table V, Panel A splits the sample into families at or above the median age (8) of the youngest child or below the median. Each pair of columns reports estimates for, respectively, employment and annual hours by these stratifications. For mothers with a youngest child ages 5 to 7, the negative magnitude of the "High 4DW Enrollment" coefficient for each outcome is larger than for mothers with a youngest child aged 8 or above (40 percent for employment and 20 percent for annual hours worked), though their confidence intervals are almost entirely coincident.

Panel B reports estimates splitting mothers by the attainment of a bachelor's degree or higher. The magnitude of the estimated employment effect is 30 percent greater for college-educated mothers, while the estimated annual hours effect is approximately three times the magnitude of the point estimate for non-college educated mothers. These results suggest that the average labor supply decrease is disproportionately driven by college-educated mothers and that much of this heterogeneity is along the intensive margin. This much larger annual hours difference is consistent with recent survey data showing that workers with a bachelor's degree or higher report a rate of scheduling flexibility double the rate of workers with less than a bachelor's degree (Maestas, Mullen, Powell, von Wachter, & Wenger, 2018). As with the main results, none of the "Low 4DW Enrollment" coefficients in these analyses are distinguishable from zero.

Table V: Effects of the Four-Day Week by Child Age and Maternal Education

	(1)	(2)	(3)	(4)
	Employment		Annual Hours	
	Child <8	Child 8+	Child <8	Child 8+
Panel A: Mothers with Children Aged 5-13 Split by Median of Youngest and Eldest Child Ages				
Low 4DW Enrollment	0.004	0.004	0.013	-0.004
	(0.021)	(0.018)	(0.043)	(0.030)
High 4DW Enrollment	-0.090*	-0.062+	-0.139+	-0.107+
	(0.034)	(0.037)	(0.079)	(0.060)
Baseline Mean	.65	.72	1,140	1,332
Observations	17,844	19,305	17,844	19,305
	< Bacc	Bacc +	< Bacc	Bacc +
Panel B: Mothers with Children Aged 5-13 Split by Educational Attainment				
Low 4DW Enrollment	0.012	-0.008	0.033	-0.033
	(0.027)	(0.017)	(0.049)	(0.031)
High 4DW Enrollment	-0.060+	-0.077*	-0.053	-0.173**
	(0.032)	(0.034)	(0.052)	(0.065)
Baseline Mean	.65	.75	1,189	1,330
Observations	20,328	16,821	20,328	16,821

All models include PUMA and year fixed-effects, controls for race, ethnicity, education, age, and their interactions, baseline outcomes interacted with year fixed effects, and outcomes of 18- to 24-year-old workers. Annual hours model uses robust Poisson regression. Regressions weighted using weights as described in text. Standard errors clustered at the PUMA level. + p<0.10, * p<0.05, ** p<0.01.

Table VI: Effects of the Four-Day Week by Number of Children

	(1)	(2)	(3)
	1 Child	2 Children	3+ Children
Panel A: Employment			
Low 4DW Enrollment	0.005	-0.013	0.052
	(0.020)	(0.017)	(0.033)
High 4DW Enrollment	-0.096**	-0.061+	-0.021
	(0.033)	(0.033)	(0.056)
Baseline Mean	.71	.70	.61
Panel B: Annual Hours Worked			
Low 4DW Enrollment	0.018	-0.004	-0.035
	(0.031)	(0.033)	(0.074)
High 4DW Enrollment	-0.109+	-0.071	-0.246+
	(0.060)	(0.059)	(0.144)
Baseline Mean	1,345	1,221	1,007
Observations	13,565	18,051	5,533

(See notes to table V above.)

Table VI presents results for employment and annual hours worked stratifying the sample by number of children. Estimates for mothers with 1 child are in column (1), estimates for mothers with two children are in column (2), and estimates for mothers with three or more children are in column (3). In these models I add controls for the ages of the eldest and youngest child. Panel A shows employment effects for these samples. The results here do not suggest that extensive margin employment is affected by increased child care costs. Instead, negative employment effects are decreasing in magnitude with the number of children. However, it is worth noting the large difference in means for baseline employment between those with 1 or 2 children and those with 3 or more children. For the former group, the estimated 10 percentage point decrease in employment would make the employment level of mothers of one child roughly equal to the baseline employment rate of mothers with 3+ children. The evidence is also different for the intensive margin. Here, annual hours worked decline significantly more for mothers with 3+ children (25 percent) than for either other group of mothers. These results are consistent with the model's assumption that higher child care costs will lead to lower labor supply among those with greater numbers of children if mothers with 3+ children systematically select into jobs with more scheduling flexibility (an amenity that may be particularly valued by these mothers even absent the four-day week). If so, then a labor supply decrease among these mothers would primarily manifest as a reduction in hours, not as exit from employment.

1.7.6 <u>Moving in Response to the Four-Day School Week</u>

An important potential response to the four-day school week by families that value five-days-per-week child care is moving. In a media report on one large district in Arizona shortly after it adopted the four-day week, a district official suggested that several hundred students would likely end up leaving the district (Olgin, 2015). If families move within-PUMA in response to the four-day week (from a four-day week district to a five-day week district), then estimates of the effect of the four-day week on labor supply would be attenuated towards zero. On the other hand, if families move across PUMAs to regain five-days-per-week schooling, then the magnitude of estimated effects would be biased upward. I can estimate the effect of the four-day week on moving by estimating changes in enrollment, which should accurately reflect changes in residential location. I estimate a DD model at the true level of policy adoption—the school district—using robust Poisson regression:[27]

$$enroll_{it} = \alpha_0 + \beta_{-5+} adopt_{i,-5+} + \sum_{k=t-4}^{t+3} \beta_k adopt_{ik} + \beta_{4+} adopt_{i,4+} + \theta_i + \delta_t + \varepsilon_{it}. \quad (11)$$

This model regresses fall enrollment for district i in year t on district and year fixed-effects, and a set of period dummies for years $t-5$ to $t+4$ (omitting $t-1$ as a reference period). The $adopt_{i,-5+}$ term is an indicator variable equal to 1 for district-years 5 or more years before a switch to the four-day week and $adopt_{i,4+}$ is the analogous term for districts-years 4 or more years after a switch to the four-day school week. The estimates, β_k (including β_{-5+} and β_{4+}), are the coefficients of interest. Figure 8 shows the results of this exercise, which indicate a negative enrollment response of around 3 percent to the four-day school week beginning in the second year after implementation, increasing to over 5 percent by the fifth year. The five-year pre-trend suggests that adoption of the four-day school week is not associated with declining enrollment in earlier years (evidence that is supportive of the overall research design). At the mean enrollment level of high four-day week enrollment PUMA-years, this amounts to losing around 25-40

[27] I use a longer period, 2003-2016 for three states in this exercise, since I have panel data on adoption and enrollment for CO, ID, and OR for this entire span. OK still uses 2011 to 2016.

students per year, suggesting that perhaps 1.5 percent of families move. This is not a large enough effect to be a cause for concern regarding the magnitude of the labor supply estimates, but it suggests that, for a small number of families, the costs of the four-day school week are economically significant enough to incur the potentially large costs associated with moving.

Figure 8: Event Study Results of Enrollment Response to the Four-Day School Week

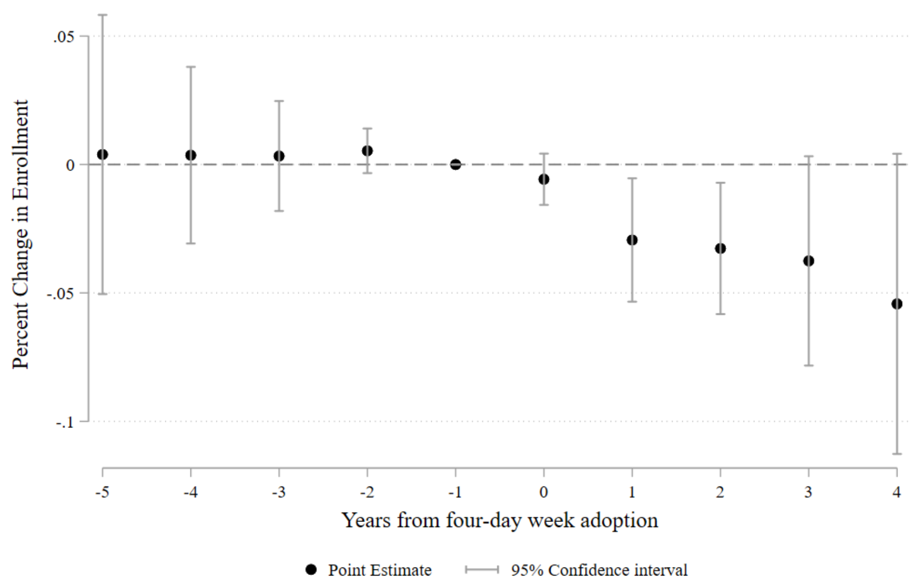


Figure presents point estimates and confidence intervals for robust Poisson regression of enrollment on district and year FEs and a set of time-period indicator variables for using the four-day school week schedule. *t*-1 is the omitted period for comparison. Confidence intervals reflect standard errors clustered at the PUMA level.

To assess whether the labor supply estimates may be biased upward in magnitude by endogenous moves, I also estimated moves across PUMAs in response to four-day week enrollment. These coefficients (not shown) are statistically insignificant, but are centered tightly around zero, suggesting that moves across PUMAs were not an important response to the four-day school week.

1.7.7 Effects of the Four-day School Week on Family Income

The evidence on maternal employment and hours worked suggests that mothers should exhibit a meaningful decrease in earnings.[28] I estimate the effect of the four-day school week on two different earnings measures for both mothers and fathers. The first is wage and salary earnings, the second is "Alternative Income," an aggregation of non-wage/non-salary income that includes self-employment/business ownership income, investment income, transfer income (welfare), and "other" income (including alimony and child support). This latter outcome may provide some evidence of behaviors that may offset the income decreases implied by the main employment estimates.

The results in table VII are presented as follows: The odd-numbered columns each regress an indicator variable for any earnings (in the indicated category) on the full model in equation (9). The even-numbered columns regress income (in the indicated category) in 2009 chained PCE (less food and energy) dollars on the full model in equation (9). Note that the two models measuring "any earnings" are conceptually equivalent to employment estimates with one important caveat: as with usual hours and weeks worked, the earnings questions in the ACS ask respondents to estimate earnings over the past 12 months. Thus, estimates on this binary outcome will be attenuated relative to the contemporaneous employment question since some respondents will have earned in the past 12 months, even if they have exited employment since the four-day

[28] While misreporting, both random and non-random, of various sources of income and transfers have been well-documented across the ACS and other data sets (Meyer & George, 2011; Meyer, Mok, & Sullivan, 2009; Murray-Close & Heggeness, 2018; O'Hara, Bee, & Mitchell, 2016; Rothbaum, 2015), unless misreporting is correlated with labor supply responses to the four-day week schedule, estimated changes in income can still provide some insight into changes in consumption associated with the four-day week schedule.

week. In the full ACS sample, around 25% of respondents who report no employment report positive wage/salary earnings.

Table VII: Effects of the Four-Day Week on the Income of Married Parents of Grade-School-Aged Children

	Mothers				Fathers			
	(1) Any Wage/ Salary Income	(2) Wage/ Salary Inc ($)	(3) Alter-nate Income	(4) Alt. Income ($)	(5) Any Wage/ Salary Income	(6) Wage/ Salary Inc ($)	(7) Alter-nate Income	(8) Alt. Income ($)
Low 4DW Enrollment	0.005	1,229	0.007	-375	-0.002	-2,079	0.021	197
	(0.014)	(1,505)	(0.011)	(555)	(0.009)	(2,283)	(0.014)	(1,167)
High 4DW Enrollment	-0.055*	-3,251	0.038*	699	-0.027	-5,404	0.038	4,943
	(0.025)	(2,009)	(0.019)	(742)	(0.030)	(3,492)	(0.025)	(3,261)
Baseline Mean	.71	27,789	.22	3,217	.90	64,368	.29	7,503
Observations	37,231	37,231	37,231	37,231	35,722	35,722	35,722	35,722

Models 1, 3, 5, 7 regress an indicator for any indicated income on four-day week enrollment, PUMA and year fixed-effects, controls for race/ethnicity, age, education, and interactions between them. Models 2, 4, 6, 8 regress indicated income in dollars on same regressors. Regressions weighted using hybrid PUMA crosswalk / ACS person weights as described in text. Standard errors clustered at the PUMA level.
+ p<0.10, * p<0.05, ** p<0.01.

The “High 4DW Enrollment” estimate for any maternal wage/salary earnings is a 5.5 percentage points decrease (or around 8 percent). There is also a statistically significant increase in “Alternative Income” of 3.8 percentage points (a 17 percent increase). The “Any Wage / Salary Income” estimate for fathers is an imprecise negative 2.7 percentage points while the estimated change in alternative income is a fairly precise 3.8 percentage points (p=0.12). None of the estimates measuring earnings in dollars (the even numbered columns) are statistically distinguishable from zero. This is perhaps unsurprising given that income questions in the ACS have an item non-response rate of between 13 and 20 percent (Luckett Clark, 2014). The point estimate for mothers, if taken at face value, indicates a 12 percent decline, larger than the 8 percent decline in the incidence of any wage/salary earnings. This direction of this discrepancy is consistent with higher earning (i.e. college-educated) mothers disproportionately driving the estimated labor supply decreases.

There is evidence that both mothers and fathers increase alternate sources of income in response to the policy. For mothers, estimates indicate a precise 3.8 percentage point increase in the probability of reporting alternate income (from a baseline level of 22 percent). The point estimate is similar for fathers (from a baseline level of 29 percent) but, while relatively precise, is not statistically significant at conventional levels. Neither of these dollar estimates are statistically significant, and the male estimate is particularly noisy but, overall, they suggest that parents may at least partially compensate for decreased wage and salary earnings with other income.

1.8 Discussion and Conclusion

The estimates in this research suggest that dual-earner families with school-aged children depend meaningfully on the five-day school week to maintain this employment arrangement. The results indicate that exiting employment is the primary response to the four-day school week among married mothers with children all aged between 5 and 13 years of age. The event study results suggest that this employment decrease appears to fully persist for around two years before partially rebounding (though these estimates lack statistical precision sufficient to reject other patterns). Such a pattern is consistent with a situation where some portion of mothers who exited employment due to a lack of schedule flexibility and part-time job options continue to search and succeed in finding a suitable job over time. The results also indicate that, even amid the ogoing convergence of gender roles between parents (Bianchi, Milkie, Sayer, & Robinson, 2000; Marshall, 2006), it is still the case that only the labor supply of mothers responds strongly to child care disruptions. The evidence that single mothers respond to the four-day school week by working more suggests that these parents may end up spending even less time with their children in response to the schedule change. The effect of this response on the welfare of these children deserves further exploration.

This study has an interesting connection to another recent study on the four-day school week. Anderson and Walker (2015) find that switching to the four-day week is associated with an increase in math and reading test scores. The authors consider two mechanisms by which scores may improve in adopting districts, 1) an increase in instructional expenditures due to the adoption of the policy, and 2) improved attendance (they provide some evidence supporting this link and this finding is confirmed in other studies of the four-day week). However, a mechanism not considered is that mothers who exit the labor force (or reduce hours) to provide fifth-day child care may contribute directly to higher academic achievement through increased academic support at home. Such a mechanism is consistent with my finding that the estimated reductions in maternal labor supply are driven primarily by the response of college-educated mothers, who may use increased child time to provide effective home inputs to the education production function. This conjecture is also broadly confluent a recent study on the effect of the four-day school week in Oregon, which finds that the policy is associated with generally lower test score, but that this effect is more pronounced for lower SES children (Thompson, 2018).

The four-day school week may also have other effects on family welfare. Fischer and Argyle (2018) use difference-in-differences analysis at the law-enforcement jurisdiction level to generate estimates indicating that the four-day school week is associated with a 20 percent increase in property crime. Other important dimensions of family welfare may be affected as well and future research should explore these potential consequences.

Overall, the results of this analysis suggest that the four-day week is inconsistent with a variety of public policies that seek to encourage or support maternal employment (e.g., subsidized pre-school programs, tax deductibility of non-school child care expenses, EITC, TANF). All of these factors should be considered in meaningful cost-benefit analyses of the overall effects of the four-day school week on communities.

The proliferation of the four-day week may also point to a limitation inherent in the way schools are funded. Districts do not have a clear mechanism to accommodate differential willingness to pay for the child care component of schooling—funding is primarily from property, income, and sales taxes, which are voted on (either directly or through elected representatives) by all citizens. Several media accounts report that adoption of the four-day week resulted directly from the failure of proposed tax increases (Bryce, 2010; Herring, 2010; Layton, 2016; Richert, 2016; Scoville, 2018). This system of financing may be hindering districts from realizing a funding stream adequate to maintain a five-day school week, despite a willingness-to-pay among parents that may far exceed the revenue needed to maintain a five-day schedule. As previously mentioned, District 27J, a large district (18,000 students) in metropolitan Denver that has just adopted the four-day school week responded to significant parental concern over losing a day of school-based child care by creating a $30/day child care program at select schools around the district (Scoville, 2018). This amounts to de facto price discrimination, allowing the district to acquire the funding needed to keep buildings staffed and open from those parents willing to pay additional money for school-based child care. Demand for this program is high. As of October 2018, 7 of the 9 schools offering the fifth-day child care (out of a total of 12 elementary schools in the district) were placing new applicants on a waitlist.

Despite the lack of evidence on the full consequences of the four-day school week, the use of this cost-cutting measure has grown more than fivefold in just the last decade. This study estimates large, negative effects of the four-day school week on employment and hours worked among married mothers with children dependent on school-based child care suggesting that, at a minimum, state and local policymakers should conceptually incorporate schooling as a critical support to dual-earner households, the dominant earning arrangement among married couples in the United States in recent decades. Given that the increase in the earnings of married mothers has been a key driver of growth in household income since the 1980s, the effects estimated here should contribute to a more holistic analysis of the net effects of this increasingly popular policy.

1.9 Cited Literature

Afterschool Alliance. (2014). *The Growing Importance of Afterschool in Rural Communities.* Washington, D.C. Retrieved September 4, 2018, from http://www.afterschoolalliance.org/AA3PM/Afterschool_in_Rural_Communities_Executive_Summary.pdf

Altonji, J. G., & Paxson, C. H. (1992). Labor Supply, Hours Constraints, and Job Mobility. *The Journal of Human Resources, 27*(2), 256-278.

Anderson, M., & Walker, M. B. (2015). Does Shortening the School Week Impact Student Performance? Evidence from the Four-Day School Week. *Education Finance and Policy, 10*(3), 314-349.

Angrist, J., & Pischke, J.-S. (2009). *Mostly Harmless Econometrics.* Princeton, New Jersey, USA: Princeton University Press.

Baker, M., Gruber, J., & Milligan, K. (2008). Universal Child Care, Maternal Labor Supply, and Family Well-Being. *Journal of Political Economy, 116*(4), 709-745.

Bianchi, S. M., Milkie, M. A., Sayer, L. C., & Robinson, J. P. (2000). Is Anyone Doing the Housework? Trends in the Gender Division of Household Labor. *Social Forces*, 191-228.

Blau, D., & Currie, J. (2006). Pre-School, Day Care, and After-School Care: Who's Minding the Kids? In *Handbook of the Economics of Education* (Vol. 2, pp. 1163-1278).

Bowen, C. T. (2011, December). Pasco County School District floats an idea: A four-day school week. *Tampa Bay Times*.

Brown, E. (2017, May). With state budget in crisis, many Oklahoma schools hold classes four days a week. *Washington Post*.

Bryce, D. (2010). SE Idaho school districts take measures to offset shortfalls from state budget cuts. *Idaho State Journal*.

Buckles, K., Guldi, M. E., & Schmidt, L. (2019). *Fertility Trends in the United States, 1980-2017: The Role of Unintended Births.* Cambridge: National Bureau of Economic Research. Retrieved from https://www.nber.org/papers/w25521

Bureau of Labor Statistics. (2018). *Employment Characteristics of Families.* Bureau of Labor Statistics.

Cascio, E. U. (2009). Maternal Labor Supply and the Introduction of Kindergartens into American Public Schools. *The Journal of Human Resources*, *44*(1), 140-170. Retrieved from https://www.jstor.org/stable/20648890?seq=1#page_scan_tab_contents

Connelly, R. (1992). The Effect of Child Care Costs on Married Women's Labor Force Participation. *The Review of Economics and Statistics, 74*(1), 83-90.

Connelly, R., & Kimmel, J. (2001). *The Effect of Child Care Costs on the Labor Force Participation and Welfare Recipiency of Single Mothers: Implications for Welfare.* Kalamazoo, MI: Upjohn Institute.

Craig, L. (2006). Parental education, time in paid work and time with children: an Australian time-diary analysis. *The British Journal of Sociology*, 553-575. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-4446.2006.00125.x

Cummings, M. (2015, May). Adults Love the Four-Day School Week. Is it Good for the Kids? *Slate*.

Currie, J., & Moretti, E. (2003). Mother's Education and the Intergenerational Transmission of Human Capital: Evidence. *The American Economic Review, 118*(4), 1495-1532.

Denwalt, D. (2016, September 15). *Oklahoma Communities Learning To Deal With Four-Day School Weeks Created By Budget Cuts*. Retrieved August 25, 2018, from http://www.kgou.org/post/oklahoma-communities-learning-deal-four-day-school-weeks-created-budget-cuts

Donis-Keller, C., & Silvernail, D. L. (2009). *A Review of the Evidence on the Four-Day School Week.* Center for Educational Policy, Applied Research and Evaluation - University of Southern Maine.

Doyle, C. (2017, January 30). Church helps solve 4-day school week issue. *The Baptist Messenger*. Retrieved from https://www.baptistmessenger.com/church-helps-solve-4-day-school-week-issue/

Eissa, N., & Liebman, J. B. (1996). Labor Supply Response to the Earned Income Tax Credit. *The Quarterly Journal of Economics*, 605-637.

Evans, W. N., & Garthwaite, C. L. (2014, May). Giving Mom a Break: The Impact of Higher EITC Payments on Maternal Health. *American Economic Journal: Economic Policy, 6*(2), 258-290.

Fischer, S., & Argyle, D. (2018, June). Juvenile crime and the four-day school week. *Economics of Education Review, 64*, 31-39.

Fisher, R. A. (1935). *The Design of Experiments.* London: Oliver and Boyd.

Fitzpatrick, M. D. (2010). Preschoolers Enrolled and Mothers at Work? The Effects of Universal Prekindergarten. *Journal of Labor Economics, 28*(1), 51-85.

Fitzpatrick, M. D. (2012). Revising Our Thinking About the Relationship Between Maternal Labor Supply and Preschool. *The Journal of Human Resources, 47*(3), 583-612.

Gelbach, J. B. (2002, March). Public Schooling for Young Children and Maternal Labor Supply. *American Economic Review, 92*(1), 307-322.

Graves, J. (2013a). School Calendars, Child Care Availability, and Maternal Employment. *Journal of Urban Economics, 78,* 57-70.

Graves, J. (2013b). The Effects of School Calendar Type on Maternal Employment across Racial Groups: A Story of Child Care Availability. *American Economic Review (Papers and Proceedings), 103*(3), 279-283.

Greenwood, J., Guner, N., & Vandenbroucke, G. (2017). Family Economics Writ Large. *The Journal of Economic Perspectives, 55*(4), 1346-1434.

Griffith, M. (2011). *What savings are produced by moving to a four-day week?* Education Commission of the States.

Guryan, J., Hurst, E., & Kearney, M. (2008). Parental Education and Parental Time with Children. *Journal of Economic Perspectives, 22*(3), 23-46.

Hardiman, S. (2018, February 10). Amid teacher shortage, four-day school districts can't afford to go back. *Tulsa World*. Retrieved from https://www.tulsaworld.com/news/education/amid-teacher-shortage-four-day-school-districts-can-t-afford/article_cdd1b3f3-4303-574f-8352-54462e93a796.html

Herring, C. (2010, March). Schools' New Math: the Four-Day Week. *The Wall Street Journal*.

Irish, L. (2015, May). Budget cuts move Arizona students to four-day weeks. *AZED News*.

Kaestner, R. (2016). Did Masachusetts Health Care Reform Lower Mortality? No According to Randomization Inference. *Statistics and Public Policy, 3*(1), 1-6.

Kalil, A., Ryan, R., & Corey, M. (2012). Diverging Destinies: Maternal Education and the Developmental Gradient in Time With Children. *Demography,* 1361-1383. Retrieved from https://link.springer.com/article/10.1007/s13524-012-0129-5

Kimmel, J. (1998). Child Care Costs as a Barrier to Employment for Single and Married Mothers. *The Review of Economics and Statistics, 80*(2), 287-299.

Landers, R., Rebitzer, J. B., & Taylor, L. J. (1996). Rat Race Redux: Adverse Selection in the Determination of Work Hours in Law Firms. *The American Economic Review, 86*(3), 329-348.

Laughlin, L. (2013). *Who's Minding the Kids? Child Care Arrangments: Spring 2011*. Washington DC: U.S. Department of Commerce.

Layton, L. (2016, July). In trimming school budgets, more officials turn to a four-day week. *Washington Post*.

Lechner, M. (2011). The Estimation of Causal Effects by Difference-in-Difference Methods. *Foundations and Trends in Econometrics, 4*(3), 165-224.

Lefebvre, P., & Merrigan, P. (2008). Child-Care Policy and the Labor Supply of Mothers with Young Children: A Natural Experiment from Canada. *Journal of Labor Economics, 26*(3), 519-548.

Levin, K. (2016, September). More districts experimenting with four-day school week. *Associated Press*.

Lubotsky, D., & Qureshi, J. (2018). Assessing the Smooth Rise in Mother's Employment as Children Age. *Journal of Human Capital, 12*(4), 604-639. Retrieved from https://lubotsky.people.uic.edu/uploads/2/3/1/7/23178366/mothers_labor_supply_kaestner_lubotsky_qureshi_sept_2_2015.pdf

Luckett Clark, S. (2014). *Evaluation of the Effect on Item Nonresponse of Changes to the Failed Edit Follow-up Operation.* Washington DC: American Community Survey Office - United States Census Bureau.

Maestas, N., Mullen, K. J., Powell, D., von Wachter, T., & Wenger, J. B. (2018). *The Value of Working Conditions in the United States and Implications for the Structure of Wages.* Cambridge, MA: National Bureau of Economic Research.

Marshall, K. (2006). *Converging Gender Roles.* Ottowa: Statistics Canada.

Meyer, B. D., & George, R. M. (2011). *ERRORS IN SURVEY REPORTING AND IMPUTATION AND THEIR EFFECTS ON ESTIMATES OF FOOD STAMP PROGRAM PARTICIPATION.* Washington D.C.: Center for Economic Studies. Retrieved August 14, 2018, from https://www2.census.gov/ces/wp/2011/CES-WP-11-14.pdf

Meyer, B. D., Mok, W. K., & Sullivan, J. X. (2009). *The Under-Reporting of Transfers in Household Surveys: Its Nature and Consequences.* Cambridge, MA: National Bureau of Economic Research.

Moored, G., & Frank, V. (2013). *The Recession's Impact on Teacher Salaries.* Washington DC: National Council on Teacher Quality. Retrieved from https://www.nctq.org/dmsView/The_Recessions_Impact_On_Teacher_Salaries_NCTQ_Report

Murray-Close, M., & Heggeness, M. L. (2018). *Manning up and womaning down: How husbands and wives report their earnings when she earns more.* Washington D.C.: Social, Economic, and Housing Statistics Division - United States Census Bureau.

Myers, C., & Ladd, D. (2017). *Did Parental Involvement Laws Grow Teeth? The Effects of State Restrictions on Minors' Access to Abortion.* Bonn: IZA Institute for Labor Economics.

National Conference of State Legislatures. (2018, May 4). *Four-Day School Week Overview*. Retrieved July 13, 2018, from http://www.ncsl.org/research/education/school-calendar-four-day-school-week-overview.aspx

O'Hara, A., Bee, A., & Mitchell, J. (2016). *Preliminary Research for Replacing or Supplementing the Income Question on the American Community Survey with Administrative Records.* Washington DC: Center for Administrative Records Research and Applications (CARRA).

Olgin, A. (2015, November). What A 4-Day School Week Might Cost More Than It Saves. *National Public Radio*.

Oreopoulos, P., Page, M. E., & Huff Stevens, A. (2003). *Does Human Capital Transfer from Parent to Child? The Intergenerational Effects of Compulsory Schooling.* Cambridge, MA: National Bureau of Economic Research.

Peters, L. H., Jackofsky, E. F., & Salter, J. R. (1981). Predicting Turnover: A Comparison of Part-Time and Full-Time Employees. *Journal of Occupational Behavior,* 89-98. Retrieved July 30, 2018, from https://www.jstor.org/stable/pdf/3000280.pdf?casa_token=BD3ohQ0x8SgAAAAA:gd6xh8TRW7BF7vb3D8KzYQVEsJkcz-D2L3uawnEWvehyBMFxy4A_ovz2ooUlMGRyMlQy39oao_tjMzLxTCkjUUppI8uZ-KnGd-FJK4-FpNoCLjmkmOy_

Ramey, G., & Ramey, V. (2010). *The Rug Rat Race.* Washington DC: The Brookings Institution.

Rebitzer, J. B., & Taylor, L. J. (1995). Do Labor Markets Provide Enough Short-Hour Jobs? An Analysis of Work Hours and Work Incentives. *Economic Inquiry, 33*(2), 257-273.

Ribar, D. C. (1992). Child Care and the Labor Supply of Married Women: Reduced Form Evidence. *The Journal of Human Resources, 27*(1), 134-165.

Richert, K. (2016, August 25). The 2006 tax shift still divides Idaho leaders. *Idaho Ed News*. Retrieved August 25, 2018, from https://www.idahoednews.org/news/ten-years-later-tax-shift-still-divides-idaho-leaders/

Rindfuss, R., Morgan, S. P., & Offutt, K. (1996). Education and the changing age pattern of American fertility: 1963–1989. *Demography*, 277-290.

Rosenbaum, P. R. (2002). Covariance Adjustment in Randomized Experiments and Observational Studies. *Statistical Science*(17), 286-327.

Rothbaum, J. L. (2015). *Comparing Income Aggregates: How do the CPS and the ACS Match the National Income and Product Accounts, 2007-2012.* Washington DC: U.S. Census Bureau.

Ruggles, S., Genadek, K., Goeken, R., Grover, J., & Sobek, M. (2015). Integrated Public Use Microdata Series: Version 6.0 (dataset).

Sall, S. P. (2014). Maternal Labor Supply and the Availability of Public Pre-K: Evidence from the Introduction of Prekindergarten into American Public Schools. *Economic Inquiry, 52*(1), 17-34.

Scoville, A. (2018, March 19). First metro Denver school district adopts 4-day school week. *Denver Post*.

Simpson, K. (2012, September). Despite slim savings, more Colorado districts opt for 4-day week. *Denver Post*.

Sousa-Poza, A., & Ziegler, A. (2003). Asymmetric information about workers' productivity as a cause for inefficient long working hours. *Labour Economics, 10*(6), 727-747.

Tennent, J. (2018, March 25). Are 4 Day Weeks the Answer to Problems Facing America's School Districts? *Newsweek*. Retrieved from http://www.newsweek.com/four-day-weeks-school-districts-859419

Thompson, P. (2018). *Effects of Four-day School Weeks on Achievement: Evidence from Oregon.* Unpublished manuscript.

Valleta, R., & Bengali, L. (2013, August). What's Behind the Increase in Part-Time Work? *Federal Reserve Bank of San Francisco Economic Letter*.

Vanek, C. (2016, September). Peoria school district releases report on 4-day week. *The Arizona Republic*.

2. THE EFFECTS OF THE SUMMMER SCHOOL BREAK ON PARENTAL LABOR SUPPLY AND FAMILY OUTCOMES

2.1 Introduction

The summer break has been a persistent feature of public schooling since Progressive Era reformers succeeded in standardizing the school year and in getting compulsory schooling laws adopted more than a century ago (Lapidos 2007). This significant schooling interruption has drawn the attention of researchers and policy makers primarily because of the potential for student learning to regress during the long summer break (Cooper, et al. 1996, Quinn, et al. 2016, Augustine, et al. 2016, Lynch 2016, Fairchild and Boulay 2002, Rich 2012). While this so-called "summer slide" is an important consequence of the summer break, there are other potential impacts. One of the most important is the effect of the summer break on parental labor supply. The summer break requires working parents to arrange for alternative child care for 2.5 months while school is not in session. The loss of free childcare each summer will likely affect parents' choice of occupation, labor supply, earnings and time spent with children.

While the labor supply of both mothers and fathers may be affected by the summer break, it is mothers who continue to disproportionately provide child care, despite significant convergence in labor force participation rates among mothers and fathers since the end of World War II (Bureau of Labor Statistics 2018, Greenwood, Guner and Vandenbroucke 2017). Thus, maternal labor supply may be particularly affected by the summer break. Mothers who choose to reduce employment and hours of work to accommodate the summer vacation will accumulate less labor market experience, which will reduce future earnings and may affect the probability of career advancement. The benefit of reducing labor market effort for these mothers is more time with children. For mothers who do not reduce employment and hours in response to the summer break, less time with children is an opportunity cost. The summer break represents a constraint that makes mothers choose between income and child care, both of which are important determinants of child outcomes (D. M. Blau 1999, Berger, Paxson and Waldfogel 2009, Hardy and Gershenson 2013, Aizer 2004). Moreover, if maternal labor supply responses to the summer break are correlated with socioeconomic status (SES), then this behavior may contribute to diverging outcomes for low- and high-income families and, in turn, to the intergenerational transmission of inequality.

Relatedly, the summer break may also influence occupational choice. The most obvious example is choosing teaching or other occupations directly tied to the school calendar, but the annual summer break may also induce mothers to select occupations with skills that do not rapidly depreciate and are easily transferable between occupations and firms.[29] Such jobs may be in low-skilled occupations such as cashiers and food service occupations, but also in some high-skilled jobs such as pharmacy (Goldin and Katz 2016). Mothers may also select into work featuring fixed-length contracts (e.g., contract nursing[30]) or into seasonal occupations (e.g., holiday retail sales, accounting).

In this chapter, I document a previously unexamined, statistically and economically significant decline in both employment and presence on the job among mothers of school-aged children during the summer months. This fact is established using data from several different sources: the Current Population Survey (CPS), the American Time Use Survey (ATUS), and multiple data sets from the National Longitudinal Surveys (NLS). I present a comprehensive

[29] These types of jobs are sometimes referred to as “high substitutability” jobs (Jäger 2016). Low substitutability jobs are those where an individual’s occupation- or firm-specific skills are less readily replaced by others labor market.
[30] See https://ahsnursestat.com/tips/per-diem-vs-contract-nursing-2/ for more info on these schedules.

characterization of the phenomenon of parental summer labor supply reductions over time, across birth cohorts, by marital status, education level, and child age. I consider whether these reductions appear to influence occupational selection, the extent to which they contribute to tenure and experience gaps between women and men, and the extent to which they are associated with an effect on earnings. I also document changes in parental time use associated with the summer school break and I present evidence on correlations between maternal summer labor supply and measures of child cognitive and non-cognitive skills.

In addition to documenting an important and previously unexplored empirical phenomenon, this chapter contributes to a more complete understanding of the nature of experience differences among mothers and fathers (recent work in this vein includes Goldin 2014, Kleven, Landais and Sogard 2017, Juhn and McCue 2017, Chung et al 2017), as well as to a fuller understanding of the relationship between occupational choice and parenting preferences (Polacheck 1981, Budig and England 2001, Maestas, et al. 2018). Summer time-use differences documented in this chapter also complement recent work demonstrating increasing divergence in child time inputs by parental education (Guryan, Hurst and Kearney 2008, Ramey and Ramey 2010, Kalil, Ryan and Corey 2012, Dotti Sani and Treas 2016). Finally, the associations I document between maternal labor supply over the summer break and child outcomes are consistent with a positive causal relationship between parental time and child cognitive and non-cognitive skills (Aizer 2004, Hsin and Felfe 2014, Todd and Wolpin 2007).

2.2. <u>Background of the Summer School Break and Maternal Employment</u>

The contemporary school schedule, with an 11 to 12 week break from roughly early June to late August, is often erroneously attributed to the need for seasonal child farm labor (Von Drehle

2010, Rich 2012). But the origin of the summer break traces back to the need for a standardized school schedule that balanced the desires of urban and rural constituencies. 19th century urban schools were often open year-round, but many students attended for only about half the year. The times of lowest attendance were typically the summer months when hot, unventilated buildings increased absenteeism significantly (Lapidos 2007, Pederson 2012). By contrast, many schools in rural areas were only open for around half the year and reformers in these communities were agitating to extend the school year. The summer break was a compromise that addressed both of these concerns as Progressive Era reformers sought to compel attendance to a school year of standard length.

Prior to the World War II, the summer break was not particularly disruptive to family decisions about work because the majority of families with children had two parents and the majority of married mothers did not work. In these times, there was a ready parental caregiver for school-aged children during the school year and over the summer months. In the ensuing decades, changes in the returns to education and the opening of many occupations to women (Goldin 2006), changes in female employment directly associated with the shortage of male workers during World War II (Goldin and Olivetti 2013), and changes in the ability of women to control fertility timing all contributed to a dramatic increase in labor force participation rates of married mothers (Goldin and Katz 2002, Bailey 2012, Myers 2017). As a result, the majority of two-parent households in the U.S. have been dual-earner families since around 1980 (Pew Research Center 2015). Another important change in the labor force participation of mothers has been the increased incidence of single-female-headed households, from 9 percent of all households with children under 18 in 1960 to 26 percent in 2014 (Pew Research Center 2015).

These labor market changes have raised the opportunity cost of not working for mothers because of the increase in labor market opportunities (i.e., wages). But they have also raised the market cost of cost of outside child care because the vast majority of childcare workers are women and women's wages increased.[31] Both of these factors are reflected in the professionalization of child care work in recent decades. Between 1970 and 2000, the number of workers classified as babysitters or home-based child care workers declined from around 500,000 to less than 200,000, while the number of workers in non-home-based child care increased from around 250,000 to nearly 2,000,000 (Kornrich 2012).

In summary, the better labor market opportunities of mothers, the associated increase in the labor market attachment of mothers, and the increased use of market-based child care suggest that, on average, mothers have decided that the tradeoff between working more and spending less time caring for their children is welfare enhancing. While this issue has been extensively considered in a broad way, it has not been examined vis-a-vis the summer break. As I show later, the fundamental tradeoff between work and childcare just described is also present for intra-year labor supply decisions and specifically around the summer break. Like the broader literature, the intra-year variation in maternal labor supply has potentially important consequences for families that, to date, has been largely ignored.

2.3. Existing Literature

The effect of summer break on maternal labor supply relates to several literatures including studies of occupational choice, assessments of the effect of experience and tenure on earnings,

[31] Laughlin (2013) reports that, among married, employed mothers in the Survey of Income and Program Participation, average weekly child care expenditures rose 70 percent in inflation-adjusted dollars from 1985 to 2011. Herbst (2015) finds that the earnings of center-based child care workers (a proxy for the market price since labor makes up approximately 80 percent of the costs of child care centers) rose by 14 percent across the 1990s.

changes over time in parental time use, and the relationship between parental characteristics (e.g. education and income) and subsequent child outcomes. Below I provide a review of representative examples of each of these areas drawing not only from economics, but also from demography, sociology, and psychology.

2.3.1 Occupational Selection and Labor Market Experience

A sizeable literature has explored the effects of children on occupational choice and earnings. Mincer and Polachek (1974) developed a model in which they showed that a higher likelihood of career interruptions implies a lower initial level of human capital accumulation and a lower early-career earnings profile followed by an increase in human capital investments as children age and require less care. Mincer and Ofek (1982) explored this idea empirically. Using data from the National Longitudinal Survey of Women, they found that interruptions due to child bearing and child rearing lower wages upon reentry, but that the subsequent path of wage growth is steeper. Polachek (1981) extended the theory by allowing for different types of human capital to show that expected interruptions to employment, for example, due to childbearing, may lead an individual to optimally shift toward the accumulation of human capital for which there is a lower penalty for discontinuous employment. He found empirical support for the hypothesis that the “atrophy rate” of human capital in female-dominated occupations is lower than in other occupations.

The studies of Mincer and Polachek provide a conceptual, and limited empirical, explanation of the observed gender gap in earnings. Many studies have followed this literature using various empirical approaches to assess the extent to which differences in tenure, experience, and human capital explain the gender earnings gap. These explanations are often contrasted with other explanations, such as taste-based discrimination. Corcoran and Duncan

(1979), used data from the Panel Study of Income Dynamics (PSID) in a regression framework that sequentially added covariates and measured the amount of remaining variation in wages to estimate that, net of observable variables, unexplained gender wage differentials ranged from 1/3 to 3/5 of the unadjusted difference between white men and white women.[32] Light and Ureta (1995) used weekly work history data from the National Longitudinal Survey of Labor Market Experience, to assess the effects of actual, as opposed to imputed, experience on earnings. Notably they rejected the standard quadratic parameterization of experience in wage regressions. They found substantially lower returns to overall tenure and substantially higher returns to continuous employment spells than found in past research. These results suggest that accurate measurement of both overall experience and continuous tenure is a critical aspect of estimating the effect of these characteristics on earnings and the gender wage gap.

Gronau (1988) explored the idea that the direction of the causal relationship between wages and labor supply may be bi-directional and, specifically, may also run from low potential earnings to low levels of labor market attachment. Using PSID data, he first showed that there was a negative relationship between separations and hourly wages. But, using a two-stage least squares approach and instrumenting for labor force separations with future marital status, children, geographical mobility, and (future) separations, he showed that this negative relationship disappears, suggesting that causality runs from earnings to labor force attachment. Using a Oaxaca/Binder decomposition of female characteristics, he found that, if women interrupted employment at the male rate with male rates of experience, tenure and occupational structure, they would hold only marginally more skill intensive jobs than the jobs they actually held. Gronau concluded that this evidence suggested the existence of a structural barrier (i.e., a

[32] They also explore raced-based differences and find substantial unexplained differences between white men and both black men and black women.

penalty for assumed future interruptions related to children) to women achieving equal returns to men from similar human capital investments.

In a similar vein, Korenman and Neumark (1992) used instrumental variables, first differences, and fixed effects models with National Longitudinal Survey of Women data to explore variation in estimated relationships between motherhood on wages due to different estimation approaches. Consistent with Gronau's hypothesis, results suggested that children lower wages directly, and mothers respond to this by lowering labor supply, leading to less tenure and experience.

More recent papers have continued to focus on empirical approaches to estimate the "motherhood penalty." Albrecht et al (1999) used Swedish panel data to estimate the effects of different types of time out of the labor force on earnings. They found that women are penalized more than men for unemployment spells unrelated to neonatal leave, but that men are penalized more than women for taking neonatal or other family-related leave (e.g., medical emergencies, family deaths). The authors suggested that these differences are consistent with a model where interruptions signal lower labor force attachment for men, but not for women, for whom the strength of the norm to take maternal neo-natal leave renders this signal uninformative in terms of a woman's labor force attachment. Thus, institutional factors (such as a country's culture and regulations around leave-taking) may be an important factor in the extent of the returns to tenure and experience (Weinberger, et al. 2018).

Baum (2002) used National Longitudinal Survey of Youth 1979 (NLSY79) data to estimate the wage effects of leave-taking in response to child birth. He found that returning to work for same employer reduces the wage penalty and leads to faster catch up. Anderson, Binder and Krause (2002) used NLS data to explore whether the wage penalty for child-related interruptions differs by skill level (using education as a proxy). They found no wage penalty for high school dropouts, a modest penalty for high school graduates or those with some college, and a larger penalty for college-educated mothers. Given the broader set of occupational choices of those with more education, these findings are consistent with a potentially greater scope for choice among those with greater educational attainment to select into occupations with higher or lower levels of cross-worker substitutability, as discussed above.

Most recently, a pair of similar studies used administrative data on earnings and childbirth to estimate the motherhood penalty over the life cycle using an event study approach. Klevens, Landais and Sogaard (2017) used Danish administrative data to plot the time path of the gap in log earnings between parents across the first birth of a child. They found a 20% decline in earnings after the birth that persists for up to 20 years. Chung et al (2017) used data from the Survey of Income and Program Participation (SIPP) linked to Social Security earnings records to estimate similar models. They found average results similar to the Danish study, but also showed evidence that the effect of children on earnings is increasing in children (around a 10% penalty per child), has varied across time—decreasing overall since the 1980s, but being higher today than in the 1990s—and that the earnings penalty for both younger (less than 25) and older (35+) mothers recovers to zero around 16 years after initial child birth, but remains large in magnitude for mothers who gave birth between ages 25 and 35.

However recent studies have focused on the potentially important role of non-linearities in the earnings returns to working particularly long hours or demanding schedules in driving the gender-wage gap among parents. Weeden, Cha, and Bucca (2016) use a regression decomposition approach to show that changes in both the incidence of working long hours across mothers and fathers and increasing returns to doing so have contributed to increases in the “motherhood penalty” and the “fatherhood premium” in wages. Cortés and Pan (2016) use variation in low-skilled immigrant flows across cities as a source of plausibly exogenous variation in the “cost” of working long hours in terms of household production to show that the demand for such jobs among mothers and is responsive to changes in the opportunity cost of non-market work.

Taken together, these studies suggest a few important things about the complex relationship between child-related employment interruptions and earnings. First, measuring experience accurately and, conditional on total labor market experience, distinguishing the length and persistence of employment interruptions is important in assessing the association between earnings and experience. Second, once these factors are accounted for, there appears to remain a substantial gap in earnings between mothers and fathers that may be related to accumulation of different types of human capital across genders, gender-related occupational selection (either related to or independent of human capital characteristics), and gender-based differences in hours worked and/or (unobservable) effort. Third, earnings differences may remain after controlling for observable skills, tenure, and experience, owing to gender-based employer expectations that may drive a reverse causal relationship from potential maternal earnings to occupational choice and labor supply. In short, the earnings gap between mothers and fathers is the tradeoff (constrained choice) that families make between the benefits of maternal time spent with children relative to market work. This tradeoff exists within a year for mothers, as well as across years. The former tradeoff, which is non-trivial, has been not previously explored.

2.3.2 Effects of Income and Parental Time on Child Development

There is a large literature assessing the relative effects of income and parental time on child development. The theoretical cornerstone of this literature is the work of Gary Becker on child investments (see, e.g., Becker 1981). Becker's work has driven more recent models exploring the relative importance of early parental investments in children relative to later investments is developed, as exemplified by Cunha and Heckman (2007) and Cunha, Heckman, and Schennach (2010). The key insight of these papers is the primacy of early parental investments in skill creation along with the fact that skills beget skills, and the decreasing intertemporal substitutability for these early investments as children age. This basic theoretical framework has informed a host of empirical studies on the trade-off between the return to direct parental time investments in children versus income. Most of this literature either explicitly or implicitly suggests that parental time inputs dominate money inputs into child development. Here, I review a sample of studies that document these relative effects.

Thomson, Hanson, and McLanahan (1994) used data from the National Survey of Families and Households to estimate the importance of economic resources relative to family structure (e.g., single mother) and fixed family characteristics (e.g., parental education). They found that controlling for income doesn't meaningfully change the association between these family factors and a variety of child outcome measures on average, but that income is associated with more positive outcomes among older children. Blau (1999) used NLSY79 data to estimate the relative effects of temporary increases in income versus permanent income levels on several child outcome measures and found a small effect of current income relative to permanent income (which is highly correlated with permanent characteristics such as parental education and non-cognitive skills). Importantly, though, these studies lack a plausible source of exogenous variation in parental income.

Weinberg (2001) developed a theoretical model of parental influence on child behaviors where corporal incentives (e.g., physical punishment, grounding) and pecuniary incentives are substitutes and where the price of using pecuniary incentives to influence child behavior is decreasing in family income. He found empirical evidence that parents make this substitution most noticeably as family income increases from lower initial income levels.[33] Studies finding that parental income may be a proxy for both cognitive and non-cognitive skills (patience, ability to manage stress) that directly influence child outcomes suggest that policy-based changes in parental income may do relatively little to affect these more permanent characteristics and, thus, may have a limited influence on child outcomes (Berger, Paxson and Waldfogel 2009).

Del Boca, Flinn, and Wiswall (2014) develop a model of child cognitive development within a standard household behavior model to consider the relative strengths of income versus parental time. They find that time inputs are more important than income and that this relationship is particularly strong at younger child ages. Ruhm (2004) using matched parent and child data from the NLSY79 cohort and variety of ordinary least squares (OLS) regression models estimates a strongly negative relationship between maternal employment and both reading and math achievement among five- and six-year-olds, suggesting a strong role for maternal time. Bernal and Keane (2011) use plausibly exogenous variation in welfare rules that increased the proportion of single mothers using outside child care, finding that a year of such care reduced child test scores by around 2 percent.

Evidence, like the studies just reviewed, suggest that time with children is a key driver of child outcomes and may be more influential than income. This underscores why the summer break may be an important overlooked margin where the tradeoff between work and childcare occurs. As I show below, summer breaks have the potential to add significantly to annual time

[33] In a related study, Doepke and Zilibotti (2017) develop a model of comparative advantage in parenting “styles” (the extent to which parents explicitly constrain non-preferred child behaviors versus incentivizing preferred behaviors) according to differences in economic conditions and find support for this hypothesis in a cross-section of countries with differing economic opportunities.

spent with children, and therefore, to improved child development. The "motherhood penalty" may also differ for interruptions related to summer breaks, and I provide the first evidence on this possibility below.

Finally, differences in time spent with children by SES may be a potentially important explanation of intergenerational differences in child outcomes. A recent literature has emerged around this possibility. Guryan, Hurst, and Kearney (2008) used ATUS data to document a striking fact: college-educated mothers work nearly twice as much as mothers with less than a high school education (27 hours versus 15), but also spend around 40 percent more time providing child care than these same mothers (17 hours versus 12). Ramey and Ramey (2010) showed that this phenomenon has arisen only recently. Regression-adjusted estimates of the gap in weekly child care time between mothers with a four-year college degree or higher and those without was near-zero in the early 1990s, but grew to over 4 hours by 2005. Furthermore, Kalil, Ryan, and Corey (2012) found evidence in ATUS data that, in addition to a large difference in child time across maternal education levels, more educated mothers also make a more pronounced shift over time in the characteristics of this child time (from more basic care and play time to "management activities" as children grow older), which they dubbed the "developmental gradient."

2.3.3 <u>Parental Time Use During the Summer Months</u>

A small body of research from across several disciplines in the social sciences has explored changes in parental time use related to children over the summer months, Crouter and McHale (1993) surveyed 125 families with children regarding child time during the summer based on whether a family is consistently dual-earner, consistently single-earner, or a mixture of the two. They documented a shift toward additional maternal time with children over the summer among both mixed dual- and single-earner families and single-earner families, as well as greater paternal child involvement in dual-earner families.

Gershenson (2013) used American Time Use Survey (ATUS) and Activity Pattern Survey of California Children (APSCC) data to estimate the interaction effects of summer time use and parental income. He reported estimates indicating that the previously observed negative relationship between parental education and child television viewing was even larger during the summer months (around 100 percent larger than the average difference in the non-summer months). Hardy and Gershenson (2013) used NLSY79 matched mothers and children to explore how parental time spent on activities such as reading to children and organized summer activities are associated with increased educational attainment by children. They initially find the (standard) positive correlation between mother's and child's educational attainment, but when measures of enriching activities are added, these estimated correlations weaken or go to zero, suggesting that these time-use measures are important mechanisms in the intergenerational correlation of educational attainment. Chin and Phillips (2004) conducted an ethnographic study of 32 elementary school families to assess the correlates of SES differences in the richness of summer activities and found that differences in knowledge about the availability of summer programs and ability to pay for such programs explained more of the SES differences in summer activities than preferences over such activities.

Finally, Herbst (2013) uses the predictable, annual summer decrease in use of market-based child care and the fact that the interview schedule of parents in the Early Childhood Longitudinal Study is linked to a child's birthday in an instrumental variables framework (where the quasi-random occurrence of a child's birthday-based interview date is an instrument for seasonal differences in childcare use) to generate plausibly causal estimates on the effect of outside child care, relative to parental care, on the cognitive abilities of two-year-olds. He finds that the positive relationship between outside child care and test scores in OLS estimates is due to selection bias: family income is correlated with both a higher incidence of using center-based care and higher test scores. His IV estimates point to significant negative effects of non-parental, center-based care on child cognitive development.

This small collection of studies explores a few key aspects of the summer break. The documented changes in child care use and parental time in the summer suggest that parental time with children changes with the summer break, that the magnitude of these changes may vary by parental SES, and that children likely benefit from increased parental time in the absence of schooling.

2.3.4 Contribution

While the studies cited in this partial review are related to issues that arise with respect to the summer break, none directly explore this significant interruption in the provision of free child care on parental labor market outcomes and child development. The present analysis advances understanding of several aspects of maternal labor supply over the child's life cycle and contributes to a clearer picture of the pattern of overall gender differences in labor supply, as well as providing new evidence that may help explain the intergenerational transmission of cognitive and noncognitive skills. The important relationships raised here are only descriptively addressed in this study, but the near total absence of any previous documentation of these facts, and the potential importance of the changes in maternal labor supply around the summer months, makes such a descriptive study valuable. In addition, the results documented here can be used to motivate future research.

2.4. Theoretical Implications of the Summer School Break

In this section I outline a simple model of the choices that a working mother of school-aged children confronts with respect to the existence of summer break. A mother who works during the school year can choose to work at the same level during the summer break, to work less, or to exit employment. I ignore mothers who choose no work during the school year since this choice implies that there is no differential trade-off to be made during the summer break (i.e. I assume that no mother will begin working as a result of her children not being in school during the summer).

I use a two-period model of labor supply where the first period can be thought of as aggregating years of a child's life where parental time is relatively more important than market goods, for example, ages 5 to 12. The second period can be thought of as aggregating years when a child can care for herself for extended periods and when market goods (e.g., extracurricular activities, lessons, computers) have a relatively higher return due to the declining productivity of parental time.[34] The mother's labor supply decision trades off between the direct productivity of child care time and the wage gains realized through continuous employment.[35]

For simplicity, I assume that a mother obtains utility from child quality across two periods (0 and 1). Child quality is a function of: market goods, *x* (e.g., books, clothing, computers), which increase child quality equally across both periods; parental child care, t^{cc}, which increases child quality more in the first period than in the second; and non-parental child

[34] Silver (2000) records a more than 30 percent decrease in maternal hours per day spent with children and a more than 20 percent increase in maternal hours of work per day between ages 9-12 and ages 13-14. American Time Use Survey data shows a sharp decline in "secondary child care" (as described below) provided by a mother has her youngest child turns 13 (an age that corresponds, no average, with the eldest child turning 16).

[35] Foregone wages associated with interrupted labor supply can occur via mechanisms such as a lower rate of accumulation of on-the-job training, human capital depreciation occurring during a period of interrupted work (Mincer and Ofek, 1982), or a wage penalty associated with signaling lower productivity (Landers, Rebitzer and Taylor 1996, Albrecht et al 1999, Sousa-Poza and Zeigler, 2003).

care, t^{occ}, which also increases child quality more in the first period than in the second. The price of the market good is normalized to 1 and the price of child care in period i is p_i. I further assume that: 1) non-weekday child care time (evenings, weekends) is constant across the year; 2) that weekday, daytime child care during the school year is fully provided by the child's school and that the quality of schooling in constant across years. These assumptions allow me to omit both of these inputs from the child quality utility function because my focus on differences across periods would be unchanged.

I assume that the father works and provides no summer child care, earning Y in each period.[36] The mother has one unit of time in each period, i, that is allocated to either child care, t_i^{cc}, or market work, $t_i^w = 1 - t_i^{cc}$, and the mother's wage is increasing in experience so that working in period 0 results in a higher wage in period 1, $w_1(t_0^w > 0) > w_1(t_0^w = 0)$. Maternal utility, then, is given by

$$U = q_0(x_0, \phi_0 t_0^{occ}, \theta_0 t_0^{cc}) + \beta q_1(x_1, \phi_1 t_1^{occ}, \theta_1 t_1^{cc}). \tag{12}$$

q_i is a concave, increasing function. ϕ_i is a scalar that measures the relative monetary benefit of outside child care time in period i, and θ_i is the analogous scalar measuring the relative monetary benefit of maternal child care time. $\beta = \frac{1}{1+\rho}$ is the discount rate. The mother's budget constraint (with market work time written in terms of non-child care, non-leisure time) is

$$\begin{aligned} x_0 + p t_0^{occ} + \frac{x_1 + p_1 t_1^{occ}}{1+r} &= Y_0 + w_0[1 - t_0^l - t_0^{cc}] \\ &+ \frac{Y_1 + w_1(1 - t_0^l - t_0^{cc})[1 - t_1^l - t_1^{cc}]}{1+r}. \end{aligned} \tag{13}$$

Assuming $r = \rho$, the FOC for maternal child care time in period 0 is

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[36] This simplification just amounts to holding one parent's child care level constant, but the plausibility of this assumption is also generally supported by observed behavior and the empirical findings that follow.

$$\theta_0 q_{cc_0} = q_{x_1}\left[w_0 + w_1{}'\frac{1-t_1^{cc}}{1+r}\right]. \tag{14}$$

The marginal benefit of market goods in period 1 is used to quantify the shadow price of direct maternal child care in the first period ($\lambda = q_{x_1}$). The left-hand side of (14) is the marginal benefit of a mother providing child care directly in period 0. It is increasing in her child care productivity. The marginal cost, expressed in terms of period 1 market goods, is the wage in period 0 plus the increase in the period 1 wage resulting from working in period 0 multiplied by market work time in period 1.

Expressed as a marginal rate of substitution, this period 0 tradeoff is given by

$$\frac{q_{cc_0}}{q_{x_1}} = \frac{\left[w_0 + w_1{}'\frac{1-t_1^{cc}}{1+r}\right]}{\theta_0}. \tag{15}$$

According to (15) higher maternal productivity, lower wages, and a lower wage penalty for work interruptions will increase the probability of providing summer child care directly. An increase in paternal earnings will also lower q_{x_1}, leading a mother to optimally increase direct provision of summer child care. Notably, there are no paternal earnings in single-female-headed households (abstracting from child support, which estimates suggest are typically small in magnitude relative to mother's own income among unmarried couples (Sinkewicz and Garfinkel 2009)), so these mothers face a more binding income constraint, increasing q_{x_1} and reducing the propensity to provide own child care relative to married mothers.

Now consider the FOC for outside child care in period 0. The analogous expression to equation (15) above is $q_{occ_0}/q_{x_1} = p_0/\phi_0$. The propensity to use outside child care is decreasing in price, increasing in quality and increasing in income (wealth). This expression can be combined with (4) to give the MRS between maternal and outside child care time. This ratio is

$$\frac{q_{cc_0}}{q_{occ_0}} = \frac{\phi_0}{\theta_0} \frac{\left[w_0 + w_1{}' \frac{1 - t_1^{cc}}{1 + r}\right]}{p_0}. \tag{16}$$

This ratio shows that, holding income constant, the propensity to provide direct maternal care relative to using outside care is increasing in the price of outside care and in the productivity of maternal child care time, and decreasing in the productivity of outside care, maternal wages and the wage penalty associated with less prior experience ($w_1{}'$).

A few factors regarding the implications of child care price and quality on the effects predicted by (16) bear mention. First, evidence suggests there is a positive gradient between parental SES and a child care quality preference (Johansen, Leibowitz and Waite 1996, Herbst, Desouza, et al. 2018, Gordon, Herbst and Tekin 2018). Second, there is a positive relationship between the quality and the cost of child care from factors such as the child-to-caregiver ratio, costs of training, and turnover ratio (D. M. Blau 1991). These two points suggest an ambiguous relationship between childcare quality and maternal child care time since it is unclear whether price (in the denominator) or quality (in the numerator) would dominate, as they both increase. Evidence in chapter 1 on maternal responses to the four-day school week are consistent with child care price increasing faster than quality since I find that highly-educated mothers are more likely to exit employment and reduce hours when school provision is reduced. But this ambiguity is also explored in the analysis below comparing the magnitude of labor supply responses to the summer break across maternal education levels.

Third, low-income families have a variety of options for subsidized child care including a variety of government subsidies, publicly funded child care centers, and sliding-scale costs at many private child care centers (Haldar and Tran 2018, Ward 2018). This implies that there may be less difference in the use of outside child care by income than would be observed if all families paid the full market rate.

Finally, forward-looking maternal behavior with respect to child-bearing plans suggests that there may also be a role for occupational selection (see, e.g. Polachek, 1981). While the model above assumes that the wage penalty associated with prior work reductions is exogenous, it is plausible that mothers can make a tradeoff between wage levels and wage penalties. First, consider the case in which, across all occupations, wage levels and wage penalties are positively correlated. In this case, there will be a negative association between wages and maternal time spent in child care during the summer. Weakening the positive correlation between wage levels and wage penalties will diminish the negative association between wages and maternal time spent in child care during the summer.

Depending on the nature of the occupation and the skills involved, there may be greater opportunities than otherwise expected for high-wage mothers to spend time with children during the summer. School teacher is the most obvious example of a job that has a small wage penalty associated with summer work interruptions, particularly because of collectively bargained wages based primarily or solely on job tenure and educational attainment. Careers in law or business consulting are examples of the alternate extreme where the returns to working long hours continuously are very high (Bertrand, Goldin and Katz 2010, Miller 2019).

Below, I provide evidence on this issue by comparing the occupational distributions of mothers who reduce their employment during the summer. But this descriptive analysis is unable to assess the extent to which parenting preferences my drive occupational selection or be driven by them. Pursuing this question further would be a fruitful direction for future research.

2.5 Changes in Parental Labor Supply By Month

I begin the empirical analysis with an assessment of the extent of parental responses to the summer break along both the extensive and intensive margins using CPS data for the years 1982 to 2017. The CPS is the primary data source of labor statistics for the U.S. population. The survey uses an address-based sampling frame to poll around 50,000 households per year on employment and a variety of demographic and socioeconomic characteristics. Respondents are interviewed for four sequential months, then are not interviewed for the next eight months, then are surveyed for the same four months as in the initial round one year later.[37] I select a sample of adults in their prime working years (ages 25 to 44) and estimate the relationship between calendar year months and two outcomes: employment and, among the employed, being present at work in the week prior to being surveyed (henceforth, I will simply refer to this as "presence at work").[38]

Estimates of labor supply patterns across the year are generated using the following weighted least squares linear probability model:

$$y_{ismt} = \sum_{k \neq 4} \beta_k * \mathbf{I}[k = \text{month}_m] + \gamma_a + \theta_s + \lambda_n + \delta_t + \boldsymbol{\Gamma X_i} + \epsilon_{ismt}. \qquad (17)$$

This model uses the CPS as a cross-sectional data set. y_{ismt} is an employment outcome for individual *i* in state *s* in month *m* in year *t*. The β_k terms represent a set of 11 month dummies that excludes April, so that the estimated coefficients are relative to this month's employment level.[39] To control non-parametrically for a variety of characteristics that may influence monthly

[37] The CPS data used in these analyses were obtained from the Integrated Public Use Microdata Series (Flood, et al. 2018). For a detailed history of the CPS see https://www.census.gov/prod/2006pubs/tp-66.pdf. For more on the panel structure of the CPS see Rivera Drew, Flood, and Warren (2014).
[38] Further details on the sample selection and variable construction is included in the data appendix.
[39] April is used since it is at least 1 full month before the earliest typical start of the summer break and it is also at least a few months away from the typical post-holiday dip in employment, making it a good candidate for a month

patterns of employment and presence at work, the model includes age (γ_a), state (θ_s), number of children (λ_n), and year (δ_t) fixed effects, as well as a vector ($\boldsymbol{X_i}$) of educational attainment dummies (bachelor's degree or higher and high school dropout indicators) and indicators for Hispanic ethnicity and a non-white racial classification. Standard errors are clustered at the state level and the model is weighted using CPS survey weights.[40]

To assess the magnitude of labor supply behaviors that are directly related to the summer break from schooling and the extent to which they are likely to be correlated specifically with the summer break, estimates of equation (6) are obtained by running this regression on a sample of married parents of children all aged 6 to 13 and, for comparison, on a sample of married adults with no children and plotting these results together. I assume that patterns of seasonality in the labor supply of married adults that are not related to the presence of children will be equally reflected in these two groups of married adults, and that the difference in their patterns of employment and presence at work across the summer months is related to the presence of grade-school-aged children on their summer break. I also test this assumption empirically by generating similar estimates of (17) for parents with only pre-school aged children (ages 0 to 4). Finally, I generate estimates for single women with children all aged 6 to 13 and childless single women of the same age. More detail on the CPS data construction is given in appendix B.

Table VIII presents descriptive statistics for the samples of married parents and childless adults to assess their comparability. Conceptually, the married parents group is "treated" with the summer break from schooling, while the childless married adult group is not. While these groups

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of "average" employment. However, the estimates aren't particularly sensitive to the choice of this omitted month as long as it is not one of June through August.

[40] Models estimated with a full set of state-by-year fixed effects did not vary from these results in any statistically distinguishable fashion, so this more parsimonious model was used. In addition, unweighted estimates were not qualitatively different from the weighted estimates presented here.

Table VIII: Mean Characteristics of Current Population Survey Respondents

	(1)		(2)	
	Mean	SD	Mean	SD
Panel A: Married Women Ages 25 to 44				
	With Children Ages 6 to 13		Childless	
Age	36.0	[4.8]	33.6	[6.1]
Employed	0.70	[0.46]	0.79	[0.40]
Bachelor's Degree	0.25	[0.43]	0.37	[0.48]
Less Than HS	0.09	[0.29]	0.06	[0.24]
Non-White	0.14	[0.35]	0.15	[0.35]
Hispanic	0.12	[0.32]	0.09	[0.28]
Family Income	75,197	[53,109]	78,933	[53,195]
Observations	951,040		1,053,018	
Panel B: Married Men Ages 25 to 44				
	With Children Ages 6 to 13		Childless	
Age	37.0	[4.6]	33.7	[5.8]
Employed	0.93	[0.26]	0.90	[0.30]
Bachelor's Degree	0.25	[0.43]	0.33	[0.47]
Less Than HS	0.11	[0.31]	0.07	[0.26]
Non-White	0.14	[0.35]	0.14	[0.35]
Hispanic	0.13	[0.33]	0.10	[0.30]
Family Income	73,296	[51,940]	75,464	[51,780]
Observations	818,815		1,011,379	
Panel C: Single Women Ages 25 to 44				
	With Children Ages 6 to 13		Childless	
Age	35.0	[5.48]	33.9	[7.59]
Employed	0.74	[0.44]	0.79	[0.41]
Bachelor's Degree	0.18	[0.38]	0.34	[0.47]
Less Than HS	0.12	[0.33]	0.08	[0.27]
Non-White	0.31	[0.46]	0.24	[0.43]
Hispanic	0.14	[0.35]	0.10	[0.30]
Family Income	41,932	[42,521]	55,211	[47,610]
Observations	327,941		111,5574	

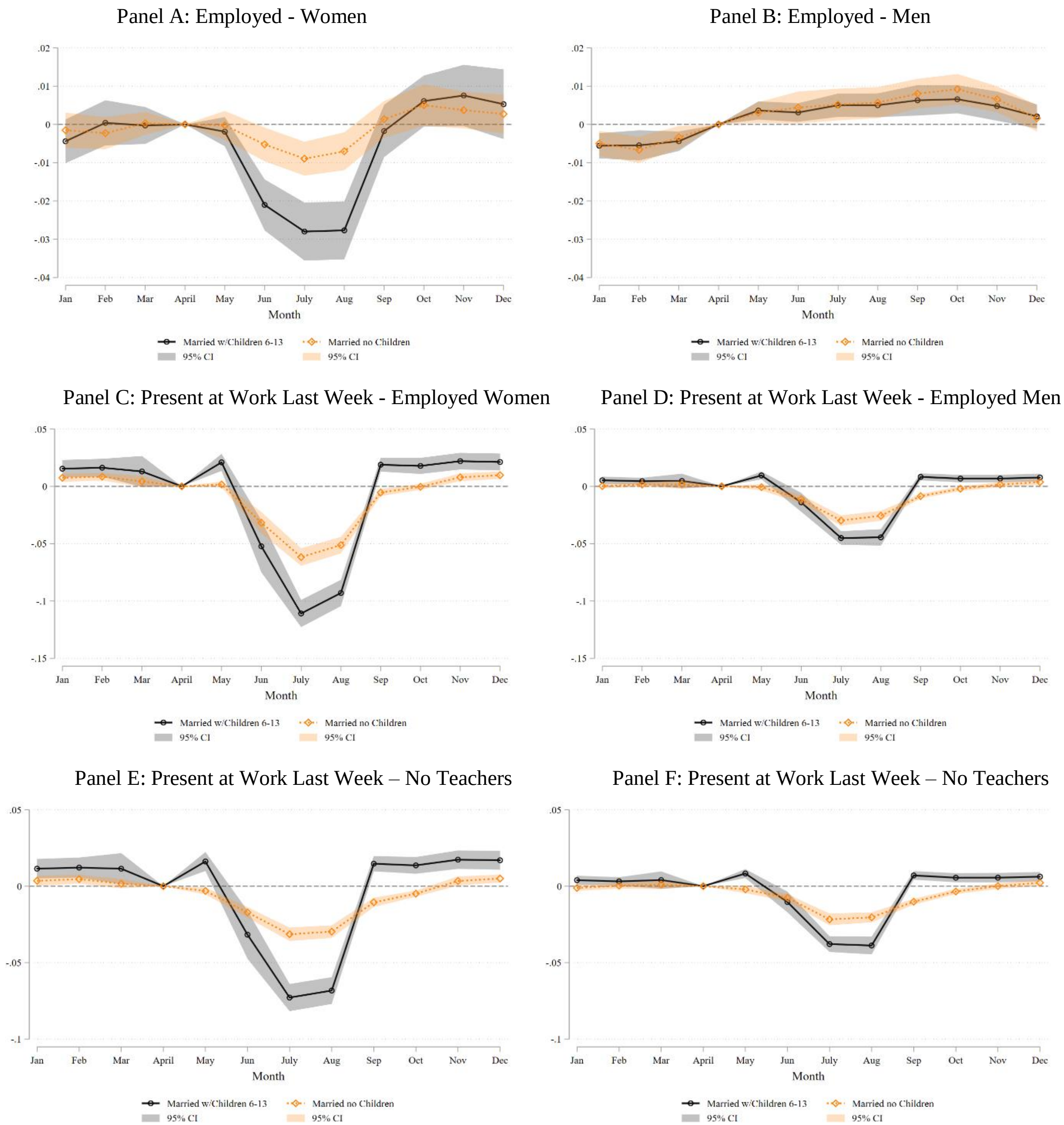
Source: Current Population Survey monthly basic survey data from IPUMS. Data covers survey years 1982-2017. Family Income uses PCE deflator (2012 dollars). Means are calculated using CPS weights. Observations report actual number of respondent-year observations.

are similar on some characteristics, there are potentially meaningful differences in evidence as well. Relative to childless married women, married mothers are about two years older, are slightly less likely to be employed, are about 1/3rd less likely to have a bachelor's degree, and are about 1/3rd more likely to be Hispanic. Among married fathers (panel B), employment and education differences with childless married men are smaller, while racial and ethnic differences are similar to women. Finally, panel C shows that, relative to single, childless women, single mothers are modestly less likely to be employed, have much lower education attainment, are around 30 percent less likely to be white, and have significantly lower family income. Relative to married mothers, single mothers are about 4 years younger, are slightly less likely to be employed, are considerably less educated, and are about 50 percent more likely to be non-white and 25 percent more likely to be Hispanic. Despite these differences in observable characteristics, consistent comparisons across these groups will provide a useful measure of relative labor supply differences.

Figure 9 presents estimates of parental labor supply by month of the year. In discussing these results, I focus on the month of July as this is the single month that is fully encompassed by the summer break across nearly all school calendars. Due to differences in school stop and start times across districts, June and August can be thought of as "partially treated" months.[41] Panel A of figure 1 shows that July current employment among married women with grade-school-aged children declines by 2.1 percentage points more than the employment of childless married women (in absolute terms, this is a 2.9 percentage point decline, or a 4 percent decrease from the

[41] A sampling of 2018-2019 to 2019-2020 school calendars from six major metropolitan school districts yields the following summer break dates (given as last instructional day to first instructional day): Atlanta Public Schools, May 24th to August 12th; Chicago Public Schools, June 18th to September 3rd; Houston Independent School District, May 31st to August 26th; Los Angeles Unified School District, June 7th to August 20th; NYC Public Schools, June 26th to September 5th (this is 2018 first day as the district hasn't yet released their 2019-2020 calendar); Seattle Public schools, June 27th to September 4th.

Figure 9: Monthly Labor Supply Among Married Parents with All Grade-School-Aged Children Relative to Childless Married Adults 25-44



Source: Current Population Survey, 1982-2017. Each figure shows estimates of equation (6) from text on a subsample of the CPS as indicated (and as further defined in the text and appendix B). 95 percent confidence intervals calculated using cluster-robust standard errors clustered at the state level.

mean employment level of .71). Panel B, which compares married fathers of children ages 6 to 13 with childless married men, shows no evidence of a summer dip and no differences between these groups. Panel C compares rates of employed persons reporting being present at work last week. Here, married women report around a 5 percentage point greater decline in being present at work than married childless women. In contrast to the employment estimates, married fathers exhibit a statistically significant decline in presence at work relative to married childless men of about 2 percentage points.

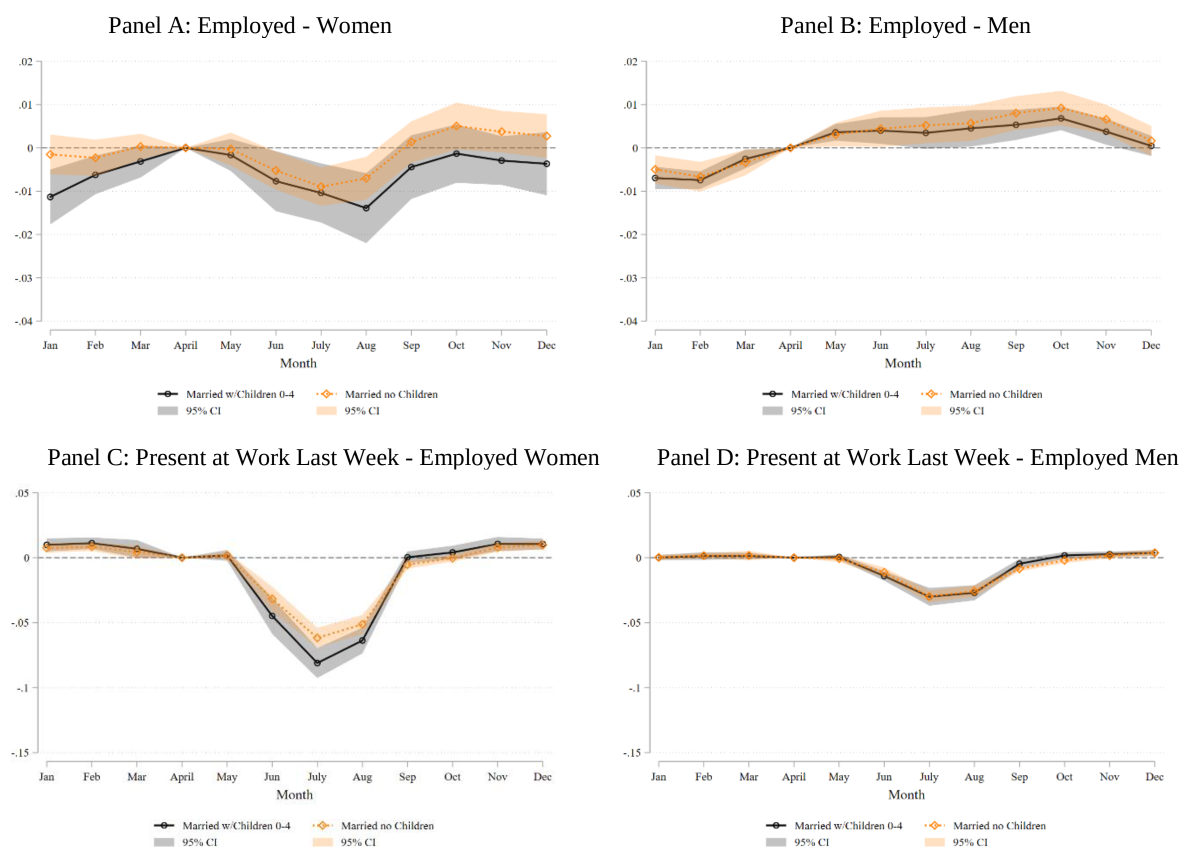
To consider the extent to which these reductions in being employed and present at work over the summer are driven by teachers, who make up around 6.5 percent of employed married mothers with children ages 6 to 13 and who have a schedule that is exactly coincident with the summer break, I also generate estimates of this outcome excluding teachers.[42] Panels E and F shows these results by gender. This sample restriction reduces the magnitude of the decline in being present at work last week by about 20 percent for both groups and leaves the gap between them largely unchanged at 4.2 percentage points (note that the negative scale is reduced by 33 percent in Panels E and F).

The differences in being present at work over the summer months by child status suggest a very different pattern of intensive margin labor supply across these family types (married families with school-aged children and childless couples). The summer decline in presence at work is roughly equal for married childless women and men once teachers are excluded, consistent with married couples taking leisure time in a complementary fashion (Michaud and

[42] Teachers are identified using the *occ1950* variable, which is harmonized over time in the IPUMS data and collects various categories of teachers (primary, secondary, kindergarten) together. Using the more recent (and disaggregated) *occ1990* variable results in the same estimate when summing teacher categories. Results for employment differences excluding teachers are omitted since they differ little from the main estimate shown (the July difference in employment between married parents and married childless adults is 2 percentage points with teachers included and 1.8 percentage points with teachers excluded).

Vermeulen 2011). The correlation within-couple in presence at work is consistent with this visual result. For married childless couples, their correlation coefficient in April is 0.22, while in July and August it is 0.26. By contrast, the April correlation between married parents of school-aged children is 0.08, and their average correlation in July and August is 0.15, suggesting that, across both non-summer and summer months (other months vary little from these two examples), time off work among married parents is likely driven more by child school schedules than by shared vacation plans (Hamermesh 2000).

Figure 10: Monthly Labor Supply Among Married Parents with Only Preschool-Aged Children Relative to Childless Married Adults 25-44

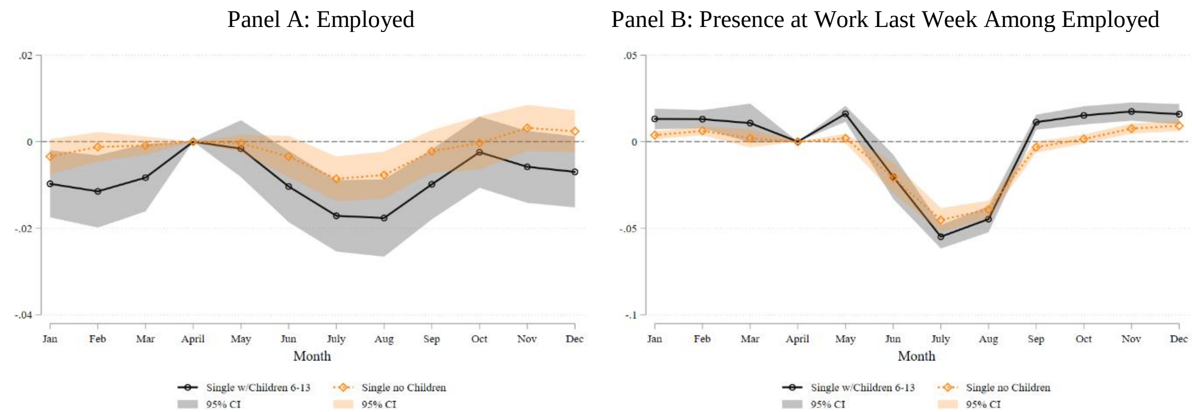


(See notes to figure 9 above.)

Figure 10 presents the results of a falsification exercise to assess how likely it is that the above results are directly related to the summer schooling break by substituting married parents with all preschool-aged children as the "treated" group and comparing their labor supply behaviors to childless married adults (a group that these parents were more recently members of). Across both measures of labor supply and both parent genders, we see no clearly distinguishable differences in the summer labor supply behavior of married parents of very young children and childless married adults. This is consistent with the summer break being a causal factor in the labor supply differences observed above and elsewhere below.

Figure 11 presents estimates for single mothers of grade-school-aged children compared with single childless women. The magnitude of employment reductions by these mothers over the summer months is difficult is around twice as large (two percentage points versus one percentage point, but the confidence intervals of these estimates overlap significantly. The summer employment response of single mothers is around one third less than the analogous reduction among married mothers. The difference in summer declines in presence at work over the summer break is indistinguishable between single mothers and childless singe women and is, similarly, around one third smaller than what is observed among married mothers. These differences are consistent with a more binding family income constraint on maternal labor supply relative to married mothers reducing direct provision of child care over the summer break, as discussed above.

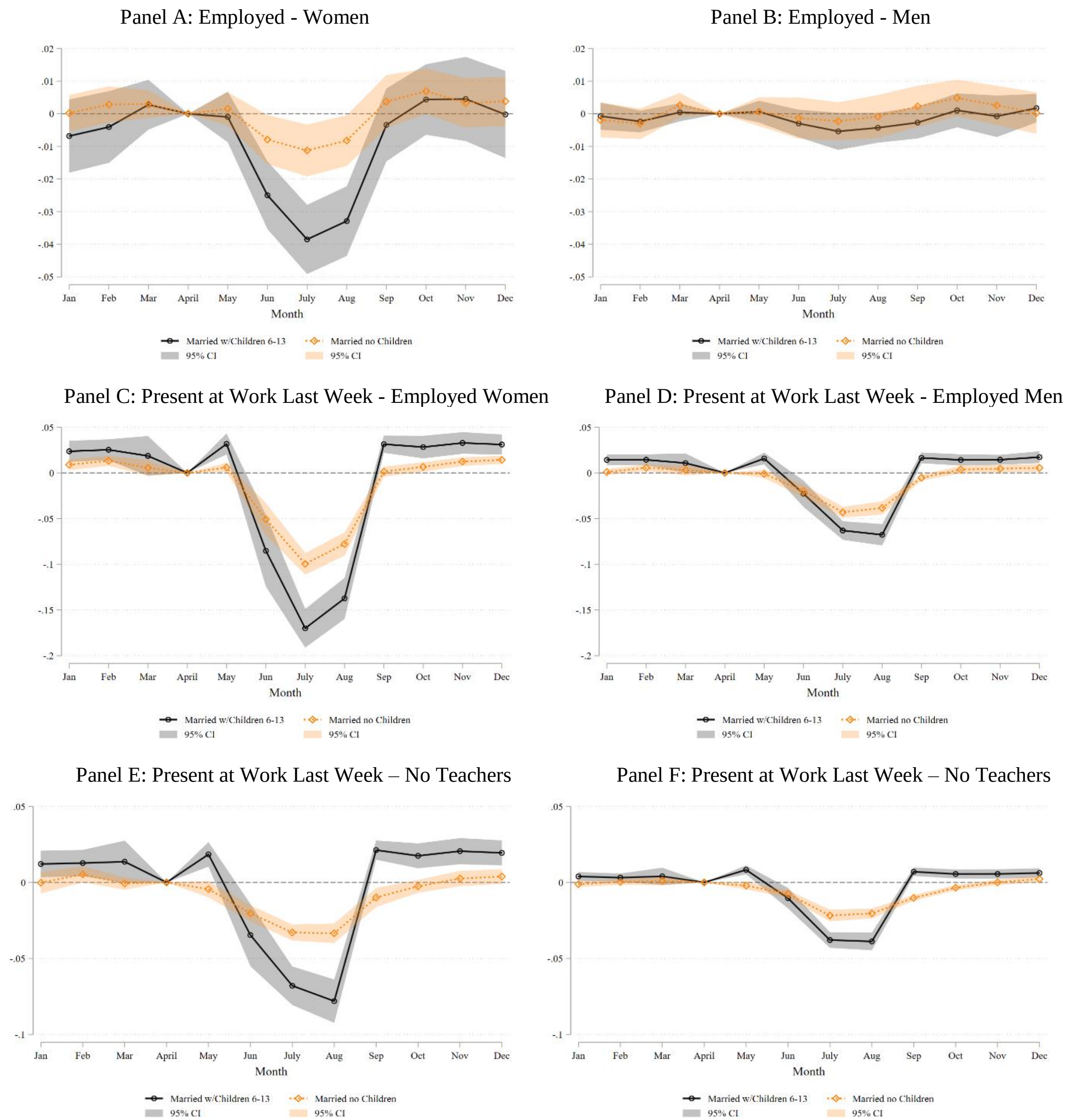
Figure 11: Monthly Labor Supply Among Single Mothers 25-44 with Children Ages 6-13



(See notes to figure 9 above.)

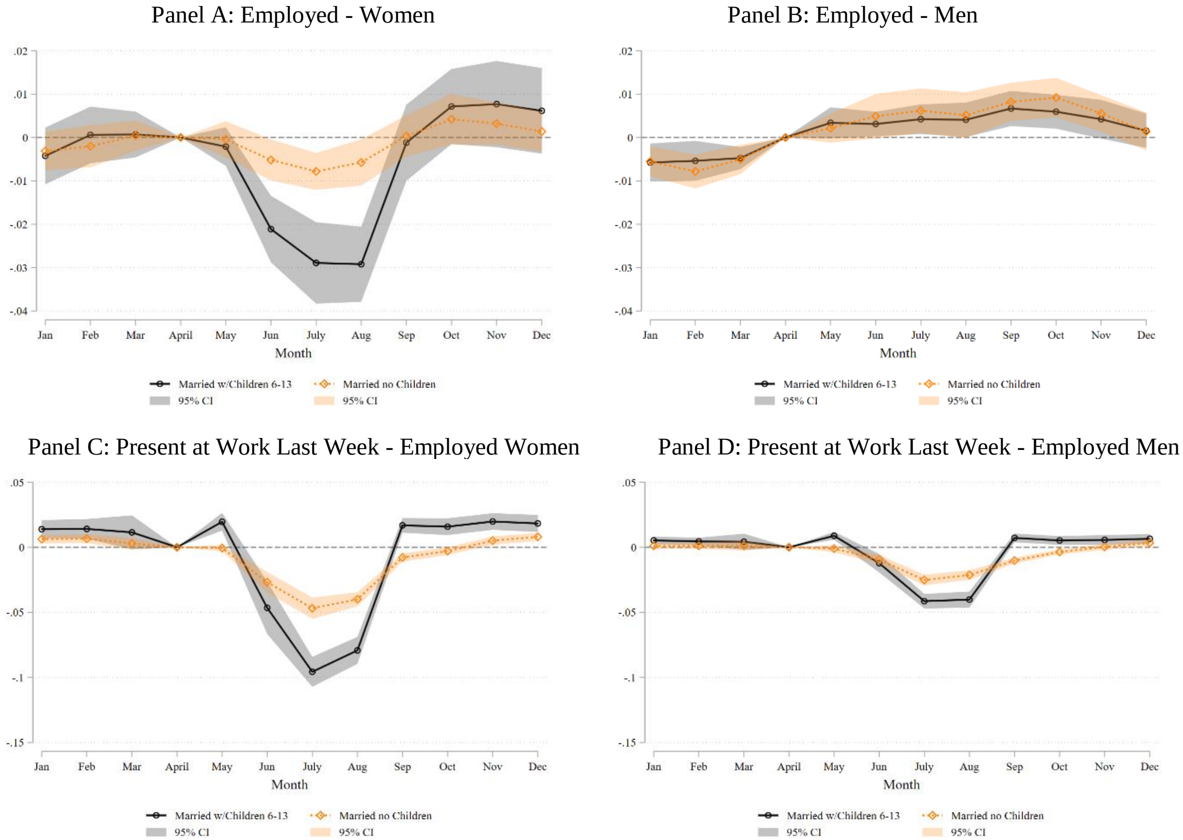
Figures 12, 13, and 14 show analogous results to Figure 9 stratifying women by educational attainment. For these results, I divide the sample of women into three groups: those with a four-year college degree or higher, those with a high school degree or some college, and those with less than a high school degree. Figure 12 presents estimates for college-educated mothers. As in figure 9, I include estimates of presence at work excluding teachers, since they comprise an even larger proportion of college-educated mothers (19 percent). Figure 13 presents estimates for those with a high school degree or some college attainment. It is notable that mothers in these two education groups, after excluding teachers from the higher educated group, exhibit remarkably similar patterns of summer labor supply behavior. Married mothers of school-aged children from both education groups reduce employment similarly relative to married childless women, with only a slightly larger reduction in employment among college-educated mothers (2.73 percentage points compared to 2.11 percentage points). Similarly, there is little difference in the patterns of presence at work between these two education groups (with

Figure 12: Monthly Labor Supply by Child Status Among Married Adults 25-44 With a Four-Year College Degree or Higher



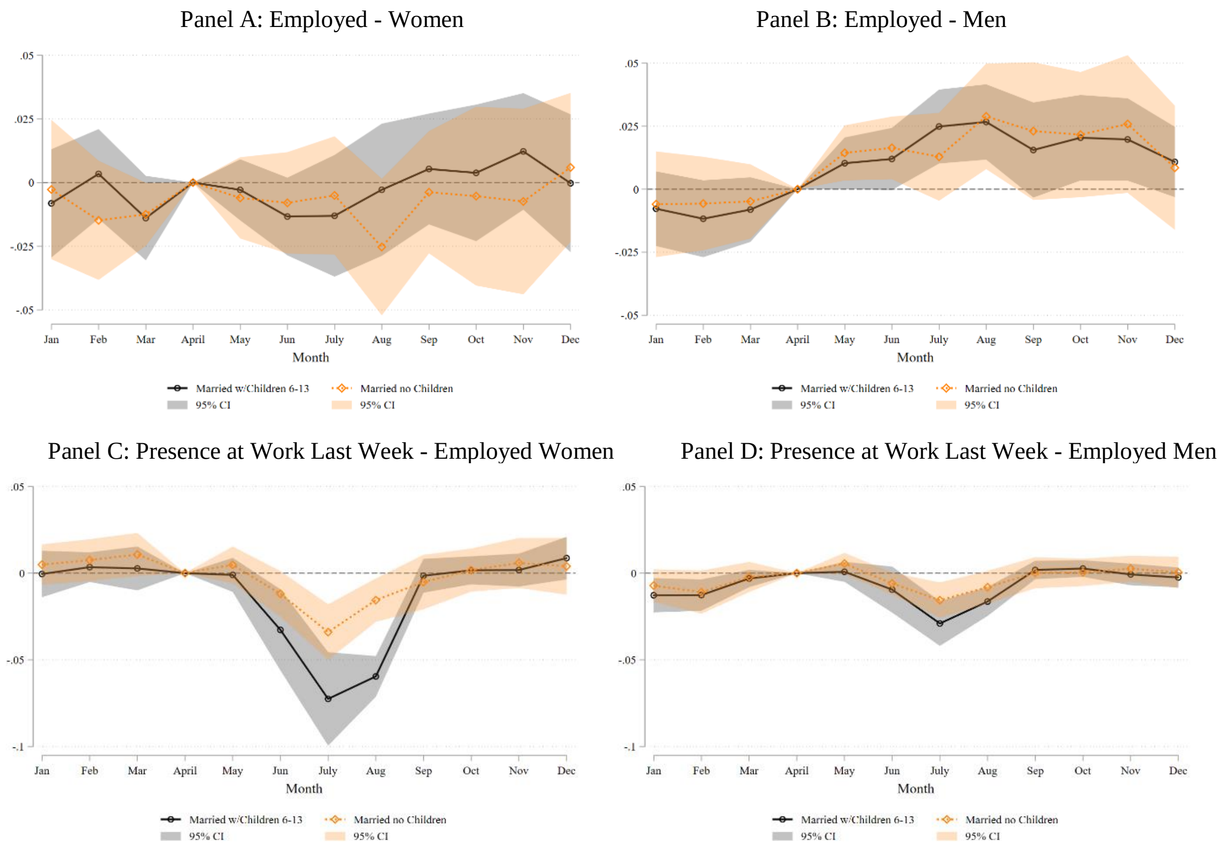
Source: Current Population Survey, 1982-2017. Each figure shows estimates of equation (6) from text on a subsample of the CPS as indicated (and as further defined in the text and appendix B). 95 percent confidence intervals calculated using cluster-robust standard errors clustered at the state level.

Figure 13: Monthly Labor Supply by Child Status Among Married Adults 25-44 With a High School Degree or Some College



(See notes to figure 12 above.)

Figure 14: Monthly Labor Supply by Child Status Among Married Adults 25-44 With a Less Than a High School Degree



(See notes to figure 12 above.)

mothers with a high school degree or some college exhibiting only slightly larger declines in July). The similarity in labor supply responsiveness to the summer break among married families suggests that the presence of two earners is a more important factor than the level of family income in terms of the propensity to provide direct summer child care. This is consistent with the existence of a quality preference over outside child care that is proportional to family income

In contrast to these findings, figure 14 presents a much different story of summer labor supply for married mothers with less than a high school degree, who do not reduce employment in a statistically significant manner in any month and who differ little from married childless women with the same education level. The precision in these estimates is notably lower, driven in large part by a much smaller sample (the sample size of married mothers with less than a high school degree is around 10 percent of the sample size of married women with a high school degree or some college), but even at the level of precision of the larger samples, the point estimates would be unlikely to be distinguishable between mothers and childless high school dropouts. Among male high school dropouts, there is a noticeable seasonality to the overall pattern of employment, with statistically significant increases in the summer months, which is likely occupational related, but no meaningful differences according to child status. In contrast with this lack of any employment response, there are declines in being present at work for high school dropout mothers relative to married childless high school dropouts (panel C) that are approximately as large as the other educational groupings. Among fathers, however, there is no meaningful evidence of a change in summer presence at work relative to married childless high school dropouts.

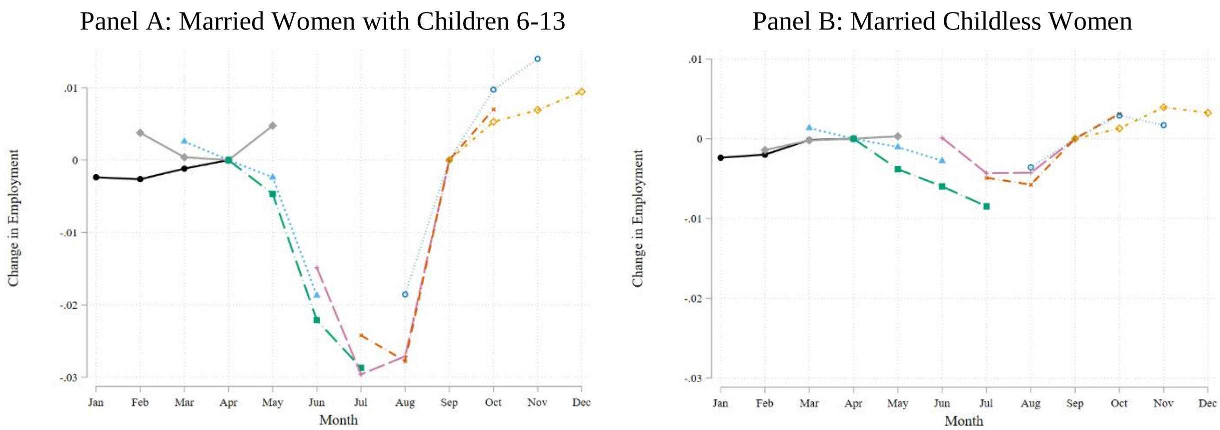
One potential interpretation of these employment patterns is that they do not represent a persistent behavior by mothers over the calendar year but, instead, are just evidence of a greater cross-sectional propensity for mothers to exit employment at the beginning of a summer break or enter at the end of a summer break and that these estimates represent the aggregation of these non-recurring tendencies. A complementary analysis that can help distinguish which of these two explanations is more likely uses the longitudinal structure of the CPS. A new cohort of CPS respondents enters the four-month interview cycle each month so that there is a cohort surveyed for four-month spans starting in each calendar month of the year. Each of these four months is assigned a sequential "month-in-sample." The first four-month cycle of interviews are months-in-sample one through four, while the second cycle of four monthly interviews are months-in-sample five through eight. This way of structuring the sample allows for estimation of an overlapping set of four-month, within-person estimates of employment across the calendar year. I generate these estimates using an individual fixed-effects regression model of the following form:

$$y_{imt} = \sum\nolimits_{k \neq 4} \beta_k * \mathbf{I}\left[k = \text{month}_{m \in \{1,2,3,4\}}\right] + \lambda_i + \delta_t + \epsilon_{imt}. \tag{18}$$

Here employment for individual *i* in month *m* and year *t* is regressed on individual fixed effects, year fixed effects, and a set of indicator variables for two sets of overlapping, four-month time sequences corresponding to the first and second half of the calendar year (the indexing in (18) uses the sequence of months January through April as an example, so that k, the omitted reference month, is the fourth month-in-sample for individual i). The set of estimates covering the months January to July uses months-in-sample one through four grouped as follows: January-April, February-May, March-June, and April-July. In each of these specifications, April is the common omitted month so that relative employment differences across the other three months are relative to this reference month. The second set of estimates use the following set of four-month sequences: June-September, July-October, August-November, September-December. These sequences all omit September as the common reference month.

Figure 15 presents these results for within-person estimates of differences in employment. Each series of estimates is denoted by a different color and symbol and the initial month-in-sample can be distinguished by the month corresponding to the start of the connected line. Panel A shows these changes for mothers of grade-school-aged children and traces out a within-person summer employment decline of around 2.8 percentage points, virtually identical to the results in panel A of figure 9. Panel B shows analogous results for childless married women,

Figure 15: Monthly Within-Person Employment Changes for Married Women Ages 25 to 44



Source: Current Population Survey data 1982-2017. Estimates of eight different 4-month employment changes are generated using an individual fixed effects model that additionally controls for age and survey year. The 4-month periods are Jan-Apr, Feb-May, Mar-Jun, Apr-July, Jun-Sep, Jul-Oct, Aug-Nov, and Sep-Dec. For the first four models, April is the common omitted month, for the latter four, September is omitted.

tracing out an approximately .5 percentage point decline, which is consistent with the cross-sectional results above as well. Notice that the estimates of the employment of respondents for whom June is the initial month-in-sample trace out a clear pattern of employment exit and reentry from June to September. These respondents provide useful evidence that this pattern is present within-person and is not a product of aggregating together single incidents of exit timed to match the end of the school year and single incidents of entry with the beginning of the school year.

Overall, analyses in Figures 9 through 15 paint a picture of significant differences in employment and presence at work over the summer between mothers of school aged children and childless women. The magnitude of these differences varies by both marital status and education, likely reflecting a combination of differences in child care productivity, own wage, spousal earnings, and outside child care costs across mothers. Differences in non-pecuniary job aspects such as vacation time, and leave-taking policy may also play a role (Glauber 2011)**.**

2.6 Changes in Maternal Summer Labor Supply Across Time

Given the increasing propensity of mothers to work over the post-war period, it is interesting to assess whether the pattern of summer labor supply reductions documented above has evolved over time. Through the 1980s, the labor force participation of married mothers rose by around 15 percentage points. This increase likely reflects multiple factors including changes in the career opportunities available to women (Goldin 2006), change in the composition of maternal age (Buckles, Guldi and Schmidt 2019), and changes in marriage patterns (Saluter and Lugaila 1996).

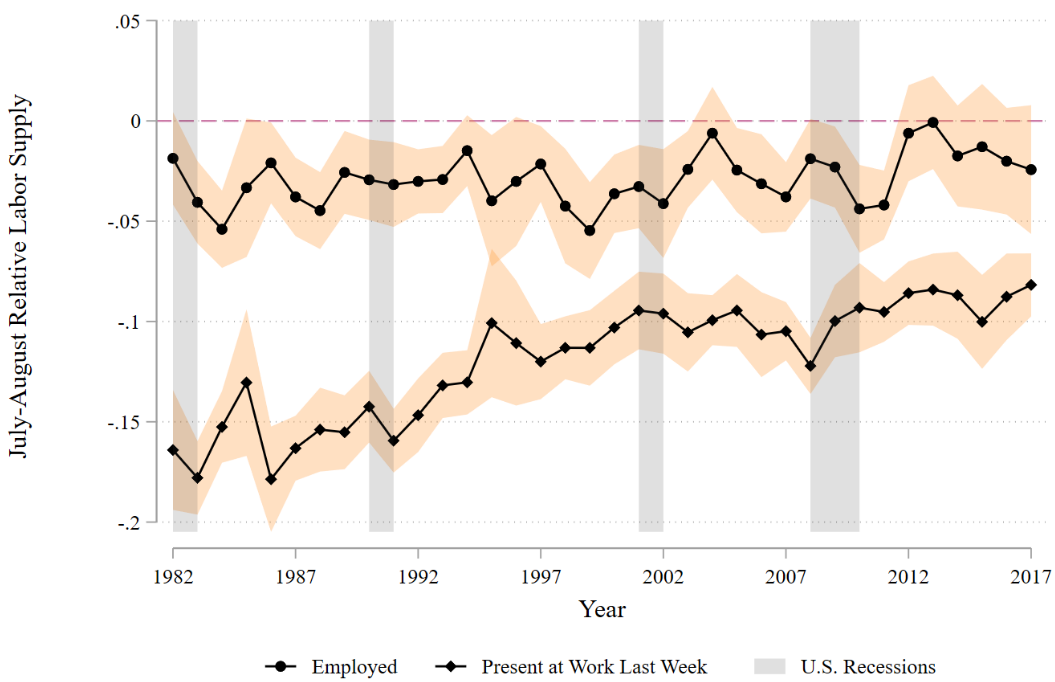
To explore this possibility of secular changes in summer reductions in maternal labor supply, I estimate a simple model that regresses a labor supply outcome on a dummy variable equal to 1 for the months of July and August and zero otherwise for each single survey year in the CPS data from 1982 to 2017.[43] I also include state fixed effects to control for permanent differences in maternal labor supply related to economic and demographic differences that may vary by state (for example, in 1990 the married maternal employment rate, as defined in this analysis, was .68 in Massachusetts but was .61 in California), and age fixed effects to control for compositional changes in the cross-sectional age of the sample in each year (e.g., the aging of Baby Boomers). The model is

$$y_{iast} = \pi\ summer + \gamma_a + \theta_s + \lambda_n + \mathbf{\Gamma X_i} + \epsilon_{iast}, \text{ for each } t \in \{1982, 1983, \ldots, 2016, 2017\}. \quad (19)$$

[43] I omit June due to the fact that most summer break start dates vary widely across this month.

Figure 16 presents results for the relative difference in employment over the summer months from 1982 to 2017. The connected lines plot year-by-year estimates of the relative summer labor supply level as indicated in the legend and the shaded orange area denotes the 95% confidence interval for each series of estimates. While year-to-year variation in the negative differences in employment for these months are sometimes as large as 2.5 to 3 percentage points, the general pattern across this 35-year period is a reduction in the magnitude of these

Figure 16: Time Series of Relative Summer Employment Status Among Married Mothers 25-44 with Children All Between Ages 6-13



Source: Current Population Survey. Figure shows results from a sequence of annual regressions of each labor supply outcome on an indicator variable for the months of July and August as well as state and age fixed effects. The comparison period for each estimate is the same labor supply outcome during the months of November to May.

employment declines from around 4 percentage points (or around 6.5 percent from a mean employment level of 0.62) to around 2.5 percentage points (or around 3.5 percent from a mean employment level of 0.72). A more striking pattern is observed when the outcome is being present at work last week for employed mothers. In the early 1980s, the seasonal difference was around 18 percentage points. In the most recent years, this difference has decreased to around 8 percentage points.

To assess whether this smaller effect over time reflects a secular decline in responsiveness to the summer break across all mothers or consistently different levels of responsiveness to the summer break across different generations of mothers, I split the sample into two birth cohorts and estimate the average labor supply responsiveness of each. The first cohort consists of women born between 1958 and 1967; the second comprises women born between 1968 and 1977. This division of the sample by birth-year allows me to observe all women in both cohorts between the ages of 24 and 40. For each of these samples, I generate a series of estimates of annual summer labor supply reductions according to the age of a mother's youngest child from the first year of the child's life until her 15th year.[44] This exercise, then, traces out the average child-life-cycle responsiveness of mothers to the summer break.

I obtain estimates of labor supply measures across summer months by regressing employment or presence at work on an indicator for the months of July and August with November through May as the omitted comparison months. As in previous models, I include fixed effects for maternal age, a, state, s, number of children, n, year, t, maternal educational attainment and race/ethnicity. The model is

$$y_{iacst} = \pi\ summer + \gamma_a + \theta_s + \lambda_n + \delta_t + \mathbf{\Gamma}\boldsymbol{X_i} + \epsilon_{iacst}, \text{for each } c \in \{1, 2, \dots, 14, 15\}. \quad (20)$$

[44] I use youngest child here since the theoretical model focuses on younger child years as the key time for a mother to substitute away from the labor market. Estimates of this exercise using age of oldest child show a qualitatively similar pattern.

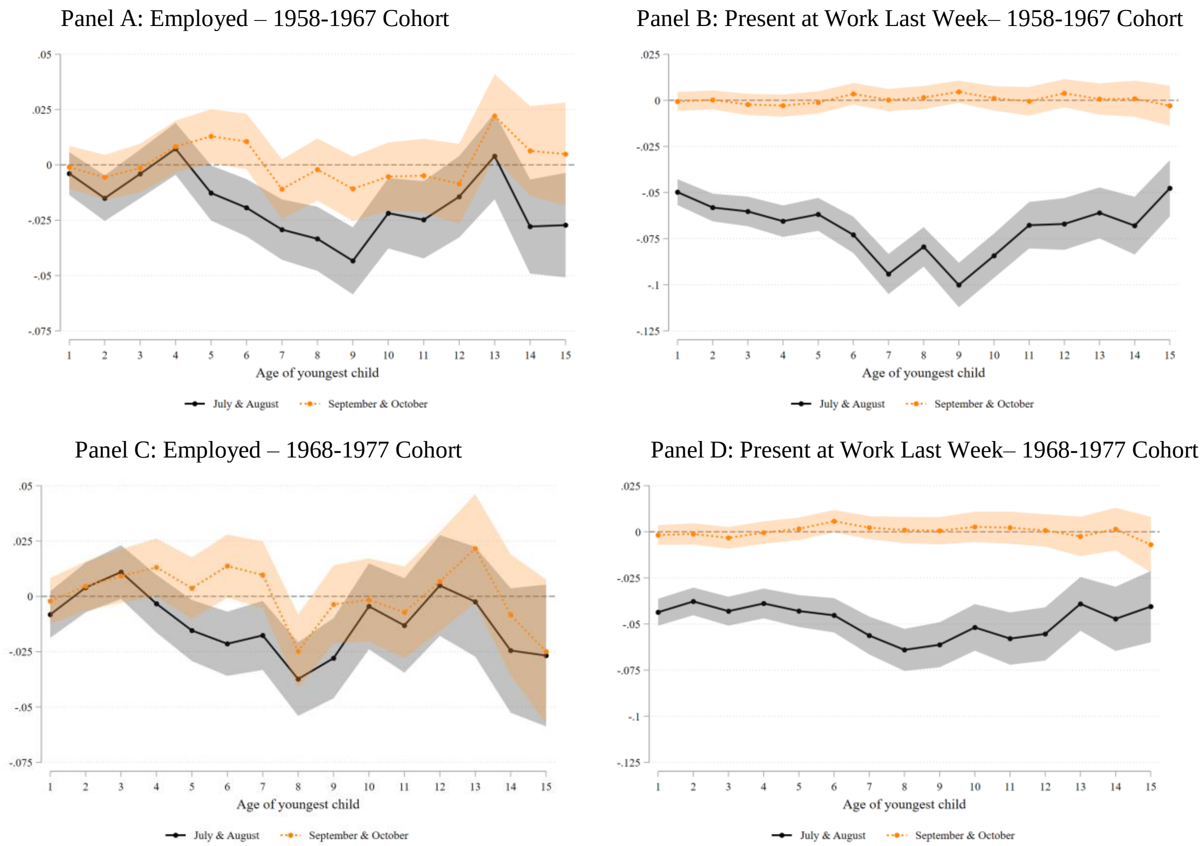
c is the age of the mother's youngest child. The estimates for π, an indicator variable for July and August, are plotted together into a single curve across the child's first 16 years of life. I also generate placebo estimates by regressing each outcome on an indicator for the months of September and October with the same omitted comparison months. Both these sets of estimates are plotted together to allow visual comparison of the relative differences in summer and fall labor supply. To follow the analysis in the latter panels in figures 9 and 12 above, I omit teachers from the analysis of presence at work (they are included when the outcome is employment).

Figure 17 presents results for these two ten-year birth cohorts of women from the CPS. The employment estimates for the older cohort in panel A show a significant dip beginning when the youngest child turns 5. This summer decline in employment reaches its maximum magnitude (nearly 4 percentage points) between the youngest child's 7^{th} and 9^{th} years and recovers back to zero by the time the youngest child reaches age 12. There is no evidence of a similar pattern during the fall months.[45] The estimates for summer presence at work show a decline that follows a similar path to the employment estimates across the youngest child's age, going from around a 5-percentage point decline in presence at work during the summer months prior to the youngest child turning 5 to a nearly 9-percentage point decline by age 7 before recovering to the initial relative difference by the time the youngest child is 15.

For the employment outcomes of the younger birth cohort in panel C, there is evidence of attenuation of both the magnitude and persistence of the employment decline. The average magnitude of the decline between youngest child years 7 through 9 is smaller and the estimated decline is not distinguishable from zero by the time the youngest child turns 10. In panel D,

[45] Notably, there is a statistically significant positive maternal employment response to a child turning age 5, when she is first eligible for schooling.

Figure 17: Summer Versus Spring Employment Status Among Married Mothers 25-40 by Age of Youngest Child Using 10-Year Birth Cohorts



Source: Current Population Survey, 1982-2017. Results are from a series of cross-sectional regressions (stratifying the analysis sample by the presence of a youngest child of the age indicated on the x-axis) of the indicated labor supply outcome on an indicator variable for summer months (July and August) age and year fixed effects, and controls for non-white, Hispanic, and indicators for holding a bachelor's degree or being a high-school dropout. Regressions use women in each indicated 10-year birth cohort between the ages of 25 and 40 (this lower maximum age cutoff is chosen since the 1968-1977 birth cohort can be no older than 41 in 2017).

presence at work, the magnitude of the negative difference over the summer during youngest child years of age 7 to 10 is around 25 to 30 percent smaller than for the older birth cohort.

Together, these results suggest that the negative labor supply responses associated with summer break may differ in important ways according to permanent differences in labor force attachment across generations, and that the propensity of mothers to reduce labor supply over the summer months may be declining across subsequent generations. This pattern is consistent with both changes in the composition of mothers by age, education and other characteristics, and changes in occupational opportunities holding constant maternal characteristics, which may have increased returns to continuous tenure and overall experience and, thus, the cost of interrupting employment or reducing presence at work during the summer break. To consider the relative magnitude of these two causes of the smaller labor supply response to the summer break, table IX provides a variety of descriptive statistics for both maternal birth cohorts. The sample in this table includes not only married mothers, but all mothers in these birth cohorts. This larger sample is used so that the marriage rate among mothers can be included to allow consideration of the role that changes in selection into marriage across the cohorts used in the analysis in figure 17 may be a factor in the observed differences in labor supply.

These cohorts, spanning 20 years, are quite similar in terms of age of first fertility, number of children, marriage rates (though marriage declined around 4 percent across cohorts), employment and hours worked. There was a large increase in educational attainment in the second birth cohort, with the rate of mothers with a bachelor's degree or higher increasing by 38 percent (from 24 percent to 33 percent). There was also a notable racial and ethnic shift in the composition of mothers to more non-White and Hispanic mothers over time. These factors suggest a meaningful role for changes in the composition of married mothers in these differences in responsiveness to the summer break. But there was also a 23 percent increase in weekly composition of mothers to more non-White and Hispanic mothers over time. These factors suggest a meaningful role for changes in the composition of married mothers in these differences

Table IX: Mean Characteristics of Mothers in Older and Younger CPS Birth Cohorts

	(1) 1958-1967 Cohort		(2) 1968-1977 Cohort	
	Mean	SD	Mean	SD
Age at 1st Birth	24.56	[5.06]	24.75	[5.28]
Number of own household children	2.19	[1.03]	2.21	[1.06]
Married	0.77	[0.42]	0.74	[0.44]
Bachelor's Degree +	0.24	[0.42]	0.33	[0.47]
Some College	0.30	[0.46]	0.30	[0.46]
Less than HS Degree	0.11	[0.31]	0.10	[0.31]
Non-White	0.18	[0.39]	0.21	[0.41]
Hispanic	0.12	[0.33]	0.19	[0.39]
Employed	0.69	[0.46]	0.67	[0.47]
Usual Hours Worked Last Week	23.21	[19.73]	22.77	[19.66]
Family Income	64,774	[43,439]	75,328	[58,756]
Weekly Earnings	598	[418]	738	[527]
Observations	75,345		68,212	

Source: Current Population Survey monthly basic survey data from IPUMS. Data covers survey years 1982-2017. Family Income uses PCE deflator (2012 dollars). Means are calculated using CPS weights. Observations report actual number of respondent-year observations.

in responsiveness to the summer break. But there was also a 23 percent increase in weekly earnings (with no change in hours of work), pointing to significant changes in occupational opportunities across cohorts. Estimates of cross-cohort increases in weekly earnings, holding constant educational attainment, are between 10 and 16 percent suggesting that broad-based changes in the returns to employment may have played the most important role in the diminished response to the summer break across younger and older cohorts.

2.7 Summer Break and Maternal Experience, Earnings, and Occupational Selection

Past research on the gender wage gap has shown that there exist important differences in job tenure, the accumulation of total experience, and occupational selection that partly explain gender differences. But prior research has failed to consider how changes in labor supply around the summer break affects these measures of labor force engagement. In this section, I provide evidence on the types of jobs associated with maternal labor supply reductions over the summer break, the role of these reductions in observed differences in the accumulation of overall hours of work experience (O'Neill and Polachek 1993, Blau and Kahn 2007), and the association between summer employment interruptions and earnings, i.e., the "motherhood penalty" (Budig and England 2001, Avellar and Smock 2004, Staff and Mortimer 2012, Juhn and McCue 2017, Glauber 2018, Jee, Misra and Murray-Close 2019). I also assess the relationship between the employment interruptions and occupational switching.

2.7.1 Occupations Associated with Summer Labor Supply Reductions

The results in section 2.5 document that there are significant labor supply interruptions that occur within the year. Further results in section 2.6 shown that differences in education and birth cohort matter. In this section, I assess whether differences in occupational choice are associated with declines in summer employment.

Using CPS data, Table X compares the top 25 occupations among married mothers aged between 25 and 44 with children all aged 6 to 13 who persistently reduce summer employment with the top 25 occupations among all employed women aged between 25 and 44.[46] The left-hand column lists the top occupations among mothers with a high school degree or less who persistently exit employment during the summer break. (For comparison, appendix B, table XXVI presents the top 25 occupations among all women ages 25 to 44 by educational attainment.) The top three occupations represented—teacher's aides, child care workers, and bus drivers—are all jobs that have a direct link with the summer break. The prevalence of these occupations among mothers with school-aged children who exit employment in the summer

[46] "Persistently" is defined as non-employment in July or August for two consecutive years for women otherwise employed in one or more non-summer months. This measure is described in more detail in Section 2.7.4 and Appendix B.

Table X: Maternal Occupations Among Women Who Interrupt Employment Over the Summer Break

High School Degree or Less		Some College or More	
Occupation Description	Pct.	Occupation Description	Pct.
Teacher's aides	18.4	Primary school teachers	31.2
Child care workers	11.4	Teacher's aides	12.9
Bus drivers	9.2	Secondary school teachers	7.7
Cooks, variously defined	5.6	Child care workers	6.7
Cashiers	5.5	Kindergarten & earlier school teachers	5.6
Misc food prep workers	4.7	Secretaries	4.3
Primary school teachers	4.4	Bookkeepers, accounting, auditing clerks	3.6
Salespersons, n.e.c.	4.0	Special education teachers	3.4
Secretaries	3.7	Subject instructors (HS/college)	2.6
Nursing aides, orderlies, & attendants	3.3	Teachers , n.e.c.	2.2
Janitors	3.3	Salespersons, n.e.c.	1.8
Textile sewing machine operators	3.0	Misc food prep workers	1.7
Housekeepers, maids, butlers, stewards	2.5	General office clerks	1.6
Kindergarten & earlier school teachers	2.3	Bus drivers	1.6
Bookkeepers, accounting, auditing clerks	2.2	Accountants & auditors	1.5
Waiter's assistant	2.1	Managers & administrators, n.e.c.	1.4
Managers & administrators, n.e.c.	1.9	Nursing aides, orderlies, & attendants	1.4
Farm workers	1.9	Designers	1.2
Retail sales clerks	1.8	Receptionists	1.2
Farmers (owners & tenants)	1.6	Door-to-door, street sales, & news vendors	1.1
Typists	1.5	Waiter/waitress	1.1
Stock handlers	1.5	Administrative support jobs, n.e.c.	1.1
Door-to-door, street sales, & news vendors	1.5	Cooks, variously defined	1.1
Supervisors & proprietors of sales jobs	1.5	Cashiers	1.0
Kitchen workers	1.2	Supervisors & proprietors of sales jobs	1.0
Unique respondents:	242	Unique respondents:	345

Source: Current Population Survey, 1982-2017. Tabulations represent the top 25 occupations (using the "occ1990" variable) among married mothers aged between 25 and 44 with children all aged between 6 and 13 of the indicated education group who report at least one month of summer non-employment and one month of fall employment in both rounds of the CPS survey.

Table XI: Maternal Occupations Among Women Who Reduce Presence at Work Over the Summer Break

High School Degree or Less		Some College or More	
Occupation Description	Pct.	Occupation Description	Pct.
Teacher's aides	25.3	Primary school teachers	39.1
Secretaries	11.3	Secondary school teachers	14.8
Child care workers	8.4	Teacher's aides	8.4
Cooks, variously defined	6.2	Kindergarten & earlier school teachers	8.2
Misc food prep workers	4.4	Special education teachers	5.8
Bus drivers	4.0	Registered nurses	3.7
Cashiers	3.5	Secretaries	2.6
Kindergarten & earlier school teachers	3.5	Vocational & educational counselors	1.9
Waiter's assistant	3.2	Subject instructors (HS/college)	1.7
Bookkeeper, accounting, & auditing clerks	3.0	Speech therapists	1.5
Managers & administrators, n.e.c.	2.9	Teachers, n.e.c.	1.4
Hairdressers & cosmetologists	2.8	Child care workers	1.4
Administrative support jobs, n.e.c.	2.2	Librarians	1.3
General office clerks	2.1	Social workers	1.2
Salespersons, n.e.c.	2.0	Managers in education & related fields	1.2
Machine operators, n.e.c.	2.0	Managers & administrators, n.e.c.	1.1
Nursing aides, orderlies, & attendants	1.6	Bus drivers	0.7
Waiter/waitress	1.5	Waiter's assistant	0.6
Textile sewing machine operators	1.5	Cooks, variously defined	0.5
Receptionists	1.5	Misc food prep workers	0.5
Primary school teachers	1.5	Receptionists	0.5
Janitors	1.5	Financial managers	0.5
Supervisors & proprietors of sales jobs	1.4	Physicians	0.5
Crossing guards & bridge tenders	1.4	Supervisors & proprietors of sales jobs	0.5
Production checkers & inspectors	1.3	Library assistants	0.5
Unique respondents:	574	Unique respondents:	1,657

Source: Current Population Survey, 1982-2017. Tabulations represent the top 25 occupations (using the "occ1990" variable) among married mothers aged between 25 and 44 with children all aged between 6 and 13 of the indicated education group who report non-presence at work in the week prior to being surveyed during at least one summer month and presence at work in the week prior to being surveyed during at least one fall month in both rounds of the CPS survey.

relative to their prevalence among women more generally (together these three occupations cover nearly 40 percent of mothers who exit over the summer while representing less than 10 percent of all women ages 25 to 44) suggests a meaningful role for occupational selection among less-educated mothers. The right-hand column, which displays the top occupations among mothers with some college or higher who persistently exit employment during the summer, presents a similar picture. The top five occupations—primary school teachers, teacher's aides, secondary school teachers, child care workers, and kindergarten and pre-k teachers—cover over 60 percent of mothers who exit over the summer, while they represent the occupations of only around 20 percent of women ages 25 to 44.

Table XI presents analogous results for presence at work during the summer break among employed mothers with school-aged children. Teacher's aides represent a quarter of mothers with a high school degree or less with a decreased presence at work during the summer break. The fact that teacher's aides are the top occupation for both categories is consistent with this job being a common conduit into teaching.[47] Additionally, both temporary and permanent status is common among teacher's aide jobs.[48] But occupations not explicitly associated with the summer break are more prevalent among less-educated mothers along this dimension of labor supply, particularly various food service workers, salespeople, and cashiers. This distribution of occupations more closely resembles the occupational distribution of jobs held by all prime-age women (after teacher's aide, the next four most common occupations among mothers not present at work over the summer break represent 30 percent of such mothers and represent 23 percent of all occupations among all women 25 to 44). This greater similarity suggests that occupational

[47] See, e.g., https://www2.ed.gov/programs/transitionteach/index.html for information on formal programs to transition teacher's aides, or paraprofessionals, into teaching.
[48] The NYC public school system, for example, requires paraprofessionals to begin as substitutes for a least 25 days of service.

selection may play a relatively less important role in inframarginal differences in labor supply (as measured above by presence at work) among less-educated mothers. By contrast, the incidence of non-presence at work among employed mothers of school-aged children with some college or higher is clearly defined by occupations with a direct connection to the summer break. The top six such occupations are teaching-related positions and together they represent over 70 percent of these mothers who reduce their labor supply over the summer months, while only representing the occupations of around 20 percent of all women.

Table XII presents descriptive evidence on the earnings differences between the 10 most common occupations associated with reduced maternal labor supply over the summer break and the 15 most common occupations that follow (i.e., splitting the ranked lists of occupations in tables 3 and 4). In each case the top 10 occupations are representative of 50 percent or more of the women contributing to the top 25 occupations, so this splitting of the sample represents roughly the median occupation among women holding these occupations. The top two panels present earnings measures for occupations associated with breaks in employment over the summer break for women with some college or more and women with a high school degree or less. The second two panels present similar means for the measure of non-presence at work. Each panel presents means and standard deviations for weekly earnings, usual hours worked in the week prior to being surveyed, and the ratio of the two, a measure of average earnings per hour of work. It is the third measure, since it accounts for differences in hours, that I focus on. Average hourly earnings for the top 10 occupations associated with summer employment exits among mothers with some college or more (panel A) are substantially higher than the next 15 occupations (40 percent). There is little difference in average hourly earnings for more educated mothers in terms of occupations associated with reduced presence at work over the summer months (panel C). Panel B shows that average hourly earnings associated with the top 10 occupations among mothers with a high school degree or less who exit employment over the summer are also higher than the next 15 occupations (19 percent). In contrast, for occupations associated with reduced summer presence at work among mothers with a high school degree or less, there appears to be a substantial penalty associated with the top 10 occupations (an average hourly earnings difference of nearly 70 percent. Notably, with the exception of panel B, the dispersion of average hourly earnings is substantially lower in each case for the top 10 occupations. In panels A and C, this is likely mechanically related to predominance of teaching occupations, which have collectively bargained salaries based primarily on tenure.

Table XII: Earnings of Occupations Associated with Summer Labor Supply Reductions

	(1)	(2)	(3)	(4)
	Top 10 Occupations		Next 15 Top Occupations	
	Mean	SD	Mean	SD
Panel A: Some College or Higher (Employment Measure)				
Weekly Earnings	378.45	[136.25]	270.81	[195.84]
Usual Hours Worked Last Week	16.67	[2.59]	13.54	[6.00]
Hourly Earnings	22.82	[7.25]	26.65	[42.96]
Panel B: High School Degree or Less (Employment Measure)				
Weekly Earnings	264.06	[139.06]	222.21	[142.89]
Usual Hours Worked Last Week	15.79	[4.07]	16.09	[7.36]
Hourly Earnings	16.15	[4.84]	13.98	[7.09]
Panel C: Some College or Higher (Presence at Work Measure)				
Weekly Earnings	796.51	[222.26]	756.16	[472.03]
Usual Hours Worked Last Week	19.76	[1.85]	18.81	[6.81]
Hourly Earnings	40.30	[11.03]	37.12	[12.55]
Panel D: High School Degree or Less (Presence at Work Measure)				
Weekly Earnings	301.25	[106.18]	504.29	[208.94]
Usual Hours Worked Last Week	15.42	[3.99]	22.83	[5.08]
Hourly Earnings	19.61	[4.53]	22.09	[7.55]

Source: Current Population Survey, 1982-2017. Columns (1) and (2) are unweighted estimates of the mean and standard deviation of the indicated measure for women working in the top 10 occupations associated with summer labor supply reductions (by incidence among CPS respondents for the indicated measure in each panel using the “occ1990” variable). “Hourly Earnings” is the ratio of Weekly Earnings over Usual Hours Worked Last Week.

Together, these results suggest that occupational selection may be a significant factor among mothers desiring to reduce summer labor supply. Many of the most common jobs associated with this behavior are much less common among women broadly. The fact that these jobs do not, in general, appear associated with a large earnings penalty, but appear to be associated with a lower dispersion in earnings would likely be a positive influence on women selecting into these jobs, and is broadly consistent with a Roy model of occupational selection, as discussed in section 2.4 above.

2.7.2 Evidence on the Accumulation of Work Experience from the NLSY

Another important question that arises from the documented decline in summer employment is how much these declines affect work experience and tenure. Work experience and tenure are important determinants of earnings and are fundamental to analyses of wage growth and gender wage gaps. The summer employment decline has the potential to be a significant influence on these outcomes.

I begin the analysis of the effect of summer labor supply reductions on the overall accumulation of hours worked using National Longitudinal Survey of Youth 1979 data (NLSY79). The NLSY79 is an annual (or biannual) longitudinal survey that follows approximately 12,000 respondents born between 1957 and 1964 from their young adult years to the present. Respondents are surveyed on a remarkable variety of topics including detailed demographic and background information, educational attainment, marital and fertility history. To date, approximately 80 percent of initial respondents have remained in the survey and have been followed by researchers for over 35 years.

A weekly work history documenting employment status and hours worked is also compiled from survey responses to labor force participation questions. Answers to questions about what weeks a respondent was employed in a job by a given employer in the period since she was last surveyed, and the usual hours associated with each job held are combined by NLSY personnel to create a matrix of weekly labor force status and weekly hours worked. This work history allows for useful exploration of seasonal variation in employment within-person over a long period of time. I use these data to document several facts about differences in the accrual of parental work experience across pre- and post-childbirth years.

To maximize comparability among parents, I select a subsample of NLSY79 parents who have valid weekly work history data from 4 years prior to the birth of their first child to the time that child turns 14. This restriction leaves a sample of 5,704 unique respondents followed over an 18-year period. One important caveat about the work history in the NLSY79 is that respondents do not report on their week-by-week labor force status and hours. Instead, these weekly measures are constructed from retrospective answers to employment status across a span of time between surveys and usual hours worked associated with a given job. So the weekly hours measure does not capture actual weekly variation in hours worked due to flexible schedules, vacations, sick days, etc.[49] For this reason, the analysis below can only represent the accrual of the usual hours associated with employment tenure in a given job over time and not variation along the intensive margin within a job (as represented by the "presence at work" analyses in the CPS and further CPS-based analyses of actual hours worked below).

Panel A of table XIII provides descriptive statistics for married parents and for the considerably smaller group of unmarried parents in this panel.[50] To improve the precision of the estimates, means are generated by aggregating survey responses for each parent when their eldest

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[49] Specifically, this analysis uses the "HOURS WORKED" array in the work history module. A much more detailed explanation of the construction of this measure is given in https://www.nlsinfo.org/content/cohorts/nlsy79/other-documentation/codebook-supplement/nlsy79-appendix-18-work-history-data

[50] I define marital status as whether the respondent is ever married in the period they are in the panel.

child was between ages 5 and 9 (for this reason, the average child age in the table is 7). Over the 19-year period of this panel, the sum of this average difference in weekly hours worked leads to a total deficit in maternal hours worked relative to fathers of more than 13,000 hours.

Table XIII: Mean Characteristics of a Balanced Panel of National Longitudinal Surveys of Youth 1979 Parents

	(1) Mothers		(2) Fathers	
	Mean	SD	Mean	SD
Age	32.52	[4.85]	33.18	[4.89]
Employed	0.68	[0.47]	0.84	[0.37]
Avg Weekly Hrs Work	21.55	[19.27]	36.62	[20.85]
Bachelor's Degree +	0.34	[0.47]	0.28	[0.45]
Less than HS Degree	0.07	[0.25]	0.14	[0.34]
White, non-Hispanic	0.66	[0.48]	0.62	[0.49]
Total Family Income	18,112	[23,153]	41,902	[40,920]
Number of Children	1.92	[0.79]	1.93	[0.83]
Age of Eldest Child	7.00	[1.41]	7.00	[1.41]
Age of Youngest Child	4.49	[2.51]	4.57	[2.55]
Unique Respondents	2,478		2,608	

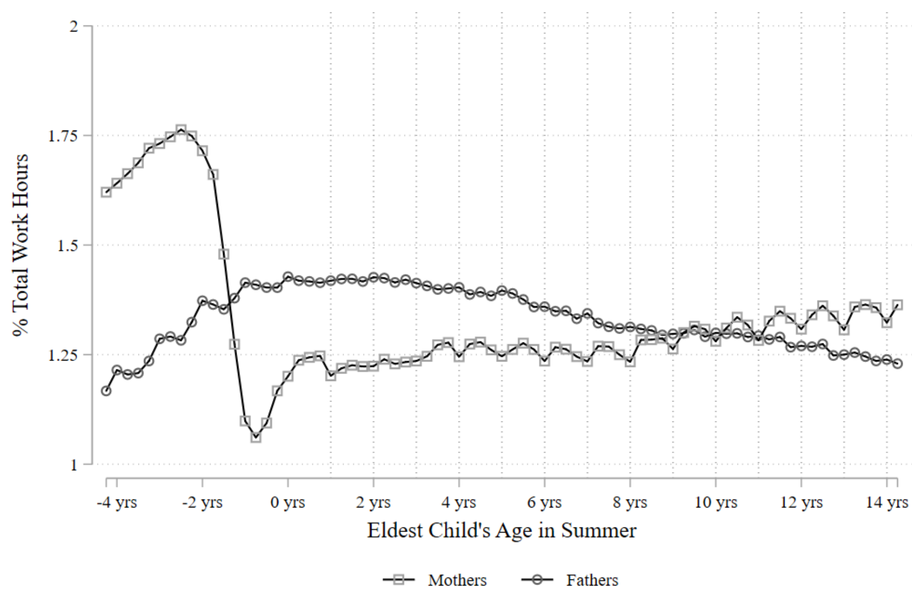
Source: National Longitudinal Survey of Youth 1979. The panel is constructed by keeping all respondents with years in the sample that span 4 years prior to the birth of the respondent's first child to the year the child reaches the age of 14. Family Income uses PCE deflator (2012 dollars). Unweighted means reported above are the average of observations when a parent's eldest child is between 5 and 9 years of age.

In figure 18, I aggregate the 18 years of weekly work history of these respondents into "seasons" of 13 weeks with spring defined as roughly March through early June (weeks 10-22), summer defined as roughly June through August (weeks 23-35), fall as roughly September through mid-November (weeks 36-48) and the remaining weeks defined as winter.[51] The x-axis measures the time in years of child age from 4 years prior to the birth of a parent's eldest child until that child turns 14. Each tick on the axis is the summer season of the indicated child age.

[51] I accomplish this aggregation by generating seasonal indicators and then collapsing the (unweighted) data down to gender-by-marital-status-by-season-by-year level.

The dashed vertical lines indicate summers beginning at age 1 to allow for identification of summer differences in experience accrual. The y-axis plots the percent of total usual hours worked at all jobs during each 13-week season over this 18-year period. Below, for simplicity, I refer to this sum of hours of work as "experience."

Figure 18: Seasonal Accrual of Work Hours Among Married NLSY79 Parents from Four Years Before Birth of the Eldest Child Until Age 14



Source: NLSY79. Each point in figure presents seasonal percentage of total work hours accrued over a 19-year time period spanning four years before the birth of the parent's first child until that child turns age 14 for a balanced panel of parents with valid work history data over this time span. This restriction keeps a sample of 5704 respondents. Seasons are defined as 13-week periods as detailed in text. The y-axis shows the percent of total work hours over 76 seasons. Dashed vertical lines denote summers of indicated year of eldest child age.

The overall pattern for mothers in figure 18 makes clear that maternal work experience is acquired in a highly non-linear fashion that is significantly organized around childbirth. In the 3 years prior to the birth of the first child, a mother is acquiring experience at a seasonal rate that averages around 1.6 percent of the total over the 18-year span of the analysis. But in the year of the birth of her first child experience accrual declines sharply before returning to a gradually increasing level consistent with substitution towards market work as time with children becomes relatively less productive (as suggested in the theoretical model in section 2.4). But within this broad pattern, note that a clear and repeated dip in hours occurs over the summer beginning in the eldest child's fourth year. This pattern becomes more apparent beyond a child's sixth year and continues through the rest of the time series (note that, when the eldest child turns 14, the youngest child is 11 on average).

In contrast to this pattern, the experience of a father is accrued across the time span of these 18 years in an inverse U-shaped fashion that is highly consistent with canonical models of life cycle consumption (Browning and Crossley 2001). Notably, there is no evidence of a summer decline in labor supply at any time over the child's life. This striking difference in overall patterns of hours worked across the perinatal years and the early life of the child highlights the extent to which maternal labor supply is organized around childbearing and child rearing relative to the labor supply of fathers. The emergence of clear seasonal patterns in only maternal labor supply coinciding with the eldest child aging into grade school suggests that the summer break may be an important factor in these differences.

2.7.3 <u>Evidence on Accumulation of Hours of Work Experience from the CPS</u>

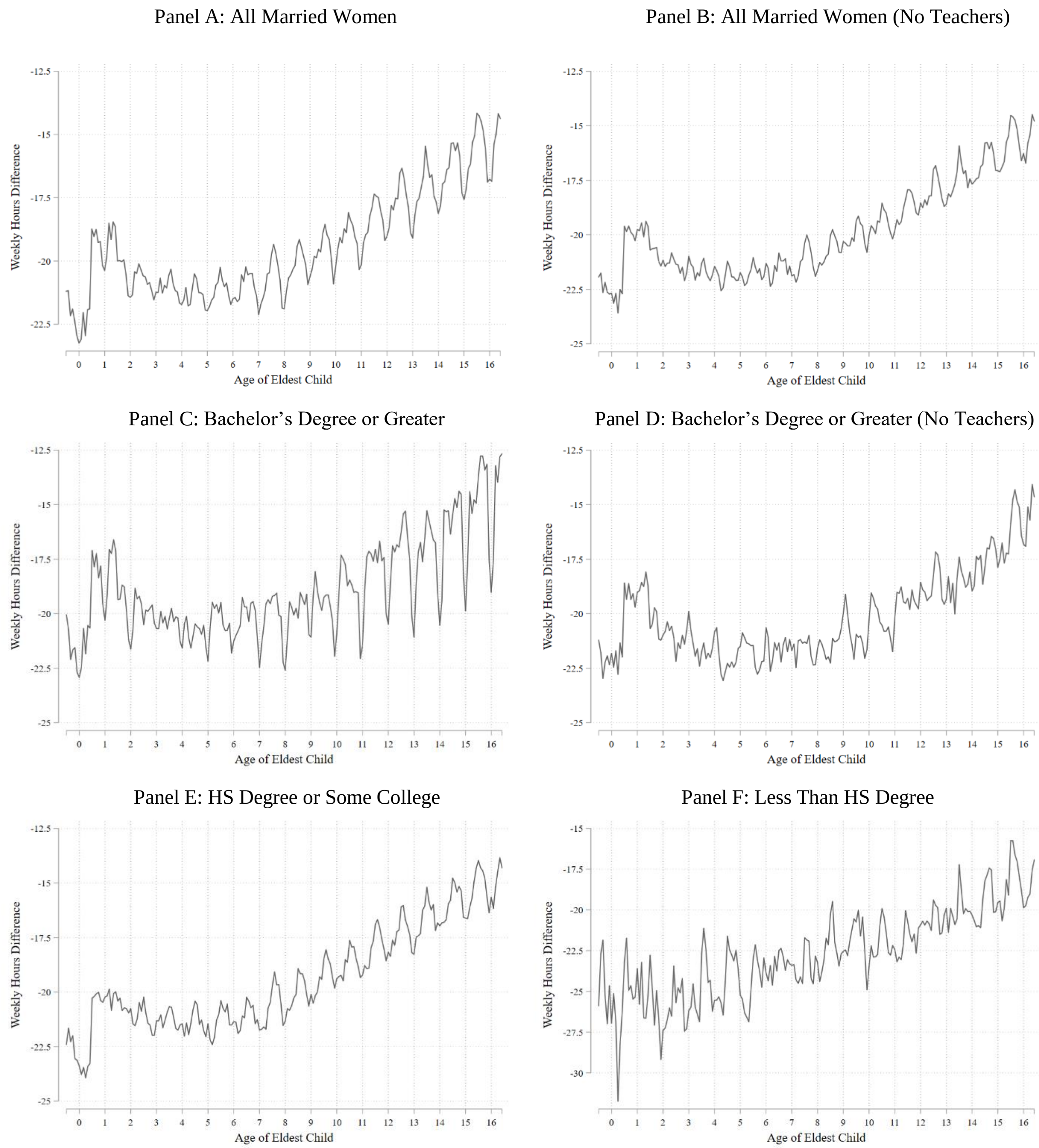
An alternate approach to estimating seasonal differences in the accrual of parental work experience by gender is to use hours differences from the CPS in a household synthetic cohort framework. This approach has three notable benefits: 1) the CPS records actual hours worked in particular week of a given month, which reflects not only hours changes associated with extensive margin employment changes, as in the NLSY data, but also intensive margin hours differences among employed persons; 2) measuring within-family differences in hours worked accounts for the joint nature of household labor supply decisions and the extent of specialization in household production versus market work that obtains within a household, as well as reflecting potential substitution within-family in hours worked according to changing circumstances around child care or other factors (for instance, a father may increase hours to facilitate a decrease in hours by a mother to accommodate a change in child care needs); 3) the much larger CPS sample size allows for meaningful analysis of subsamples stratified by educational attainment.

From CPS respondents surveyed between 1989 to 2017, I select a sample of married, cohabiting parents.[52] I then difference their actual hours worked in the week prior to being surveyed and collapse this set of observations (monthly within couple differences in hours worked) down to form a synthetic panel with each cell representing one month of age in the life of the eldest child (and using the mother's CPS person weight). Panel A of figure 19 plots the time series of the eldest child's life from birth to age 16 on the x-axis, with the dashed lines indicating child's age in July. The y-axis measures the magnitude of the average within-household difference in total hours worked in the week prior to being surveyed (maternal hours minus paternal hours) among families with an eldest child of the indicated age.

For the full sample of married women between ages 25 and 44 with children between ages 6 and 13 (panel A), the broad pattern presented is consistent with a significant maternal

[52] The variable that I use as the outcome for this exercise, total hours worked in the past week, was added to the survey in 1989.

Figure 19: Within-Household Differences in Hours Worked Among Married Parents from Birth of First Child Until Age 16



Source: Current Population Survey, 1989-2017. Each figure plots mean values of within-family weekly hours worked differences (maternal hours minus paternal hours) for each month of the first 16 years of the life of the eldest child for the indicated level of maternal education. Means derived using CPS person weight for mother in each family.

hours gap in the earlier years of the eldest child's life, and a reduction in this hours worked gap of around 30 percent by the time the child reaches age 16. Note that there is evidence of a summer hours gap almost immediately after childbirth, but beginning around age 5, the increase in magnitude of the negative within-household summer hours difference grows from around 1 hour per week to around 2.5 hours per week by eldest child age 7 and remains between 2.5 to 3 hours per week through the eldest child's 16^{th} birthday.

It is important to note, however, that teachers make up a substantial plurality of college-educated women. Thus, it is important to see how much of the results in panel A are driven by this group. Panel B makes the same hours comparison among married couples ages 25 to 44 with children all ages 6 to 13 but excluding teachers (both female teachers, of which there are around 26,500, and male teachers, of which there are around 6,500). Doing this reduces the magnitude of the seasonal differences during grade school years by around half, but the relative increase around eldest child age 7 remains. To show this difference even more clearly, panel C stratifies the sample to include only college-educated mothers, while panel D makes the same restriction on educational attainment, but drops both mothers and fathers who are teachers. In panel C, the clear, persistent negative summer hours differences that emerge beginning around eldest child age 5 reach magnitudes as large as 5 to 7 hours per week, or up to 60% or more of the overall gap. However, when teachers are excluded, the pattern of summer reductions in hours all but disappears. Thus, the college-educated contribution to within-household summer hours differences (unconditional on employment) appears to come almost entirely from teachers, as suggested in the analysis on occupational selection above.

Panel E compares within-household hours differences for the subset of married mothers with a high school degree or some college. Here the pattern of a negative summer hours difference that emerges around age 5 is again apparent, with the within-year (i.e. winter to summer) difference in differences becoming as large as 2 to 2.5 hours per week. In panel F, I stratify the sample to keep those with less than a high school diploma. Here the overall noisiness of within-family hours differences dominates any pattern related to the summer break.

To assess the magnitude of the differences suggested by these graphical analyses numerically, table XIV aggregates differences in hours worked during the non-summer months together, compares this seasonal average difference with the summer difference and adds up the cumulative effect of summer hours reductions on overall differences in experience, as measured by work hours, across the eldest child's life cycle. For each year of eldest child age, the table shows the average age of the youngest child (for brevity, this is shown only for the first group, mothers with a high school degree or some college, but it is very similar for the other two groups), the average maternal age at each year of eldest child age, the average within-household seasonal difference in hours across fall, winter, and spring (i.e., the average 13-week hours difference for the non-summer seasons), and the average additional summer hours difference at each year of eldest child age.[53] At the bottom of the table, these differences are summed. The table provides this breakdown for three subsamples, mothers with a high school degree or some college (I omit mothers with less than a high school degree since this group shows no meaningful evidence of summer hours reductions in multiple prior analyses), all mothers with a bachelor's degree or higher, and the subsample of college-educated mothers who aren't teachers.

[53] Note that, while the age of the eldest child spans 16 years, the average maternal age only spans 9 to 11 years across the various subsamples analyzed. This compression of the relative maternal age reflects the changing patterns of fertility by age over the 28 years of CPS data used here. More recent CPS surveys contribute disproportionately more to the observations of younger eldest child ages, making the average age of these mothers relatively older than the average age of mothers of eldest children in their teen years.

Table XIV: Within-Family Maternal Seasonal Hours Differences by Child Age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	HS Degree or Some College				Bachelor's Degree +			Bachelor's Degree + (No Teachers)		
Eldest Child Age	Avg Age Youngest Child	Avg Maternal Age	Avg Non-Summer Hrs Diff	Addtnl Summer Hrs Diff	Avg Maternal Age	Avg Non-Summer Hrs Diff	Addtnl Summer Hrs Diff	Avg Maternal Age	Avg Non-Summer Hrs Diff	Addtnl Summer Hrs Diff
0	0	29	-296	-11	30	-274	-24	31	-287	-11
1	0	30	-262	-4	31	-225	-33	31	-245	-12
2	1	30	-270	-6	32	-249	-29	32	-267	-16
3	1	30	-275	-8	33	-261	-9	33	-282	6
4	2	30	-276	-8	33	-266	-11	33	-287	4
5	2	31	-277	-10	34	-262	-19	34	-285	-2
6	3	31	-274	-7	35	-263	-17	35	-289	4
7	3	32	-271	-12	35	-257	-27	35	-281	-5
8	4	32	-260	-18	36	-255	-33	36	-284	-9
9	5	33	-253	-15	36	-250	-18	37	-278	11
10	5	33	-244	-12	37	-243	-28	37	-270	-3
11	6	34	-237	-14	37	-236	-37	37	-262	-10
12	7	35	-225	-16	38	-222	-36	38	-252	-3
13	7	36	-217	-19	38	-215	-47	38	-242	-11
14	8	36	-210	-11	39	-206	-52	39	-236	-14
15	9	37	-197	-21	39	-193	-50	39	-223	-11
16	10	38	-189	-22	39	-171	-65	39	-195	-30
Total Hours & Average Summer % Diff			-4,233	-214		-4,048	-535		-4,465	-112
Observations (Individuals)			1,599,284 (328,746)			766,748 (150,368)			628,259 (128,184)	

Source: Current Population Survey (Basic Monthly) 1989-2017. See text for description of panel construction and estimation approach. Estimates use CPS person weights. Mean (weighted) hours per week of work over the time span in this analysis are 21.5 hours for mothers with a high school degree or some college (41.0 for compared fathers), 22.8 hours per week for mothers with a bachelor’s degree or higher (42.2 for compared fathers), and 21.5 for mothers with a bachelor’s degree or higher excluding families with a parent in teaching (42.3 for compared fathers). Correlations in parental educational attainment (using a dummy for the given maternal attainment) are as follows: high school degree or some college, 0.36, bachelor’s degree or higher, 0.54, bachelor’s degree or higher excluding teachers, 0.55.

I focus here on the pattern of additional summer hours differences. Among mothers with a high school degree or some college, from eldest child age 1, there is a small but increasing additional negative summer hours difference (column 4) from 4 hours when the eldest child is 1 to around 22 hours when the eldest child is 16 and the youngest child is an average age of 10. Over the full 17-year period, these differences add up to an additional 5 percent of the overall average seasonal hours gap of 4,233 hours (or an equivalent of 10 weeks of work relative to the cumulative average seasonal difference of 197 weeks). Among all mothers with a bachelor's degree or higher, this additional negative summer hours difference (column 7) is around 100 percent larger than for women with a high school degree or some college, a substantially larger gap. But columns 8 through 10, which excludes teachers from among college-educated mothers, shows that nearly 80 percent of this summer hours gap is due to the summer break associated with teaching. With this exclusion, the non-summer seasonal hours gap is nearly identical, but the additional summer hours gap is only a cumulative 112 hours, or around 5 weeks of work over 17 years.

Overall, these results suggest that, while the summer hours differences between mothers and fathers within-household are not trivial, they are not a major contributor to the cumulative differences in overall experience between mothers and fathers. Instead, the labor supply of mothers is significantly impacted by childbirth and is persistently lower in the following years, while childbirth has no meaningful effect on the labor supply of fathers. At a maximum, additional hours differences between mothers and fathers in the summer months account for around 10 percent of the average hours difference observed in non-summer seasons throughout the year, even including teachers, who drive a substantial part of this difference. Among mothers with a high school degree or some college, the summer difference accounts for around 5 percent of the overall gap in hours worked across the 17 years of the analysis.

2.7.4 Earnings and Occupational Selection

Thus far I have presented results showing meaningful declines in summer employment among married mothers with grade-school-aged children, as well as evidence that occupational selection may play an important role in this behavior. A natural question arising from these results is how are these patterns reflected in maternal earnings? The panel structure of the CPS can be used to generate descriptive estimates on this relationship. It is important to note, however, that such estimates may reflect a causal relationship running from labor supply choices to earnings, or may also reflect the opposite relationship, from potential earnings to labor supply (Gronau 1988, Korenman and Neumark 1992). In this section, I estimate the association between summer exits from employment and weekly earnings and also assess the role of occupational selection in the strength of these associations.

To estimate the correlation between summer employment breaks and subsequent earnings, and whether this correlation differs according to whether these breaks are persistent, I use the fact that the CPS follows respondents through two survey rounds one year apart. This allows me to estimate the association between the earnings observed during a respondent's final month in the CPS and both a more distant summer employment break and a more contemporaneous summer employment break. I can also assess whether exiting employment for two consecutive summers is associated with earnings in a distinct way as well. I use a subsample of married CPS respondents ages 25 to 44 with children all between ages 6 and 13 who are employed for at least one non-summer month in each round of the survey.

The regression model is

$$earnweek_{i,t_0} = \beta_1 nonemp_{i,t-1} + \beta_2 nonemp_{i,t_0} + \beta_3\left(nonemp_{i,t-1} \times nonemp_{i,t_0}\right)$$
$$+\theta_a + \gamma_n + \delta_t + \theta_r + \lambda_{\boldsymbol{o}} + \pi_1 faminc_{\boldsymbol{i},t_0} + \pi_2 faminc_{\boldsymbol{i},t_0}^{\boldsymbol{2}}$$
$$+\rho_1 hrs_{\boldsymbol{i},t_0} + \rho_2\, hrs_{\boldsymbol{i},t_0}^{\boldsymbol{2}} + \boldsymbol{\Gamma X_i} + \epsilon_{i,t_0}. \tag{21}$$

Weekly earnings (in deflated 2012 dollars) in the final month of a CPS respondent's time in the survey ("month-in-sample" 8) are regressed on age, number of children, year, region (and in some specifications, occupation) fixed effects, a quadratic term in hours worked in the week that the earnings outcome was measured, a quadratic term in annual family income for the second year of the respondent's time in the CPS, and a vector of individual controls (an indicator variable for non-white, a set of dummies for highest year of completed schooling, and a set of indicators for attaining a high school degree, associate's degree, bachelor's degree, and a PhD or professional degree). The regressors of interest are a pair of dummy variables indicating non-employment in at least one month during the summer months for those employed in at least one fall month for the first year and the second year the respondent was in the CPS, and their interaction. β_1 measures the association between summer non-employment in the initial four-month survey period ("months in sample" 1 through 4) and weekly earnings in the final month of the respondent's time in the survey. β_2 measures the association between summer non-employment in the second four-month survey period ("months in sample" 5 through 8) and the same weekly earnings measure. β_3, the interaction term, measures the association between two years of summer non-employment and the weekly earnings outcome. The week that earnings are measured is during a month of positive employment to avoid reflecting the mechanical effect of non-employment on earnings (weekly earnings are measured either one or two months after the episode of non-employment. So, in the model notation above, *t*-1 and t_0 denote years, not months. The construction of the non-employment measure is detailed in appendix B.

Conceptually, the idea behind this model is to first control for a variety of factors that may otherwise confound the association between the employment behavior of interest and earnings, and then to use the two indicators for summer non-employment spells to measure the association between earnings and both more distant and more recent interruptions to employment net of these factors. The interaction term is also included to measure the potentially differential association between more persistent seasonal employment interruptions and earnings (as opposed to single shocks to employment that are less likely to be associated with persistent child care preferences). If an occupation has a strong seasonal component built into it or employers view regular employment interruptions related to child care needs differently than other types of employment interruptions, then this interaction term may distinguish the effect of such jobs by being positive. If, on the other hand, summer employment interruptions simply represent a cumulative reduction in experience or tenure, then this term should be zero. For comparison, the analyses for mothers during summer and fall months are complemented by similar analyses for fathers to assess whether associations between summer employment interruptions and earnings are common across genders or differ, consistent with the notion of a "motherhood penalty" and a "fatherhood premium."

Table 15 presents estimates from (21) for both mothers and fathers in the summer and non-summer months. The estimated coefficients corresponding to β_1 and β_2 are, respectively, "Lower Summer Employment *t-1*," "Lower Summer Employment t_0," followed by the estimated coefficient on the interaction term between them. Columns (1) and (2) present results for models omitting and including occupation fixed effects. Analogous pairs are presented for mothers in the non-summer months, and fathers in summer and non-summer months in columns (3) through (8). Omitting occupation fixed effects, for married mothers (column (1)), both more distant and more recent summer employment interruptions are associated with statistically and economically significant earnings penalties of, respectively, 14 percent and 20 percent of mean earnings. The interaction term is relatively small and statistically indistinguishable from zero. Comparing this result with the results in column (3), the point estimates for more distant and more recent employment interruptions using the fall months are fairly similar (but somewhat smaller for more distant employment interruptions), but their interaction term is large and positive, equivalent to around 120 percent of the magnitude of the average of the two negative estimates and is relatively precisely estimated (p=.138). This difference suggests that persistent interruptions to employment over the fall months are associated with a lower earnings penalty than persistent interruptions over the summer.

Comparing these results with estimates from a model with occupational fixed effects (columns (2) and (4)), the estimated penalty associated with summer employment interruptions are both around 30 percent lower when differences are restricted to be within-occupation, suggesting a considerable difference across occupations in the extent to which earnings are penalized for child-related summer employment interruptions. The decrease associated with holding occupation constant for fall employment interruptions is smaller for same-year employment interruptions, and the larger, positive interaction term is not changed by occupational fixed effects (but is estimated more precisely). This difference in the importance of controlling for occupation across summer and fall spells of non-employment likely reflects the much greater incidence of jobs that are directly related to the summer break.

Table XV: The Association Between Summer Employment Exit and Weekly Earnings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mothers		Mothers		Fathers		Fathers	
Lower Summer Employment *t-1*	-99.1**	-64.1**			-39.7	-35.7		
	(19.6)	(19.8)			(50.0)	(51.2)		
Lower Summer Employment t_0	-142.3**	-96.7**			-169.2**	-156.8**		
	(26.6)	(26.6)			(48.3)	(47.3)		
Lower Summer Employment *t-1* & t_0 Interaction	28.3	-7.4			280.8**	279.4**		
	(42.6)	(41.9)			(95.4)	(89.6)		
Lower Fall Employment *t-1*			-62.5**	-34.0			-52.7	-29.2
			(21.8)	(20.9)			(61.4)	(63.5)
Lower Fall Employment t_0			-149.5**	-124.4**			-85.3+	-102.2*
			(29.6)	(31.0)			(51.6)	(52.0)
Lower Fall Employment *t-1* & t_0 Interaction			126.3	123.1+			436.6	463.4
			(85.2)	(72.8)			(396.7)	(396.3)
Occupation FEs	No	Yes	No	Yes	No	Yes	No	Yes
Mean Weekly Earnings	725	725	725	725	1,114	1,114	1,120	1,120
Weekly Hours	35	35	35	35	44	44	43	43
Observations	8,565	8,565	6,199	6,199	8,886	8,886	6,192	6,192

Source: Current Population Survey data from 1989-2017. Results are from a model regressing weekly earnings in year t_0 on fixed-effects for year, age, number of children, years of schooling, and region, in addition to a quadratic term in total family income, an indicator for non-white, a full set of years-of-schooling indicators, indicators for HS degree, AA degree, BA degree, MA degree, PhD/professional degree, an indicator for lower summer employment in year *t-1*, an indicator for lower summer employment in year t_0, and an interaction term between these two indicators. Earnings are deflated using a chained PCE deflator (2012 dollars). All regressions use CPS person-weights and heteroskedasticity-robust standard errors.

Comparing the estimates for fathers, the negative coefficients on more distant employment interruptions are between approximately 30 and 45 percent of the magnitude of the coefficients for mothers and, relative to mean earnings, they are much smaller still (around 3 percent). The negative association between earnings and contemporaneous interruptions is similar in magnitude to the coefficient for mothers (around 14 percent of mean earnings). But there is a striking difference in the interaction term, which is positive, large, and precisely estimated in columns (5) and (6). The magnitude of the interaction term is, in fact, large enough to make the overall association between persistent employment interruptions and earnings positive, consistent with the existence of a "fatherhood premium" (Glauber 2008, Killewald and Gough 2013, Glauber 2018, Weeden, Cha and Bucca 2016) among fathers who exit employment persistently in the summer months. Notably, occupational fixed effects make no difference in these associations. The estimates for distant and recent employment interruptions during the fall months are qualitatively similar, but somewhat smaller in magnitude. The interaction between them, while positive and larger in magnitude than for summer interruptions, is statistically insignificant.

These results indicate a large, negative association between summer non-employment and earnings among mothers, with no offsetting positive association with the persistence of this behavior. On the other hand, maternal fall spells of non-employment, while each associated negatively with earnings appear to be associated with an offsetting positive relationship when this relationship is persistent. These differences suggest that occupational selection may play a different role in jobs associated with summer non-employment. For fathers, on the other hand, persistent employment interruptions appear to be associated consistently with a positive earnings effect that offsets the negative relationship between both more distant and more contemporaneous interruptions to employment. Controlling for occupation plays no meaningful role in these associations for fathers, suggesting a fundamentally different earnings trade-off for mothers versus fathers in response to the needs of child care induced by the summer break.

2.7.5 Occupational Switching Associated with Summer Non-employment

Given the negative association between maternal reductions in summer employment and earnings, assessing whether these earnings reductions may be driven by a loss of occupation-specific human capital due to occupational switching across breaks in employment (Kambourov and Manovskii 2009, Sullivan 2010) is important. In table XVI, I present evidence on the extent to which summer reductions in employment are associated with occupational changes. I use the same measures of summer and non-summer employment interruptions used in section 2.7.4 above (discussed in further detail in appendix B). Since occupation during months of unemployment are coded as "unknown," I use the lagged occupation code from the prior month for these months of non-employment.[54]

Panel A of table XVI presents the percent of parents who have at least one month of non-employment in both the summer and non-summer months. The first two columns compare the incidence of lower summer employment (9.9 percent) among married mothers with children all between the ages of 6 and 13 with the incidence of lower non-summer employment (5.7 percent). The difference, -4.2 percentage points, is broadly consistent with estimates of summer employment exit by this group of mothers in Section 2.6 above. Columns (3) and (4) show a

[54] Fisher and Houseworth (2012) demonstrate evidence of "occupational inflation" in CPS occupation switches (e.g., nurses aides incorrectly reporting being a registered nurse during their sample period). However, they focused on reported changes in occupation over the break between months 4 and 5 in the sample (when respondents are not surveyed for 8 months). Regardless, to the extent occupational inflation may occur across sequential survey months, the validity of this exercise only requires that occupational misreporting not be correlated with summer (versus fall) spells of non-employment for the difference across these measures to be unbiased.

Table XVI: Incidence of Lower Summer Employment and Occupation Switching Among Married Parents of School-age Children in Summer and Non-Summer Months

	(1)	(2)	(3)	(4)
	Mothers		Fathers	
	Summer	Non-summer	Summer	Non-summer
Panel A: Incidence of Non-employment by Season				
Non-Employment Spell (%)	9.9	5.7	2.7	2.5
Respondents	39,689	31,841	42,024	33,976
Observations	205,518	168,237	221,736	182,646
Panel B: Incidence of Occupation Switching Conditional on Lower Summer Employment				
Occupation Switch (%)	66.3	73.6	61.5	63.5
Respondents	5,414	2,640	1,650	1,242
Observations	20,609	9,528	5,858	4,482

Source: Current Population Survey 1989-2017. Panel A presents (regression-based) means of the incidence of observing lower summer employment relative to non-summer months in columns 1 and 3, and the incidence of observing lower non-summer employment relative to other non-summer months (as described in text). Panel B presents (regression-based) means of the incidence of an occupational change conditional on having lower summer employment or lower non-summer employment (as described in text).

near-zero difference in summer employment for these fathers, also consistent with earlier regression-based estimates of employment by month.

Panel B shows the incidence of occupational switching conditional on having a break in employment for each gender by summer and non-summer (fall) breaks in employment.[55] For mothers who interrupt employment in the summer months, 66.3 percent of them switch occupations. This rate is more than 6 percentage points lower than the rate of occupation switching (73.6 percent) for mothers who interrupt employment in the non-summer months, consistent with a story that these summer exits from employment are less likely to be the result of unexpected shocks and may be more likely to be premeditated and perhaps undertaken with prior knowledge from employers. Among fathers, by contrast, there is no evidence of differences

[55] After substituting the lagged occupation for a subsequent month of non-employment coded as "unknown," I exclude respondents for whom either their pre- or post-exit occupation remain coded as "unknown."

in either the relative incidence of exits in summer or of occupational switching conditional on a break in employment and, in absolute terms, the rates of occupation switching during summer non-employment spells is the same across genders. So, while in absolute terms, it appears that the significant amount of occupation switching across these employment breaks may play a meaningful role in the observed earnings penalties accruing to mothers who exit in the summer, the comparisons with fathers, who switch occupations at identical rates across summer spells of non-employment, suggests that the economically large and significant difference in the association between persistent non-employment and earnings between mothers and fathers (i.e. the interaction term in (21)) cannot be explained by differences in occupation switching.

2.8 Changes in Time Use Associated with the Summer Months

Much of the analysis thus far has quantified changes in time spent in market work related to the summer break. However, underlying this focus is the idea that reductions in this use of time are reallocated to children. To motivate this exploration of the extent to which time not spent in employment is spent with children, I begin by considering the typical amount of discretionary time available for a parent to spend with children during the year.

The total time available in a year is 8760 hours (365 times 24). Assuming that children sleep for 9 hours per day leaves 5475 hours of potential child time. School days comprise around 180 days throughout the year, during which school time and associated travel represent around 8 hours per day. Subtracting this time leaves 4,035 hours. Assuming and subtracting off another 2 hours per day of time in routine activities (eating, bathing, grooming, dressing) leaves 3,335 hours.

Under the same assumption that a school day plus transit time is 8 hours, a 12-week summer break makes available 480 hours of potential child time. This is around 15 percent of the total discretionary time available with children throughout the year. Thus, parental responses to this stock of time with children may have significant effects on child development. The documented shift away from market work among mothers is highly suggestive of increased time with children, but parents may also substitute away from leisure towards child time even if they do not meaningfully reduce their time spent in market work.

I use data from the American Time Use Survey (ATUS) to provide evidence on how parents reallocate their time over the summer break. The ATUS is a 24-hour time diary completed by a subsample of CPS respondents after they complete the survey (around 12,000 per year). ATUS respondents are asked to recall in detail their time use (in minutes) on all activities in the 24-hour period prior to completing the survey.[56] Among the activities recorded in the survey are time spent working, time spent in household activities (which aggregates activities such as housework, cooking, yard care, home repair, and paying bills), time spent in all primary child care activities (which aggregates child related travel, caring for and helping household children, activities related to household children's education, and activities related to household children's health), and time spent providing "secondary child care," defined as the time a child under 13 was in a parent's care but during which time interacting with the child wasn't classified as the respondent's primary activity. This is a broad category that includes activities as disparate

[56] For more detail on the ATUS, see https://www.bls.gov/tus/overview.htm#1 and also Aguiar, Hurst, and Karabarbounis (2012).

as cooking dinner while a child watches television or reading to or speaking with a child while riding together on a train or bus.[57]

Since the ATUS sample is drawn directly from the CPS, I keep the restrictions used in the CPS analysis above (respondents ages 25 to 44 with children all aged 6 to 13). To assess the extent to which time use differences in the ATUS are likely to be representative of differences in time use among the larger CPS sample, table XVII presents direct comparisons of the means and dispersions of seven key demographic variables for both samples restricted to the ATUS survey years (2003-2017). Across married mothers, married fathers, and single mothers, the results suggest that the ATUS subsample is highly representative of the full CPS sample on key observables. The main difference is that college educated married mothers are modestly overrepresented in the ATUS sample and that, across all three groups, high school dropouts are somewhat overrepresented as well, particularly among single mothers.[58]

Table XVIII compares time use among the ATUS respondents across summer and non-summer months.[59] In each of the 3 panels the first two columns show the mean and standard deviation, in hours per week of time spent working, doing the indicated activity during the non-summer months. The second column shows the same statistics during the summer months (June through August) and the third column shows the difference in these means and the associated p-value of this difference. Means differences that are statistically significant at the 95 percent confidence level and their p-values are in bold.

[57] In many cases, child care is categorically subordinated to other activities. Travel and food preparation are examples. For more detail on the way respondents are prompted to count secondary child care, see Allard et al (2007).
[58] Hispanic ethnicity is also overrepresented among single mothers, likely due to the fairly strong correlation between Hispanic ethnicity and the probability of having less than a high school degree (.33).
[59] I define summer months as June through August and non-summer months as all other months except December and January (omitted because there is a significant break from schooling during these months that I cannot control for).

Table XVII: Mean Characteristics of CPS & ATUS Respondents, 2003 to 2017

	(1)		(2)	
	Mean	SD	Mean	SD
Panel A: Married Women Ages 25 to 44				
	With Children Ages 6 to 13 (CPS)		With Children Ages 6 to 13 (ATUS)	
Age	36.96	[4.76]	37.19	[4.71]
Employed	0.71	[0.45]	0.73	[0.45]
Bachelor's Degree	0.38	[0.49]	0.42	[0.49]
Less Than HS	0.07	[0.25]	0.10	[0.30]
Non-White	0.17	[0.38]	0.15	[0.35]
Hispanic	0.17	[0.37]	0.17	[0.38]
Family Income	89,828	[62,492]	89,126	[61,092]
Observations	317,342		5,068	
Panel B: Married Men Ages 25 to 44				
	With Children Ages 6 to 13 (CPS)		With Children Ages 6 to 13 (ATUS)	
Age	37.77	[4.54]	37.99	[4.58]
Employed	0.92	[0.27]	0.93	[0.25]
Bachelor's Degree	0.34	[0.47]	0.36	[0.48]
Less Than HS	0.09	[0.29]	0.13	[0.34]
Non-White	0.17	[0.38]	0.13	[0.34]
Hispanic	0.19	[0.39]	0.20	[0.40]
Family Income	87,579	[61,484]	88,452	[59,918]
Observations	265,175		3,715	
Panel C: Single Women Ages 25 to 44				
	With Children Ages 6 to 13 (CPS)		With Children Ages 6 to 13 (ATUS)	
Age	32.40	[4.90]	32.48	[4.79]
Employed	0.71	[0.45]	0.71	[0.45]
Bachelor's Degree	0.13	[0.34]	0.12	[0.33]
Less Than HS	0.13	[0.33]	0.23	[0.42]
Non-White	0.45	[0.50]	0.43	[0.50]
Hispanic	0.21	[0.41]	0.25	[0.43]
Family Income	38,051	[36,961]	38,188	[38,508]
Observations	80,401		1,341	

Source: CPS monthly basic survey data from 2003-2017. ATUS survey data from 2003-2017. Family Income uses PCE deflator (2012 dollars). Means are calculated using CPS and ATUS survey weights. Observations report actual number of respondent-year observations.

Table XVIII: Differences in Time Use of ATUS Respondents in Summer and Non-summer Months

	(1) Non-summer Months		(2) Summer Months		(3)	
	Mean	SD	Mean	SD	Difference	p-value
Panel A: Married Mothers with Children All Aged 6-13						
Work Hours/Wk	22.59	[20.32]	19.08	[20.68]	**-3.51**	**0.001**
Household Activities/Wk	12.09	[11.40]	13.18	[12.14]	1.09	0.083
Primary Child Care Hrs/Wk	9.95	[8.51]	7.62	[8.70]	**-2.34**	**0.000**
Secondary Child Care Hrs/Wk	21.86	[16.65]	32.23	[22.74]	**10.36**	**0.000**
Observations	1,470		620			
Panel B: Married Fathers with Children All Aged 6-13						
Work Hours/Wk	36.48	[19.97]	35.64	[19.63]	-0.84	0.494
Household Activities Hrs/Wk	5.20	[8.54]	5.25	[8.10]	0.05	0.914
Primary Child Care Hrs/Wk	4.62	[6.53]	3.87	[7.07]	-0.75	0.066
Secondary Child Care Hrs/Wk	16.05	[15.31]	19.04	[19.04]	**2.99**	**0.008**
Observations	1,034		441			
Panel C: Single Mothers with Children All Aged 6-13						
Work Hours/Wk	23.85	[19.97]	21.21	[21.19]	-2.65	0.268
Household Activities Hrs/Wk	8.30	[8.83]	7.74	[8.73]	-0.56	0.541
Primary Child Care Hrs/Wk	7.53	[8.34]	5.92	[7.39]	-1.62	0.126
Secondary Child Care Hrs/Wk	20.04	[16.38]	27.78	[23.37]	**7.74**	**0.002**
Observations	424		168			

Source: American Time Use Survey (2003-2017). Regression-based mean differences use ATUS person weights and robust standard errors. Observations are actual respondent counts.

For married mothers of children all aged 6 to 13, there are statistically significant differences in every category except household activities. These mothers reduce their work hours during the summer months by 15 percent on average, consistent with the reductions observed in the larger CPS sample. Married mothers also reduce time spent on primary child care activities during the summer months by 23 percent. However, they increase time spent in secondary child care by nearly 50 percent. Notably, the majority of parental time with children during non-summer months is also classified as secondary child care (over 70 percent).

In panel B, married fathers record no statistically significant differences in work hours, household activity hours, or primary child care hours, but increase secondary child care time by

19 percent. These results suggest that, on average, married parents increase net child care time by around 10 hours per week, or by 20 percent relative to total child care time in the non-summer months. Note that a mother's market work time and primary child care time together only decrease by around half as much as secondary child care time increases. Given that primary child care time is mutually exclusive of secondary child care time and that work time is most likely exclusive of child care time, mothers likely shift time away from not only work, but also either draw time away from leisure or other activities relative to the non-summer months or combine child care with these activities. Married fathers have no statistically distinguishable reduction in time spent working or providing primary child care, so their increase in secondary child care time also appears to be produced in a similar fashion.

Table XVIII also highlights the different time constraint faced by single mothers. These mothers (panel C) record no statistically significant reduction in work hours, household activity hours, or primary child care hours. But they spend nearly 8 more hours per week on average providing secondary child care time, an increase that is 75 percent as large as the increase among married mothers. Thus, it appears that, during the summer break, single mothers may draw time away from other activities or combine child care with them to a greater extent than married parents. This may result in important differences in the quality of maternal time spent with children over the summer break according to marital status.

Together, the results from this exercise point to a substantial increase in total time caring for children. Prima facie, the decrease in "primary" child care time may suggest that there is some substitution away from quality time with children. But among grade-school-aged children, much of primary child care time may measure direct parental participation in a school-related activities. Thus, a decrease in this time need not reflect a decrease in "investment" in children.

Many family activities, such as trips to a museum, park, or to spend time with friends, as well as most time spent talking with children, watching television together, etc. is coded as secondary child care in the ATUS. Thus, this increase likely reflects substantial additional child time investment over the summer months.

2.9 Evidence on Child Outcomes from the NLSY

Multiple results above indicate that market work time decreases and child care time increases in an economically and statistically significant way for mothers during the summer months. It is natural to ask if this additional time has an association with child development. While convincing causal evidence on the effect of additional time with children during the summer break (relative to market work and non-parental care) is difficult to produce due to the joint nature of the maternal labor supply and child time decision, it is worth considering whether descriptive evidence on this relationship is consistent with a story of summer maternal child care time having a causal effect on child behavioral and cognitive outcomes. I end this chapter with a preliminary analysis assessing the strength of the association between maternal labor supply and child outcomes. This subject is significant and far-reaching enough to fill several dissertations, but this brief analysis in the specific context of the summer break may provide initial motivation for such future work.

The ability to link NLSY79 data on mothers with longitudinal data on their children allows for such an analysis. The NLSY79 Child and Young Adult Survey (CYA) began in 1986 and has followed almost all children born to NLSY79 female respondents since. I link the NLSY79 maternal data with the NLSY79 CYA data (matching a mother’s annual or biannual data to each annual or biannual child observation in the CYA data). There were 4,641 mothers or future mothers in the NLSY79 in 1986, the year the CYA began. A total of 10,416 children in the CYA are matched to 4,470 of these mothers across the 28 years of the CYA.[60]

The CYA assesses respondents on a variety of relevant outcomes including a composite behavioral index score incorporating measures of antisocial behavior, anxiety/depression, dependent/immature behavior, hyperactive behavior, "headstrong" behavior, and peer conflicting behavior. The CYA also assesses children on cognitive measures including the Peabody Individual Achievement Test (PIAT), a standardized test assessing skills in mathematics, reading recognition, and reading comprehension.

To assess the strength of the relationship between the reductions in summer labor supply and child outcomes, I estimate a regression model that controls for a variety of potential confounders, including total hours worked over the year (which is directly linked to income), but allows the distribution of these hours across seasons to have an association with child outcomes. The model is,

$$\begin{aligned} y_{icjat} = springhrs_{jt} + summerhrs_{jt} + fallhrs_{jt} \\ + totalhrs_{jt} + \theta_a + \gamma_c + \delta_t + \mathbf{\Gamma} \boldsymbol{X_i} + \epsilon_{icjat}, \end{aligned} \qquad (22)$$

which assumes that the outcome of child *i* of mother *j* at in year *t* is a function of her total hours of work in year *t*, which determines an overall level of potential child time throughout the year, but is also a function of the relative seasonal composition of those hours across spring, summer, and fall relative to winter. The causal idea underlying this descriptive regression is that additional maternal time with grade-school-aged children during the summer may have a direct, positive effect on child educational or behavioral outcomes relative to non-maternal care. The model controls for mother's age fixed effects, θ_a, and child's age fixed effects, γ_c, and year fixed effects, δ_t, to control non-parametrically for common effects of age and time, and a set of

[60] Around 75 percent of the observations in the CYA data are in the 12-year span from 1986 to 1998.

maternal race/ethnicity and educational attainment dummies, $\boldsymbol{X_i}$ to control for the effect of these socioeconomic and demographic characteristics of mothers on this relationship.

Table XIX presents estimates from this model on the association between hours worked across seasons and child outcomes. The outcomes of interest are 3 measures of educational achievement from the PIAT and an index of behavioral problems, as discussed above.[61] In panel A, which uses a sample of all matched mothers and children, each row contains estimates of the effect of hours worked in a given season (spring, summer, or fall) relative to winter, the omitted time category. Each column is a PIAT outcome measure or, in column 4, the composite index of behavioral problems.

In column 1 of panel A, there is no statistically or economically significant association between variation in seasonal hours and PIAT math test scores for either spring or winter. However, each additional summer work hour is associated with a statistically significant .3 percent of a standard deviation lower test score (p=0.005). This pattern is present at marginal levels of statistical significance for the PIAT recognition and comprehension scores as well. For the index of behavioral problems, the same relationship holds with the opposite sign.

Given the well-documented parent-child education gradient (Guryan, Hurst and Kearney 2008, Ramey and Ramey 2010, Dotti Sani and Treas 2016, Kalil, Ryan and Corey 2012), it is also important to assess whether this relationship is present across different levels of maternal education. To explore this aspect of the results while maintaining sample sizes large enough to power findings of the magnitude suggested in the full sample, I split mothers into two roughly equal-sized educational attainment groups: those with a high school degree or less, and those

[61] I use versions of these outcomes that are normalized by child age. These measures have a mean of 100 and a standard deviation of 15. For more on this see https://www.nlsinfo.org/content/cohorts/nlsy79-children/topical-guide/assessments.

Table XIX: Relationships Between Maternal Work Hours by Season and Child Outcomes Among NLSY Families

	(1) PIAT Math	(2) PIAT Recognition	(3) PIAT Comprehension	(4) Behavioral Problems
Panel A: All NLSY79 Mothers				
Spring Work Hours	-0.001	0.002	-0.000	0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Summer Work Hours	-0.003^{**}	-0.002	-0.002^{+}	0.003^{**}
	(0.001)	(0.001)	(0.001)	(0.001)
Fall Work Hours	0.000	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Mean of Dep Variable	100.6	104.1	100.9	105
Mean Quarterly Hours	300	300	300	300
Observations	33,539	33,415	28,585	38,103
Panel B: NLSY79 Mothers with HS Degree or Less				
Spring Work Hours	-0.002	-0.001	-0.000	0.003
	(0.002)	(0.002)	(0.002)	(0.003)
Summer Work Hours	-0.005^{**}	-0.004^{*}	-0.002	0.005^{**}
	(0.002)	(0.002)	(0.002)	(0.002)
Fall Work Hours	-0.002	-0.001	0.000	0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Mean of Dep Variable	96.9	100.1	97.4	107.1
Mean Quarterly Hours	263	263	263	263
Observations	15,650	15,573	13,178	17,716
Panel C: NLSY79 Mothers with Some College or Higher				
Spring Work Hours	0.001	0.005^{+}	-0.001	-0.001
	(0.002)	(0.003)	(0.002)	(0.002)
Summer Work Hours	-0.002	0.000	-0.003	0.001
	(0.001)	(0.002)	(0.002)	(0.001)
Fall Work Hours	0.003	0.004^{+}	0.000	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Mean of Dep Variable	103.9	107.5	103.8	103.1
Mean Quarterly Hours	337	337	337	337
Observations	17,889	17,842	15,407	20,387

Data source: Matched NLSY79 / NLSY Child and Young Adult data. Panel A results are from a regression model of indicated outcomes on year, mother's age, and child's age fixed effects, education, race/ethnicity, total annual hours worked, and an exhaustive set of 13-week hours-worked totals across seasons (as defined in text) with winter hours as the omitted group. Robust standard errors in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

with some college education or more. These results are presented in panels B and C, respectively.

Using this stratification, all the negative associations between maternal labor supply and child outcomes appear to be concentrated among children of mothers with lower educational attainment. For mothers with a high school degree or less, the PIAT math score coefficient is nearly twice as large as in the full sample (-0.005 versus -0.003), the PIAT recognition score coefficient is twice as large and statistically significant at the 95 percent confidence level, and the behavioral problems index coefficient increases from 0.003 to 0.005. Interpreted causally, these results imply that a mother who reduces her summer hours from the mean for the season (263) to zero would increase her child's PIAT math score by 10 percent of a standard deviation and decrease her child's propensity to exhibit behavioral problems by the same amount. For mothers with some college and above, however, there is no statistically significant effect on any of the outcomes (the p-value for the most precise estimate, the PIAT math score coefficient, is 0.265). There are marginally statistically significant results for PIAT recognition, but these go in the "wrong" direction with respect to the hypothesized positive relationship between maternal time and academic achievement.

In considering these results, it is important to point out clearly that a causal interpretation requires a relatively strong conditional independence assumption. It is that, holding constant mother's age, education, race, and total annual hours of work, child's age and year, the seasonal hours measures in (22) above are independent of the error term. While this assumption is likely overly strong, the results are consistent with a causal story of transmission of cognitive and non-cognitive skills from parent to child that has been explored in other settings, some using plausible quasi-experimental approaches (Aizer 2004, Oreopoulos, Page and Huff Stevens 2003, Hsin and Felfe 2014, Dickson, Gregg and Robinson 2016). Allowing for the possibility that the relationship is causal, there are two important aspects of the setting that bear mentioning. The first is that the results may indicate that there is a stronger causal link between parental time and child outcomes among lower SES families, but that parents are constrained from exploiting this potential channel for increasing intergenerational mobility by workplace or other time constraints. Such a story is consistent with a positive gradient between SES and the "summer slide" suggests a potentially meaningful role for policies that improve the ability of families to increase child time over the summer.

However, data limitations in the NLSY may also affect these estimates when stratified by educational attainment. As mentioned earlier, the hours worked array in the NLSY work history data, from which these hours measures are calculated, simply marries a respondent's labor force status at a given job in a given week to the "usual hours" she reports working for a given job. So, in essence, NLSY mothers never take a vacation. The CPS estimates in section 2.5 suggested that there is a considerably larger decrease in work hours among college-educated employed mothers over the summer than among less-educated mothers. If this is the case, there may significant measurement error in the NLSY work history hours data that is non-random with respect to maternal education. If the summer work hours of college-educated mothers are measured with considerable error, this could explain the null results for summer work hours among this group. Future work using a large enough panel data set with actual hours worked (even at the monthly level) would provide a useful clarification on this ambiguity.

Regardless, however, this exercise points to a meaningful association between maternal work time during the summer break and child development. Bringing to bear a more thorough analysis using the NLSY data and further analysis using datasets that provide more accurate measures of actual summer hours worked would be a fruitful direction for future work.

2.10 Conclusion

This chapter provides the first comprehensive evidence of economically significant variation in the labor supply of mothers of school-aged children over the summer break in the social science literature. I explored several aspects of this relationship in order to provide a broad overview of the landscape of summer seasonality in maternal employment and provide non-causal but suggestive results on a variety of important aspects of this phenomenon.

Results indicated that married mothers decrease both employment and presence on the job in a way that is distinct from both married fathers and childless married women. These declines in labor supply are most clear for women with moderate to high levels of education and are generally not statistically distinguishable for the least-educated mothers. I also show that magnitude of the decline in summer maternal labor supply along both margins has decreased over time, most likely due to differential attachment to the labor force among older versus younger women (rather than trends over time affecting all mothers).

I documented that, while maternal summer labor supply reductions are economically meaningful, they are not the primary driver of the large differences in experience that develop between mothers and fathers over the school-age years of a child's life. Among mothers with a high school diploma or higher, reductions in labor supply over the summer break add a maximum of around 10 percent to the average seasonal deficit between these mothers and their spouses.

I provided evidence that occupational selection likely plays a meaningful role in explaining these observed labor supply differences. This is documented by comparing the occupations held by mothers who persistently exit employment or reduce their presence on the job over the summer break relative to all prime-age working women, where there is a higher incidence of both jobs directly related to the summer break (teachers, teacher's aides, bus drivers, child care workers) and jobs that require less individual-specific capital (cashiers, food service, and sales jobs). Additionally, the magnitude of regression-based estimates of the negative association between non-employment and earnings over the summer break is reduced substantially when controls for occupation are added. I also documented the incidence of occupational switching associated with summer spells of non-employment and showed that, though it is relatively high (around 65 percent), the incidence of occupation switching is actually lower among women who exit employment in the summer than in the non-summer months, suggesting a limited role for the loss of occupation-specific human capital in explaining the negative association between summer employment exit and earnings..

I provided evidence that time spent with children among both mothers and fathers increases appreciably during the summer break, but that the changes for mothers are much larger in magnitude and the single mothers increase child time substantially despite exhibiting no statistically significant decrease in work hours. Finally, I concluded by providing evidence that lower maternal work hours over the summer are associated with statistically and economically significant positive differences in child cognitive test scores and with declines in the incidence of behavioral problems. Though descriptive in nature, these results are consistent with a causal role for maternal time in the summer on child outcomes.

Fruitful directions for future work in this area would be to explore heterogeneity in summer maternal labor supply reductions according to the costliness of summer child care. The extent to which these reductions are sensitive to child care costs may have important implications for optimal policy around fostering maternal employment. Additionally, further exploration of the association between child outcomes and maternal time with children over the summer and, particularly, how this relationship may vary according to parental education, could have important implications for estimating the tradeoffs associated with home and market production among parents, and may also be a mechanism that can attenuate or amplify the transmission of cognitive and non-cognitive skills across generations.

2.11 Cited Literature

Aguiar, Mark, Erik Hurst, and Loukas Karabarbounis. 2012. "Recent Developments in the Economics of Time Use." *Annual Review of Economics* 4: 373-397.

Aizer, Anna. 2004. "Home alone: supervision after school and child behavior." *Journal of Public Economics* 88: 1835-1848.

Albrecht, James W., Per-Anders Edin, Marianne Sundström, and Susan B. Vroman. 1999. "Career Interruptions and Subsequent Earnings: A Reexamination Using Swedish Data." *The Journal of Human Resources* 34 (2): 294-311.

Allard, Mary Dorinda, Suzanne Bianchi, Jay Stewart, and Vanessa R. Wright. 2007. "Comparing childcare measures in the ATUS and earlier time-diary studies." *Monthly Labor Review.*

Anderson, Deborah, J., Melissa Binder, and Kate Krause. 2002. "The Motherhood Wage Penalty: Which Mothers Pay It and Why?" *American Economic Review* 92 (2): 354-358.

Augustine, Catherine H., Jennifer Sloan McCombs, John F. Pane, Heather L. Schwartz, Jonathan Schweig, Andrew McEachin, and Kyle Siler-Evans. 2016. *Learning from Summer: Effects of Voluntary Summer Learning Programs on Low-Income Urban Youth.* Santa Monica: RAND Corporation.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review: Papers and Proceedings* 96 (2): 189-194.

Autor, David. 2010. *The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings.* Center for American Progress and The Hamilton Project Working Paper.

Avellar, Sarah Avellar, and Pamela J. Smock. 2004. "Has the Price of Motherhood Declined Over Time? A Cross-Cohort Comparison of the Motherhood Wage Penalty." *Journal of Marriage and Family* 65 (3): 597-607.

Bailey, Martha J. 2012. "Reexamining the Impact of Family Planning Programs on US Fertility: Evidence from the War on Poverty and the Early Years of Title X." *American Economic Journal: Applied Economics* 4 (2): 62-97.

Barsky, Robert B., and Jeffrey A. Miron. 1989. "The Seasonal Cycle and the Business Cycle." *Journal of Political Economy* (University of Chicago Press) 97 (3): 503-534.

Baum, Charles L. 2002. "The Effect of Work Interruptions on Women's Wages." *Labour* 16 (1): 1-37.

Becker, Gary S. 1981. *A Treatise on the Family.* Harvard University Press.

Berger, Lawrence M., Christina Paxson, and Jane Waldfogel. 2009. "Income and child development." *Children and Youth Services Review* 21 (9): 978-989.

Bernal, Raquel, and Michael P. Keane. 2011. "Child Care Choices and Children's Cognitive Achievement: The Case of Single Mothers." *Journal of Labor Economics* 29 (3): 459-512.

Bertrand, Marianne, Claudia Goldin, and Lawrence F. Katz. 2010. "ynamics of the Gender Gap for Young Professionals in the Financial and Corporate Sectors." *American Economic Journal: Applied Economics* 2 (3): 228-255.

Black, Dan A., and Jeffrey A. Smith. 2006. "Estimating the Returns to College Quality with Multiple Proxies for Quality." *Journal of Labor Economics* 24 (3): 701-728.

Black, Sandra E., and Alexandra Spitz-Oener. 2010. "Explaining Women's Success: Technological Change and the Skill Content of Women's Work." *The Review of Economics and Statistics* 92 (1): 187-194.

Blakemore, Arther E., and Stuart A. Low. 1984. "Sex Differences in Occupational Selection: The Case of College Majors." *The Review of Economics and Statistics* 66 (1): 157-163.

Blau, David M. 1999. "The Effect of Income on Child Development." *Review of Economics and Statistics* 81 (2): 261-276.

Blau, David M. 1991. "The Quality of Child Care: An Economic Perspective." In *The Economics of Child Care*, 145-174. New York: Russell Sage Foundation.

Blau, Francine D., and Lawrence M. Kahn. 2007. "Changes in the Labor Supply Behavior of Married Women: 1980–2000." *Journal of Labor Economics* 25 (3): 393-438.

Borjas, George J. 1987. "Self-Selection and the Earnings of Immigrants." *American Economic Review* 77 (4): 531-553.

Bound, John, and Sarah Turner. 2007. "Cohort crowding: How resources affect collegiate attainment." *Journal of Public Economics* 91 (5-6): 877-899.

Brewer, Dominic J., Eric R. Eide, and Ronald G. Ehrenberg. 1999. "Does It Pay to Attend an Elite Private College? Cross-Cohort Evidence on the Effects of College Type on Earnings." *The Journal of Human Resources* 34 (1): 104-123.

Browning, Martin, and Thomas F. Crossley. 2001. "The Life-Cycle Model of Consumptionand Saving." *Journal of Economic Perspective* 15 (3): 3-22.

Buckles, Kasey, Melanie E. Guldi, and Lucie Schmidt. 2019. *Fertility Trends in the United States, 1980-2017: The Role of Unintended Births.* Working Paper Series, Cambridge: National Bureau of Economic Research. https://www.nber.org/papers/w25521.

Budig, Michelle J., and Paula England. 2001. "The Wage Penalty for Motherhood." *American Sociological Review* 66 (2): 204-225.

Bureau of Labor Statistics. 2018. *Employment Characteristics of Families.* News Release USDL-18-0589, Bureau of Labor Statistics.

Cappelli, Peter. 1993. "Are Skill Requirements Rising? Evidence from Production and Clerical Jobs." *ILR Review* 46 (3): 515-530.

Chin, Tiffani, and Meredith Phillips. 2004. "Social Reproduction and Child-rearing Practices: Social Class, Children's Agency, and the Summer Activity Gap." *Sociology of Education* 77 (3): 185-210.

Cooper, Harris, Barbara Nye, Kelly Charlton, James Lindsay, and Scott Greathouse. 1996. "The Effects of Summer Vacation on Achievement Test Scores: A Narrative and Meta-Analytic Review." *Review of Educational Research* 66 (3): 227-268.

Corcoran, Mary, and Greg J. Duncan. 1979. "Work History, Labor Force Attachment, and Earnings Differences between the Races and Sexes." *The Journal of Human Resources* 14 (1): 3-20.

Cortés, Patricia, and Jessica Pan. 2016. *When Time Binds: Returns to Working Long Hours and the Gender Wage Gap among the Highly Skilled.* Bonn: IZA Discussion Paper Series #9846.

Crouter, Ann C., and Susan M. McHale. 1993. "Temporal Rhythms in Family Life: Seasonal Variation in the Relation Between Parental Work and Family Processes." *Developmental Psychology* 29 (2): 198-205.

Cunha, Flavio, and James Heckman. 2007. "The Technology of Skill Formation." *American Economic Review Papers and Proceedings* 97 (2): 31-47.

Cunha, Flavio, James Heckman, and Susanne Schennach. 2010. *Estimating the Technology of Cognitive and Noncognitive Skill Formation.* Cambridge: National Bureau of Economic Research Working Paper #15664.

Del Boca, Daniela, Christopher Flinn, and Matthew Wiswall. 2014. "Household Choices and Child Development." *The Review of Economic Studies* 81 (1): 137-185.

Dickson, Matt, Paul Gregg, and Harriet Robinson. 2016. "Early, Late or Never? When Does Parental Education Impact Child Outcomes?" *The Economic Journal* 126 (596): F184-F231.

Doepke, Matthias, and Fabrizio Zilibotti. 2017. "Parenting With Style: Altruism and Paternalism in Intergenerational Preference Transmission." *Econometrica* 85 (5): 1331-1371.

Dotti Sani, Giulia M., and Judith Treas. 2016. "Educational Gradient in Parents' Child-Care Time Across Countries, 1965-2012." *Journal of Marriage and Family* 78 (4): 1083-1096.

Duncan, Greg J., and Richard J. Murnane. 2016. "Rising Inequality in Family Incomes and Children's Educational Outcomes." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 2 (2): 142-158.

England, Paula, Jonathan Bearak, and Michelle J. Budig. 2016. "Do Highly Paid, Highly Skilled Women Experience the Largest Motherhood Penalty?" *American Sociological Review* 81 (6): 1161-1189.

Fairchild, Ronald A., and Matthew Boulay. 2002. "What if Summer Learning Loss Were an Education Policy Priority?" *Association for Public Policy Analysis and Management Fall Research Conference.*

Fisher, Jonathan, and Christina Houseworth. 2012. *Occupation Inflation in the Current Population Survey.* CES Working Paper #12-26, Washington DC: U.S. Census Bureau Center for Economic Studies.

Flood, Sarah, Miriam King, Renae Rodgers, Steven Ruggles, and J. Robert Warren. 2018. "Integrated Public Use Microdata Series, Current Population Survey: Version 6.0 [dataset]." Minneapolis, MN.

Gershenson, Seth. 2013. "Do Summer Time-Use Gaps Vary by Socioeconomic Status?" *American Educational Research Journal* 50 (6): 1219-1248.

Glauber, Rebecca. 2011. "Limited Access: Gender, Occupational Composition, and Flexible Work Scheduling." *The Sociological Quarterly* 52 (3): 472-494.

Glauber, Rebecca. 2008. "Race and Gender in Families and at Work: The Fatherhood Wage Premium." *Gender & Society* 22 (1): 8-30.

Glauber, Rebecca. 2018. "Trends in the Motherhood Wage Penalty and the Fatherhood Wage Premium for Low, Middle, and High Earners." *Demography* 55 (5): 1663-1680.

Goldin, Claudia. 2014. "A Grand Gender Convergence: Its Last Chapter." *American Economic Review* 104 (1): 1091-1119.

Goldin, Claudia. 2006. "The Quiet Revolution That Transformed Women's Employment, Education, and Family." *American Economic Review: Papers and Proceedings* 96 (2): 1-21.

Goldin, Claudia, and Claudia Olivetti. 2013. "Shocking Labor Supply: A Reassessment of the Role of World War II on Women's Labor Supply." *American Economic Review: Papers & Proceedings* 103 (3): 257-262.

Goldin, Claudia, and Joshua Mitchell. 2017. "The New Life Cycle of Women's Employment: Disappearing Humps, Sagging Middles, Expanding Tops." *Journal of Economic Perspectives* 31 (1): 161-182.

Goldin, Claudia, and Lawrence F. Katz. 2002. "The Power of the Pill: Oral Contraceptives and Women's Career and Marriage Decisions." *Journal of Political Economy* 110 (4): 730-770.

Goldin, Claudia, and Lawrence Katz. 2016. "A Most Egalitarian Profession:Pharmacy and the Evolution of aFamily-Friendly Occupation." *Journal of Labor Economics* 34 (3): 705-746.

Gordon, James, Chris M. Herbst, and Erdal Tekin. 2018. *Who's Minding the Kids? Experimental Evidence on the Demand for Child Care Quality.* Bonn: IZA Institute for Labor Economics Discussion Paper Series 11985.

Greenwood, Jeremy, Nezih Guner, and Guillaume Vandenbroucke. 2017. "Family Economics Writ Large." *The Journal of Economic Perspectives* 55 (4): 1346-1434.

Gronau, Reuben. 1988. "Sex-Related Wage Differentials and Women's Interrupted Labor Careers-the Chicken or the Egg." *Journal of Labor Economics* 6 (3): 277-301.

Guryan, Jonathan, Erik Hurst, and Melissa Kearney. 2008. "Parental Education and Parental Time with Children." *Journal of Economic Perspectives* 22 (3): 23-46.

Haldar, Sweta, and Victoria Tran. 2018. "How much do low-income families pay for subsidized child care?" *Urban Wire: The Blog of the Urban Institute.* April 17. Accessed May 10, 2019. https://www.urban.org/urban-wire/how-much-do-low-income-families-pay-subsidized-child-care.

Hamermesh, Daniel. 2000. *Togetherness: Spouses' Synchronous Leisure, and the Impact of Children.* Cambridge: National Bureau of Economic Research Working Paper #7455.

Hardy, Bradley, and Seth Gershenson. 2013. "Parental Involvement, Summer Activities, and the Intergenerational Transmission of Educational Attainment." Unpublished manuscript, American University, Washington DC.

Herbst, Chris M. 2013. "The impact of non-parental child care on child development: Evidence from the summer participation “dip”." *Journal of Public Economics* 105: 86-105.

Herbst, Chris M. 2015. *The Rising Cost of Child Care in the United States: A Reassessment of the Evidence.* Working Paper No. 9072, Bonn: IZA. Accessed July 30, 2018. http://ftp.iza.org/dp9072.pdf.

Herbst, Chris M., Kevin C. Desouza, Saud Alashri, Srinivasa Srivatsav Kandala, Mayank Khullar, and Vikash Bajaj. 2018. *What Do Parents Value in a Child Care Provider? Evidence from Yelp Consumer Reviews.* Bonn: IZA Institute for Labor Economics Discussion Paper Series #11741.

Hofferth, Sandra L. 1996. "Child Care in the United States Today." *The Future of Children* 6 (2): 41-61.

Hsin, Amy, and Christina Felfe. 2014. "When Does Time Matter? Maternal Employment, Children's Time With Parents, and Child Development." *Demography* 51 (5): 1867-1894.

Jäger, Simon. 2016. *How Substitutable Are Workers? Evidence from Worker Deaths.* Unpublished manuscript, Cambridge: Harvard University.

Jee, Eunjung, Joya Misra, and Marta Murray-Close. 2019. "Motherhood Penalties in the U.S., 1986–2014." *Journal of Marriage and Family* 81 (2): 434-449.

Johansen, Anne S., Arleen Leibowitz, and Linda J. Waite. 1996. "The Importance of Child-Care Characteristics to Choice of Care." *Journal of Marriage and Family* 58 (3): 759-772.

Juhn, Chinhui, and Kristen McCue. 2017. "Specialization Then and Now: Marriage, Children, and the Gender Earnings Gap across Cohorts." *Journal of Economic Perspectives* (American Economic Association) 31 (1): 183-204.

Kalil, Ariel, Rebecca Ryan, and Michael Corey. 2012. "Diverging Destinies: Maternal Education and the Developmental Gradient in Time With Children." *Demography* 49 (4): 1361-1383.

Kambourov, Gueorgui, and Iourii Manovskii. 2009. "Occupational Specificity of Human Capital." *International Economic Review* 50 (1): 63-115.

Killewald, Alexandra, and Margaret Gough. 2013. "Does Specialization Explain Marriage Penalties and Premiums?" *American Sociological Review* 78 (3): 477-502.

Kleven, Henrik, Camille Landais, and Jakob Egholt Søgaard. 2018. *Children and Gender Inequality: Evidence from Denmark.* Cambridge: National Bureau of Economic Research Working Paper #24219.

Korenman, Sanders, and David Neumark. 1992. "Marriage, Motherhood, and Wages." *The Journal of Human Resources* 233-255.

Kornrich, Sabino. 2012. "Hiring Help for the Home:Household Services in theTwentieth Century." *Journal of Family History* 37 (2): 197-212.

Kornrich, Sabino. 2016. "Inequalities in Parental Spending on Young Children: 1972 to 2010." *AERA Open.*

Landers, Renee, James B. Rebitzer, and Lowell J. Taylor. 1996. "Rat Race Redux: Adverse Selection in the Determination of Work Hours in Law Firms." *The American Economic Review* 86 (3): 329-348.

Lapidos, Juliet. 2007. *Do Kids Need a Summer Vacation?* July. https://slate.com/news-and-politics/2007/07/why-do-schoolchildren-get-a-three-month-summer-vacation.html.

Laughlin, Lynda. 2013. *Who's Minding the Kids? Child Care Arrangments: Spring 2011.* Washington DC: U.S. Department of Commerce.

Light, Audrey, and Manuelita Ureta. 1995. "Early-Career Work Experience and Gender Wage Differentials." *Journal of Labor Economics* 13 (1): 121-154.

Lubotsky, Darren, and Javaeria A. Qureshi. 2018. "Assessing the Smooth Rise in Mothers' Employment as Children Age." *Journal of Human Capital* 12 (4): 604-639.

Lynch, Matthew. 2016. *Edvocate.* August 13. Accessed April 4, 2019. https://www.theedadvocate.org/top-3-reasons-the-us-should-switch-to-year-round-schooling/.

Maestas, Nicole, Kathleen J. Mullen, David Powell, Till von Wachter, and Wenger Jeffrey B. 2018. "The Value of Working Conditions in the United States and Implications for the Structure of Wages." Working Paper #25204, National Bureau of Economic Research, Cambridge.

Michaud, Pierre-Carl, and Frederic Vermeulen. 2011. "A collective labor supply model with complementarities in leisure: Identification and estimation by means of panel data." *Labour Economics* 18 (2): 159-167.

Miller, Claire Cain. 2019. "Women Did Everything Right. Then Work Got 'Greedy.' How America's obsession with long hours has widened the gender gap." *The New York Times*, April 26.

Mincer, Jacob, and Haim Ofek. 1982. "Interrupted Work Careers: Depreciation and Restoration of Human Capital." *The Journal of Human Resources* 17 (1): 3-24.

Mincer, Jacob, and Simon Polachek. 1974. "Family Investments in Human Capital: Earnings of Women." *Journal of Political Economy* 82 (2): S76-S108.

Miron, Jeffrey A. 1990. *The Economics of Seasonal Cycles.* NBER Working Paper #3522, Cambridge: National Bureau of Economic Research.

Mulligan, Casey B. 2010. *Does Labor Supply Matter During a Recession? Evidence From the Seasonal Cycle.* NBER Working Paper #16357, Cambridge: National Bureau of Economic Research.

Myers, Caitlin Knowles. 2017. "The Power of Abortion Policy: Reexamining the Effects of Young Women's Access to Reproductive Control." *Journal of Political Economy* 125 (6): 2178-2224.

O'Neill, June, and Solomon Polachek. 1993. "Why the Gender Gap in Wages Narrowed in the 1980s." *Journal of Labor Economics* 11 (1): 205-228.

Oreopoulos, Philip, Marianne E. Page, and Ann Huff Stevens. 2003. *Does Human Capital Transfer from Parent to Child? The Intergenerational Effects of Compulsory Schooling.* National Bureau of Economic Research Working Paper #10164.

Pederson, James. 2012. "The History of School and Summer Vacation." *Journal of Inquiry and Action in Education* 5 (1): 54-62.

Petersen, Trond, Andrew M. Penner, and Geir Høgsnes. 2014. "From Motherhood Penalties to Husband Premia: The New Challenge for Gender Equality and Family Policy, Lessons from Norway." *American Journal of Sociology* 119 (5): 1434-1472.

Pew Research Center. 2015. "Parenting in America: The American Family Today." *Pew Research Center Social and Demographic Trends.* December 17. Accessed May 24, 2019. https://www.pewsocialtrends.org/2015/12/17/1-the-american-family-today/.

—. 2015. *The Rise in Dual-Income Households.* http://www.pewresearch.org/ft_dual-income-households-1960-2012-2/.

Polacheck, Solomon William. 1981. "Occupational Self-Selection: A Human Capital Approach to Sex Differences in Occupational Structure." *The Review of Economics and Statistics* 63 (1): 60-69.

Quinn, David M., North Cooc, Joe McIntyre, and Celia J. Gomez. 2016. "Seasonal Dynamics of Academic Achievement Inequality by Socioeconomic Status and Race/Ethnicity: Updating and Extending Past Research With New National Data." *Educational Researcher* 45 (8): 443-453.

Ramey, Garey, and Valerie Ramey. 2010. *The Rug Rat Race.* Brookings Papers on Economic Activity, Washington DC: The Brookings Institution.

Rich, Mokoto. 2012. "To Increase Learning Time, Some Schools Add Days to Academic Year." *The New York Times*, August 6.

Rivera Drew, Julia A., Sarah Flood, and John Robert Warren. 2016. "Making full use of the longitudinal design of the Current Population Survey: Methods for linking records across 16 months." *Journal of Economic and Social Measurement* 39: 121-144.

Roy, A. D. 1951. "Some Thoughts on the Distribution of Earnings." *Oxford Economic Papers* 3 (2): 135-146.

Ruhm, Christopher J. 2004. "Parental Employment and Child Cognitive Development." *The Journal of Human Resources* 39 (1): 155-192.

Saluter, Arlene F., and Terry A. Lugaila. 1996. *Marital Status and Living Arrangements: March 1996.* Current Population Reports, Washington DC: U.S. Department of Commerce.

Silver, Cynthia. 2000. "Being there: The time dual-earner couples spend with their children." *Candian Social Trends* 26-29.

Sinkewicz, Marilyn, and Irwin Garfinkel. 2009. "Unwed Fathers' Ability to Pay Child Support: New Estimates Accounting for Multiple-Partner Fertility." *Demography* 46 (2): 247-263.

Sousa-Poza, Alfonso, and Alexandre Ziegler. 2003. "Asymmetric information about workers' productivity as a cause for inefficient long working hours." *Labour Economics* 10 (6): 727-747.

Staff, Jeremy, and Jeylan T. Mortimer. 2012. "Explaining the Motherhood Wage Penalty During the Early Occupational Career." *Demography* 49 (1): 1-21.

States, The Parental Gender Earnings Gap in the United. 2017. *Chung, YoonKyung; Downs, Barbara; Sandler, Danielle H.; Sienkiewicz, Robert.* Washington DC: Center for Economic Studies Working Paper #17-68.

Strauss, Richard S., and Judith Knight. 1999. "Influence of the Home Environment on the Development of Obesity in Children." *Pediatrics* 103 (6).

Sullivan, Paul. 2010. "Empirical evidence on occupation and industry specific human capital." *Labour Economics* 17 (3): 567-580.

Thomson, Elizabeth, Thomas L. Hanson, and Sara S. McLanahan. 1994. "Family Structure and Child Well-Being: Economic Resources vs. Parental Behaviors." *Social Forces* 73 (1): 221-242.

Todd, Petra, and Kenneth Wolpin. 2007. "The Production of Cognitive Achievement in Children: Home, School, and Racial Test Score Gaps." *Journal of Human Capital* 1 (1): 91-136.

U.S. Census Bureau. 2017. *Highest Education Levels Reached by Adults in the U.S. Since 1940.* Release Number CB17-51, Washington DC: U.S. Census Bureau. https://www.census.gov/newsroom/press-releases/2017/cb17-51.html.

Von Drehle, David. 2010. "The Case Against Summer Vacation." *Time Magazine.*

Votruba-Drzal, Elizabeth. 2003. "Income Changes and Cognitive Stimulation in Young Children's Home Learning Environments." *Journal of Marriage and Family* 65: 341-355.

Ward, Kate. 2018. "9 child care subsidies every family should know about." *care.com.* September 7. Accessed May 10, 2019. https://www.care.com/c/stories/3153/child-care-subsidies-and-programs/.

Weeden, Kim A., Youngjoo Cha, and Mauricio Bucca. 2016. "Long Work Hours, Part-Time Work, and Trends in the Gender Gap in Pay, the Motherhood Wage Penalty, and the Fatherhood Wage Premium." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 2 (4): 71-102.

Weinberg, Bruce A. 2001. "An Incentive Model of the Effect of Parental Income on Children." *Journal of Political Economy* 109 (2): 266-280.

Weinberger, Jillian, Sarah Kliff, Amy Drozdowska, and Byrd Pinkerton. 2018. "Denmark gives new fathers paid leave. Why do so few take it?" *Vox.* December 14. Accessed May 13, 2019. https://www.vox.com/podcasts/2018/12/14/18136315/denmark-new-fathers-paid-leave-paternity.

Wiswall, Matthew, and Basit Zafar. 2017. "Preference for the Workplace, Investment in Human Capital, and Gender." *Quarterly Journal of Economics* 133 (1): 457-507.

APPENDICES

APPENDIX A

Figure 20: Timeline of ACS Survey Wave and "Look Back" Period Relative to The School Year

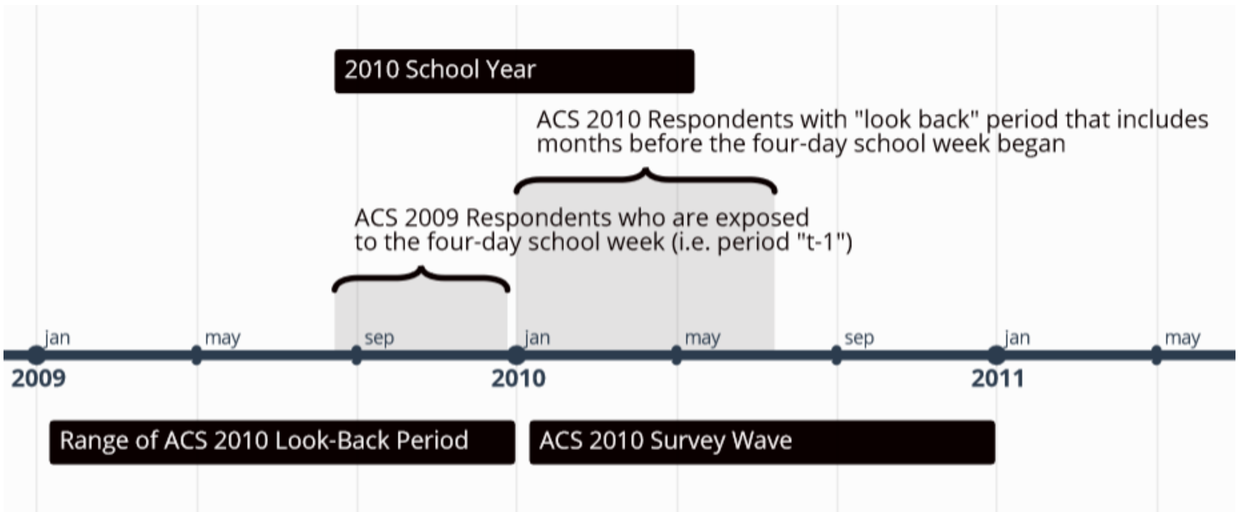
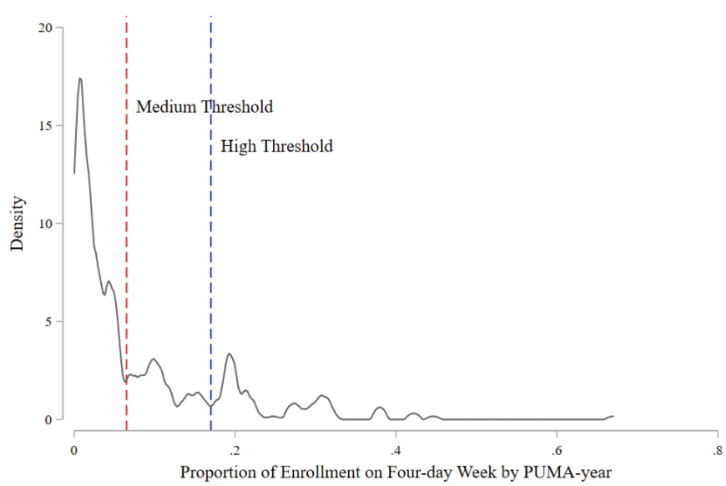


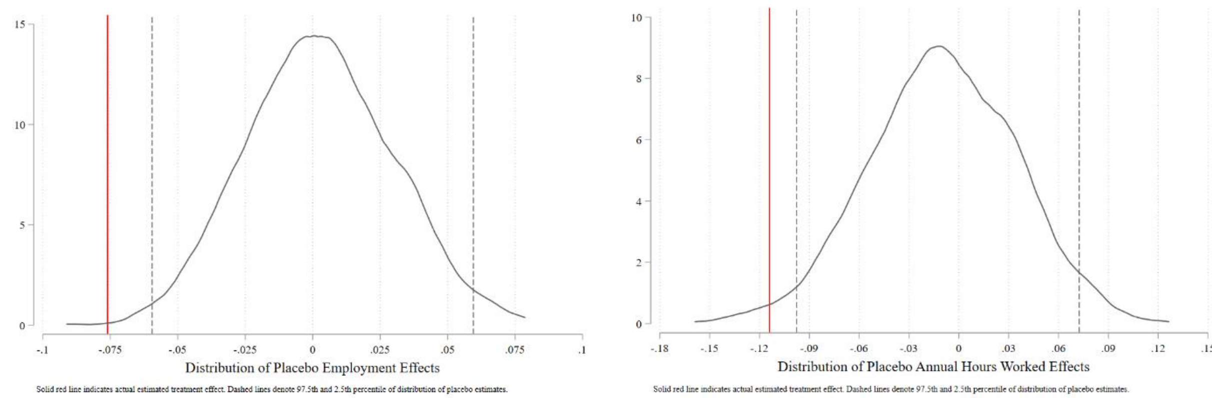
Figure 21: Distribution of Four-Day Week Enrollment with Alternate Enrollment Cutoffs



APPENDIX A (continued)

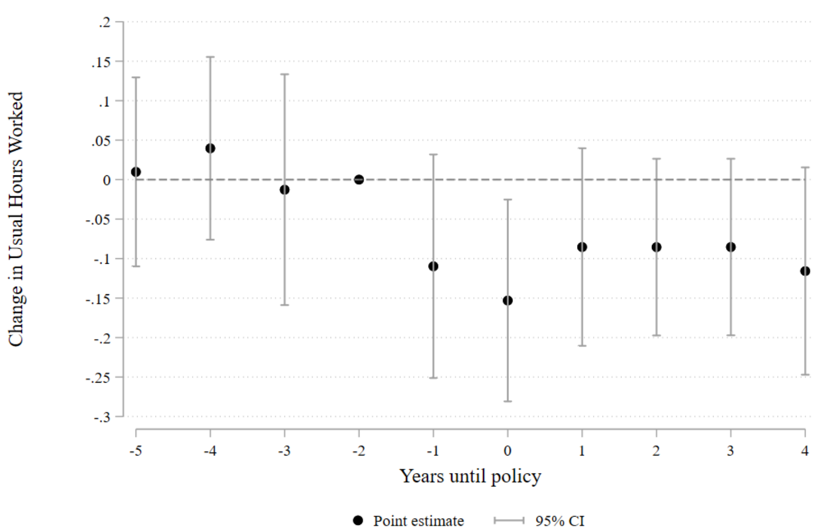
Figure 22: Randomization Inference Results - Maternal Employment and Annual Hours Worked

Panel A: Maternal Employment | Panel B: Maternal Annual Hours Worked



Each figure presents the distribution of estimates from a permutation test that randomly assigns vectors of four-day week enrollment levels to PUMAs (within-state) and runs specification 3 of model (9) on the resulting placebo data set. The red (solid) line is the main estimated effect in Table 4. The dashed lines are the tails of the 95% confidence interval from the placebo distribution (two-sided test). These results are from 1000 permutations of the data.

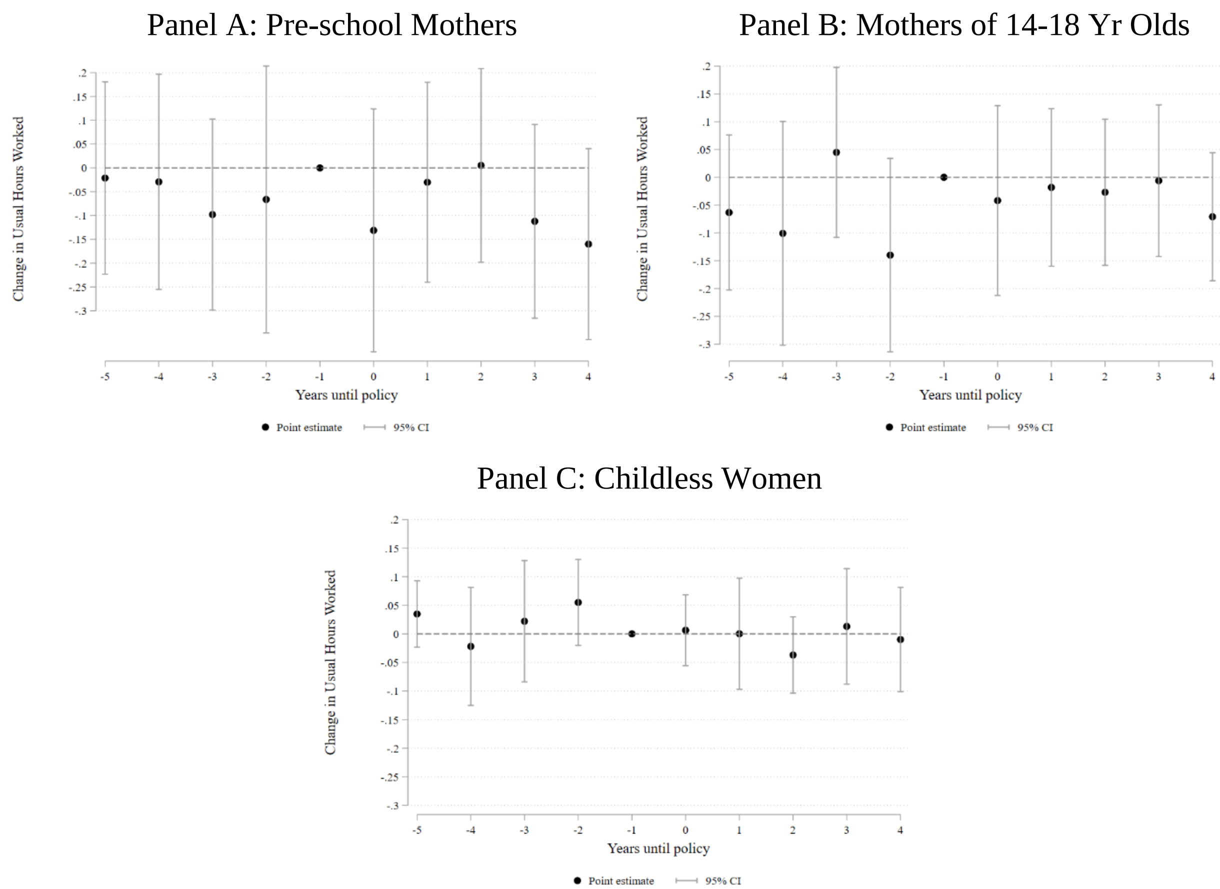
Figure 23: Maternal Annual Hours Worked Event Study Using Alternate Reference Period



Result are from a regression of outcome on a pair of indicator variables for low and high four-day week enrollment. All models include year and PUMA fixed-effects, controls for race, ethnicity, age, education and interactions between the two, baseline outcome interacted with year fixed effects, and annual outcome level of 18- to 24-year-old workers. Regressions use hybrid PUMA crosswalk / ACS person weights as outlined in text. Confidence intervals are generated from standard errors clustered at the PUMA level.

APPENDIX A (continued)

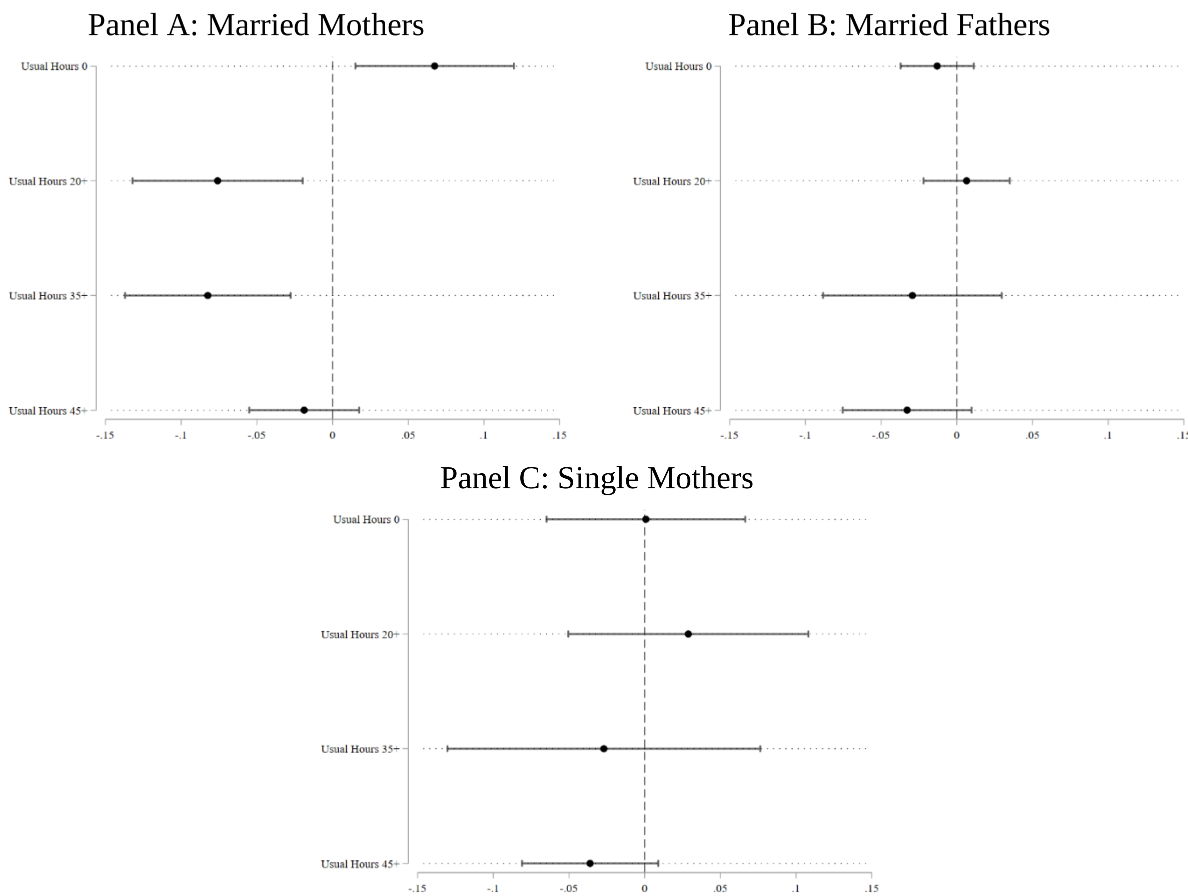
Figure 24: Annual Hours Worked Event Study Results for Placebo Groups (High Four-Day Week Enrollment Only)



Result are from a regression of outcome on a pair of indicator variables for low and high four-day week enrollment (high four-day week enrollment coefficient and CIs shown). All models include year and PUMA fixed-effects as well as controls for race/ethnicity, age, education and interactions between the two, and a set of baseline and other outcome-variable controls as outlined in text. Confidence intervals are generated from standard errors clustered at the PUMA level.

APPENDIX A (continued)

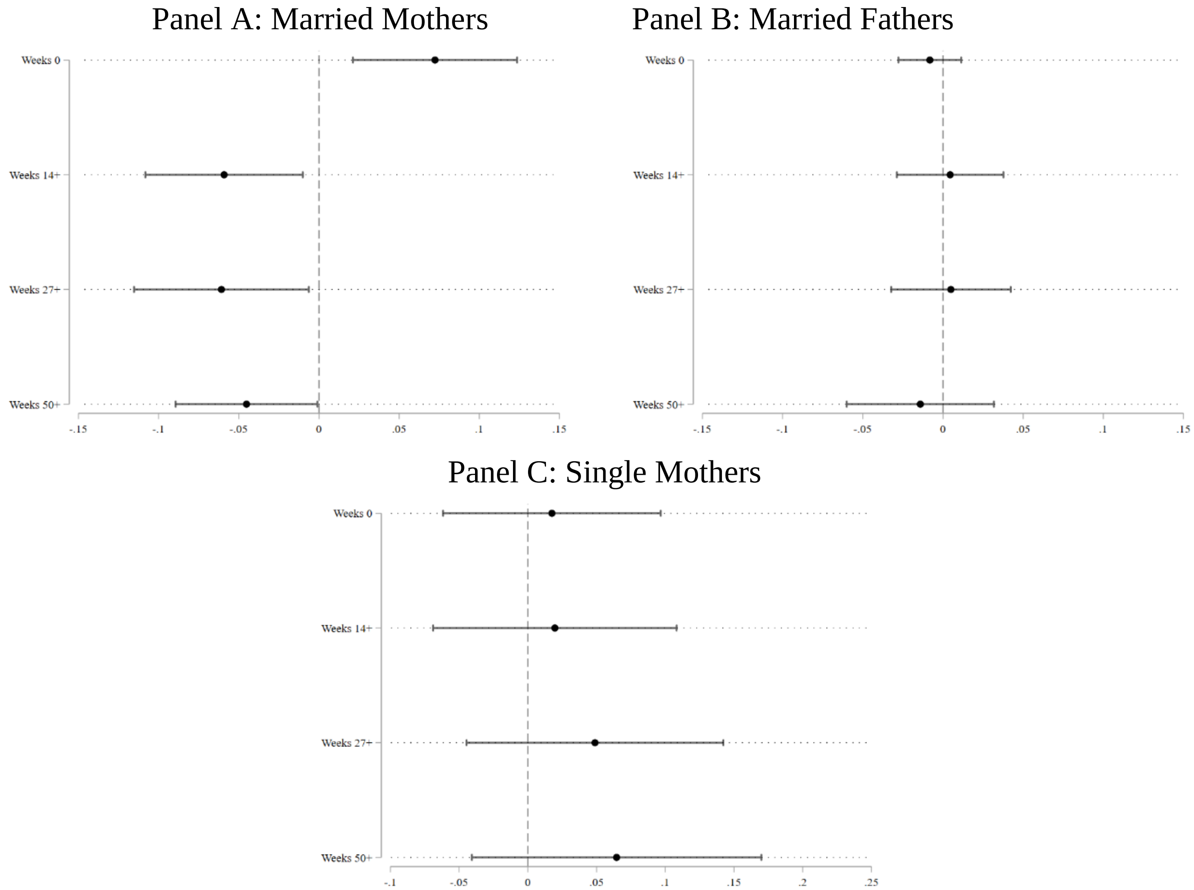
Figure 25: Alternate Linear Estimates of Effects of High Four-Day Week on Usual Hours Worked Per Week



Result are from WLS regression of usual hours worked on a pair of indicator variables for low and high four-day week enrollment (high four-day week enrollment coefficient and CIs shown). Each outcome is an indicator variable equal to 1 if usual hours worked are greater than or equal to the indicated value. All models include year and PUMA fixed-effects as well as controls for race/ethnicity, age, education and interactions between the two, and a set of baseline and other outcome-variable controls as outlined in text. Confidence intervals are generated from standard errors clustered at the PUMA level.

APPENDIX A (continued)

Figure 26: Alternate Linear Estimates for Effect of High Four-Day Week Enrollment on Weeks Worked Per Year



Result are from WLS regression of usual hours worked on a pair of indicator variables for low and high four-day week enrollment (high four-day week enrollment coefficient and CIs shown in figure). Each outcome is an indicator variable equal to 1 if usual hours worked are greater than or equal to the indicated value. All models include year and PUMA fixed-effects as well as controls for race/ethnicity, age, education and interactions between the two, and a set of baseline and other outcome-variable controls as outlined in text. Confidence intervals are generated from standard errors clustered at the PUMA level.

APPENDIX A (continued)

Table XX: Four-Day School Week Enrollment by State and Year

	Colorado		Idaho		Oregon		Oklahoma	
Year	Five-day	Four-day	Five-day	Four-day	Five-day	Four-day	Five-day	Four-day
2005	779,349	2,053	253,781	5,167	532,740	15,731	-	-
2006	790,211	2,141	258,313	5,167	539,464	15,797	-	-
2007	797,168	3,774	262,934	7,806	542,965	15,903	-	-
2008	811,728	3,779	265,844	7,806	546,040	15,974	-	-
2009	824,995	4,386	267,951	8,950	543,262	16,819	-	-
2010	834,584	4,579	268,860	10,112	535,609	20,364	-	-
2011	842,901	7,024	270,906	17,936	534,085	20,082	655,238	4,377
2012	850,865	7,230	269,458	18,911	529,356	23,368	660,658	5,183
2013	865,079	24,654	274,319	20,244	529,363	25,864	666,456	6,734
2014	872,148	31,813	274,786	22,486	532,925	25,852	627,941	53,637
2015	880,497	33,136	274,295	22,486	541,168	25,927	655,730	32,463
2016	885,299	36,592	276,722	24,241	529,709	34,416	660,286	32,384

Source: Author calculations from Department of Education data for each indicated state.

APPENDIX A (continued)

Table XXI: Predicted Means from Multinomial Logit Estimates of the Effect of the Four-Day Week

	0 Hours			1-19 Hours			25-34 Hours			35+ Hours		
4DW Enrollment:	None	Low	High	None	Low	High	None	Low	High	None	Low	High
Panel A: Usual Hours Worked Among Married Mothers with Children All Ages 5 to 13												
Predicted Mean	0.231	0.232	0.307	0.085	0.087	0.090	0.182	0.180	0.186	0.502	0.501	0.418
	(0.006)	(0.010)	(0.025)	(0.003)	(0.006)	(0.010)	(0.005)	(0.008)	(0.021)	(0.006)	(0.010)	(0.021)
95% CI UB	0.242	0.251	0.356	0.091	0.098	0.110	0.191	0.197	0.226	0.514	0.521	0.459
95% CI LB	0.220	0.212	0.257	0.079	0.076	0.070	0.172	0.164	0.145	0.491	0.481	0.376
Panel B: Usual Hours Worked Among Married Fathers with Children All Ages 5 to 13												
Predicted Mean	0.048	0.036	0.034	0.010	0.013	0.021	0.041	0.054	0.083	0.901	0.897	0.862
	(0.003)	(0.003)	(0.008)	(0.001)	(0.003)	(0.009)	(0.002)	(0.006)	(0.025)	(0.004)	(0.007)	(0.031)
95% CI UB	0.042	0.031	0.019	0.009	0.007	0.002	0.036	0.042	0.033	0.892	0.882	0.802
95% CI LB	0.054	0.042	0.050	0.012	0.018	0.039	0.046	0.066	0.133	0.909	0.911	0.922
Panel C: Usual Hours Worked Among Single Mothers with Children All Ages 5 to 13												
Predicted Mean	0.135	0.135	0.123	0.048	0.046	0.025	0.170	0.181	0.222	0.647	0.639	0.630
	(0.010)	(0.016)	(0.023)	(0.006)	(0.007)	(0.014)	(0.008)	(0.015)	(0.050)	(0.010)	(0.019)	(0.048)
95% CI UB	0.154	0.166	0.168	0.060	0.059	0.052	0.185	0.210	0.321	0.667	0.676	0.724
95% CI LB	0.117	0.103	0.077	0.037	0.032	-0.002	0.154	0.152	0.123	0.626	0.602	0.537

	0 Weeks			1-26 Weeks			27-49 Weeks			50-52 Weeks		
4DW Enrollment:	None	Low	High	None	Low	High	None	Low	High	None	Low	High
Panel D: Weeks Worked Among Married Mothers with Children All Ages 5 to 13												
Predicted Mean	0.230	0.233	0.312	0.093	0.080	0.082	0.135	0.124	0.115	0.542	0.563	0.491
	(0.005)	(0.010)	(0.025)	(0.005)	(0.006)	(0.020)	(0.004)	(0.005)	(0.018)	(0.006)	(0.010)	(0.017)
95% CI UB	0.241	0.252	0.360	0.103	0.091	0.120	0.142	0.134	0.150	0.554	0.583	0.524
95% CI LB	0.220	0.213	0.263	0.083	0.069	0.044	0.128	0.114	0.080	0.531	0.543	0.458
Panel E: Weeks Worked Among Married Fathers with Children All Ages 5 to 13												
Predicted Mean	0.047	0.036	0.038	0.036	0.039	0.041	0.098	0.117	0.116	0.819	0.808	0.804
	(0.003)	(0.003)	(0.007)	(0.002)	(0.004)	(0.012)	(0.003)	(0.008)	(0.011)	(0.005)	(0.009)	(0.022)
95% CI UB	0.053	0.042	0.053	0.040	0.047	0.065	0.105	0.133	0.137	0.829	0.826	0.849
95% CI LB	0.041	0.031	0.024	0.032	0.032	0.018	0.092	0.101	0.096	0.809	0.789	0.760
Panel F: Weeks Worked Among Single Mothers with Children All Ages 5 to 13												
Predicted Mean	0.133	0.134	0.121	0.112	0.066	0.042	0.126	0.144	0.102	0.628	0.656	0.736
	(0.010)	(0.016)	(0.022)	(0.010)	(0.008)	(0.016)	(0.005)	(0.014)	(0.041)	(0.010)	(0.018)	(0.051)
95% CI UB	0.153	0.166	0.164	0.132	0.081	0.072	0.136	0.172	0.181	0.647	0.691	0.835
95% CI LB	0.114	0.103	0.079	0.092	0.050	0.011	0.116	0.117	0.022	0.609	0.620	0.637

Multinomial logit regression results as described in text. Sample sizes: married mothers w/children all aged 5-13, n=37,321; married fathers w/children all aged 5-13, n=35,722; single mothers w/children all aged 5-13, n=11,324. Delta method standard errors in parentheses.

APPENDIX A (continued)

Table XXII: Effects of the Four-Day Week Among Parents of Grade School Aged Children Using Alternate Enrollment Groupings

	(1)	(2)	(3)	(4)	(5)	(6)
	Mothers			Fathers		
Panel A1: Employment (Alternate 4DW Enrollment Categories)						
Low 4DW Enrollment	0.010	0.010	0.007	0.002	0.000	0.003
	(0.018)	(0.018)	(0.017)	(0.008)	(0.008)	(0.008)
Mid 4DW Enrollment	-0.036	-0.035	-0.034	0.005	0.006	0.001
	(0.025)	(0.025)	(0.021)	(0.014)	(0.014)	(0.012)
High 4DW Enrollment	-0.112*	-0.099*	-0.095+	-0.030	-0.033	-0.032
	(0.044)	(0.044)	(0.051)	(0.022)	(0.023)	(0.023)
Panel A2: Employment (Continuous Measure of 4DW Enrollment)						
4DW Enrollment	-0.306**	-0.278**	-0.267**	-0.049	-0.055	-0.067
	(0.087)	(0.090)	(0.101)	(0.057)	(0.055)	(0.048)
Baseline Mean	.69	.69	.69	.92	.92	.92
Panel B1: Annual Hours Worked (Alternate 4DW Enrollment Categories)						
Low 4DW Enrollment	0.017	0.017	0.011	-0.006	-0.008	-0.004
	(0.029)	(0.030)	(0.028)	(0.013)	(0.012)	(0.012)
Mid 4DW Enrollment	-0.097**	-0.089**	-0.094**	-0.008	-0.007	0.001
	(0.030)	(0.031)	(0.030)	(0.019)	(0.018)	(0.017)
High 4DW Enrollment	-0.132*	-0.110*	-0.133*	-0.089+	-0.091	-0.083
	(0.052)	(0.056)	(0.054)	(0.052)	(0.056)	(0.057)
Panel B2: Annual Hours Worked (Continuous Measure of 4DW Enrollment)						
4DW Enrollment	-0.461**	-0.411**	-0.422**	-0.090	-0.088	-0.085
	(0.145)	(0.149)	(0.158)	(0.076)	(0.078)	(0.080)
Baseline Mean	1,215	1,215	1,215	2,101	2,101	2,101
PUMA & year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Race, Age, Ed Controls	No	Yes	Yes	No	Yes	Yes
Outcome Controls	No	No	Yes	No	No	Yes
Observations	37,149	37,149	37,149	35,642	35,642	35,642

Models (1) include year and PUMA fixed effects. Models (2) include race/ethnicity, age, educational attainment and interactions between age and education. Models (3) include baseline outcome interacted with year fixed effects and annual PUMA by year outcome of 18- to 24-year olds. Annual hours models use robust Poisson regression. Regressions weighted using hybrid PUMA crosswalk / ACS person weights as described in text. Standard errors clustered at the PUMA level. + p<0.10, * p<0.05, ** p<0.01.

APPENDIX A (continued)

Table XXIII: Effects of the Four-Day Week Among Parents of Pre-School Aged Children

	(1)	(2)	(3)	(4)	(5)	(6)
	Mothers			Fathers		
Panel A: Employment						
Low 4DW Enrollment	0.017	0.019	0.029+	0.008	0.006	0.008
	(0.020)	(0.019)	(0.016)	(0.009)	(0.009)	(0.008)
High 4DW Enrollment	-0.008	0.005	0.018	-0.012	-0.015	-0.007
	(0.028)	(0.025)	(0.022)	(0.020)	(0.022)	(0.022)
Baseline Mean	.62	.62	.62	.93	.93	.93
Panel B: Annual Hours Worked						
Low 4DW Enrollment	0.015	0.020	0.040+	0.006	0.004	0.003
	(0.028)	(0.026)	(0.021)	(0.014)	(0.014)	(0.014)
High 4DW Enrollment	-0.044	-0.018	-0.006	-0.031	-0.036	-0.036
	(0.040)	(0.036)	(0.034)	(0.025)	(0.026)	(0.028)
Baseline Mean	1,055	1,055	1,055	2,116	2,116	2,116
PUMA & year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Race, Age, Ed Controls	No	Yes	Yes	No	Yes	Yes
Outcome Controls	No	No	Yes	No	No	Yes
Observations	23,680	23,680	23,680	25,404	25,404	25,404

Models (1) include year and PUMA fixed effects. Models (2) include race/ethnicity, age, educational attainment and interactions between age and education. Models (3) include baseline outcome interacted with year fixed effects and annual PUMA by year outcome of 18- to 24-year olds. Annual hours models use robust Poisson regression. Regressions weighted using hybrid PUMA crosswalk / ACS person weights as described in text. Standard errors clustered at the PUMA level. + $p<0.10$, * $p<0.05$, ** $p<0.01$.

APPENDIX A (continued)

Table XXIV: Effects of the Four-Day Week Among Parents of High School Aged Children

	(1)	(2)	(3)	(4)	(5)	(6)
	Mothers			Fathers		
Panel A: Employment						
Low 4DW Enrollment	-0.004	-0.003	-0.001	0.002	0.001	0.003
	(0.019)	(0.019)	(0.018)	(0.010)	(0.010)	(0.011)
High 4DW Enrollment	0.023	0.011	0.006	0.018	0.020	0.015
	(0.025)	(0.025)	(0.027)	(0.023)	(0.022)	(0.023)
Baseline Mean	.78	.78	.78	.91	.91	.91
Panel B: Annual Hours Worked						
Low 4DW Enrollment	-0.013	-0.013	-0.008	-0.009	-0.010	-0.007
	(0.029)	(0.029)	(0.025)	(0.017)	(0.018)	(0.015)
High 4DW Enrollment	0.041	0.022	0.019	-0.027	-0.027	-0.010
	(0.043)	(0.044)	(0.044)	(0.027)	(0.027)	(0.027)
Baseline Mean	1,478	1,478	1,478	2,100	2,100	2,100
PUMA & year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Race, Age, Ed Controls	No	Yes	Yes	No	Yes	Yes
Outcome Controls	No	No	Yes	No	No	Yes
Observations	20,530	20,530	20,530	17,954	17,954	17,954

Models (1) include year and PUMA fixed effects. Models (2) include race/ethnicity, age, educational attainment and interactions between age and education. Models (3) include baseline outcome interacted with year fixed effects and annual PUMA by year outcome of 18- to 24-year olds. Annual hours models use robust Poisson regression. Regressions weighted using hybrid PUMA crosswalk / ACS person weights as described in text. Standard errors clustered at the PUMA level. + p<0.10, * p<0.05, ** p<0.01.

APPENDIX A (continued)

Table XXV: Effects of the Four-Day Week Among Childless Married Adults

	(1)	(2)	(3)	(4)	(5)	(6)
		Women			Men	
Panel A: Employment						
Low 4DW Enrollment	0.004	0.008	0.007	0.005	0.007	0.007
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
High 4DW Enrollment	-0.012	-0.007	-0.008	0.008	0.009	0.005
	(0.022)	(0.020)	(0.022)	(0.010)	(0.011)	(0.012)
Baseline Mean	.77	.77	.77	.89	.89	.89
Panel B: Annual Hours Worked						
Low 4DW Enrollment	-0.011	-0.004	-0.005	-0.000	0.005	0.001
	(0.012)	(0.010)	(0.011)	(0.010)	(0.010)	(0.009)
High 4DW Enrollment	-0.041^{+}	-0.031	-0.032	-0.012	-0.009	-0.004
	(0.023)	(0.021)	(0.021)	(0.015)	(0.017)	(0.015)
Baseline Mean	1,527	1,527	1,527	2,018	2,018	2,018
PUMA & year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Race, Age, Ed Controls	No	Yes	Yes	No	Yes	Yes
Outcome Controls	No	No	Yes	No	No	Yes
Observations	69,077	69,077	69,077	59,304	59,304	59,304

Models (1) include year and PUMA fixed effects. Models (2) include race/ethnicity, age, educational attainment and interactions between age and education. Models (3) include baseline outcome interacted with year fixed effects and annual PUMA by year outcome of 18- to 24-year olds. Annual hours models use robust Poisson regression. Regressions weighted using hybrid PUMA crosswalk / ACS person weights as described in text. Standard errors clustered at the PUMA level. + p<0.10, * p<0.05, ** p<0.01.

APPENDIX B

A few notes on the Current Population Survey sample construction

The CPS data used in the main analyses (e.g., section 2.5) was constructed using CPS basic monthly survey data from IPUMS. I downloaded data for the years 1982 to 2017 (years earlier than 1982 had anomalous monthly employment means in testing of the data that cast doubt on their usefulness for this study). From this entire sample, I keep respondents between ages 25 and 44 during "month-in-sample" 1 in the survey (i.e., the first month a respondent is surveyed).

I used the "ahrsworkt" variable to measure usual hours of work in the week prior to being surveyed. The *employment* dummy variable is equal to 1 if the empstat variable in the CPS is equal to 10 ("At work") or 12 ("Had job, not at work last week") and is 0 otherwise. The *present at work last week* dummy variable is equal to 1 if empstat is equal to 10 among those respondents with empstat equal to 10 *or* 12, i.e. those currently employed. I create a variable to identify single-female-headed households by flagging households without a member identified as a spouse ("relate" equal to 201) or an unmarried partner ("relate" equal to 1114).

To create the measures of reduced employment (for summer and fall) used in sections 2.7.1 and 2.7.4, I keep CPS rotation groups 6 through 9 (comprising respondents who enter the CPS sample in months June through September) and generate a ratio of the minimum value (0 or 1) of employment in July and/or August to the maximum value of employment in September and, for some groups, October. This ratio is a zero for any respondent who reports not working in one included summer month but reports working in any included fall month, and is a one for any respondent who reports working in all included summer months and any included fall month (I also generate a similar ratio of employment in non-summer months using September and, in some groups, October in the numerator and November and, in some groups, December in the denominator). This ratio is $empratio_i = \frac{\max(employment\ month_i,\ employment\ month_j)}{\max(employment\ month_k, employment\ \ month_l)}$, where i={July}, j={August} for groups 6, and 7, and i={}, j={August} for group 8, and k={September}, l={} for group 6, and k={September}, l={October} for groups 7 and 8. For the non-summer months i={September}, j={October} for groups 8 and 9, k={November}, l={} for group 8, and k={November}, l={December} for group 9. This ratio is calculated separately for the first round ("months in sample" 1 through 4) and the second round ("months in sample" 5 through 8) for each respondent. In this analysis, I use only respondents present in one or more months in each round. For more on CPS rotation groups, see https://www.bls.gov/opub/hom/cps/design.htm#rotation-of-the-sample.

The indicator variables used in 2.7.1 and 2.7.4 are the inverse of this employment ratio, so that an employment ratio of "0" indicating that a parent had an episode of non-employment in the summer months but worked in a fall month becomes a dummy variable equal to 1 in the regression. The analogous process is used to identify parents who consistently reduce their presence at work over the summer months where, rather than employment in a given month, presence at work is used to form the ratio described above.

APPENDIX B (continued)

Table XXVI: Most Common Female Occupations in the Current Population Survey

Mothers with a High School Degree or Less		Mothers with Some College or More	
Occupation Description	Pct.	Occupation Description	Pct.
Secretaries	11.5	Registered nurses	11.9
Nursing aides, orderlies, & attendants	7.5	Primary school teachers	10.2
Cashiers	7.0	Managers and administrators, n.e.c.	9.4
Bookkeepers, accounting, & auditing clerks	5.6	Secretaries	9.4
Supervisors & proprietors of sales jobs	5.3	Supervisors and proprietors of sales jobs	4.8
Managers & administrators, n.e.c.	5.2	Accountants and auditors	4.7
Cooks, variously defined	5.1	Bookkeepers, accounting & auditing clerks	4.4
Housekeepers, maids	4.8	Salespersons, n.e.c.	4.2
Child care workers	4.5	Secondary school teachers	3.8
Salespersons, n.e.c.	4.3	Nursing aides, orderlies, and attendants	3.3
Waiter/waitress	4.2	Social workers	3.0
Hairdressers & cosmetologists	3.8	Customer service reps, investigators & adjusters (non-insurance)	2.8
Assemblers of electrical equipment	3.7	Kindergarten & earlier school teachers	2.7
Janitors	3.5	Child care workers	2.4
Receptionists	2.9	Managers and specialists in marketing, advertising, and public relations	2.2
Textile sewing machine operators	2.7	Administrative support jobs, n.e.c.	2.2
Customer service reps, investigators & adjusters (non-insurance)	2.7	Teacher's aides	2.2
Teacher's aides	2.5	Office supervisors	2.2
Machine operators, n.e.c.	2.4	Teachers, n.e.c.	2.1
Administrative support jobs, n.e.c.	2.2	Cashiers	2.1
General office clerks	2.2	Receptionists	2.1
Office supervisors	1.7	Computer systems analysts & scientists	2.0
Typists	1.7	Managers in education & related fields	2.0
Misc food prep workers	1.7	Personnel, HR, training, & labor relations	2.0
Retail sales clerks	1.6	Financial managers	1.9

Source: Current Population Survey, 1982-2017. Tabulations represent the top 25 occupations (using the "occ1990" variable) among employed women aged between 25 and 44.

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EDUCATION

2019 (Expected)	PhD in Economics, University of Illinois at Chicago
2016	M.A. in Economics, University of Illinois at Chicago
2014	B.A. (with Honors) in Economics, University of Illinois at Chicago

AWARDS & HONORS

2018	U.S. Census Bureau Center for Economic Studies Dissertation Mentorship Program
2018	Sylvia L. Saffrin Award, University of Illinois at Chicago Dept. of Economics
2014	University Fellowship, University of Illinois at Chicago Graduate College

RESEARCH

7. "The Impact of Parental Involvement Laws on Teen Abortions" (with Theodore Joyce, and Robert Kaestner), NBER Working Paper #25758, April 2019

6. "The Effect of Large-scale Performance-Based Funding in Higher Education" (with Ben Ost), Forthcoming in Education Finance and Policy

5. "The Four-day School Week and Parental Labor Supply" (job market paper) September 2018

4. "A Test of Supply-side Explanations of Geographic Variation in Healthcare Use" (with Kevin Callison and Robert Kaestner), NBER Working Paper 25037 September 2018

3. "Education and Health: An Age, Period and Cohort Analysis" (with Robert Kaestner and Cuiping Schiman), under review May 2018

2. "Licensure Requirements and Regional Equilibrium in Teacher Labor Markets" (Unpublished manuscript), March 2017

1. "Decentralized Governance and the Quality of School Leadership" (with Derek Laing, Steven Rivkin and Jeff Schiman), NBER Working Paper 22061 March 2016

RESEARCH IN PROGRESS

5. “Summer School Breaks, Maternal Labor Supply, and Family Outcomes” (dissertation chapter)

4. “The Effects of the Opioid Epidemic on Household Composition and Family Roles”

3. “Compensating Differentials and Teacher Turnover: Evidence from the Four-Day School Week” (with Jeffrey Schiman)

2. “Educator Pension Reform as a Cut in State School Aid” (with Chuanyi Guo, David Merriman, and Darren Lubotsky)

1. “Gentrification, Neighborhood Sorting, and School Desegregation: Evidence from the Chicago Tier System” (with Marcus Casey)

MEDIA

“A test of supply-side explanations of geographic variation in health care use” (with Kevin Callison and Robert Kaestner) Vox CEPR Policy Portal, October 13, 2018.
https://voxeu.org/article/explaining-geographic-variation-health-care-use

PRESENTATIONS

“A Test of Supply-Side Explanations of Geographic Variation in Healthcare Use”
American Society of Health Economists Annual Meeting, Atlanta, GA (Poster 6/2018)

“The Four-day School Week and Parental Labor Supply”
Midwest Economics Association 82nd Annual Meeting, Evanston, IL (3/2018)
Association for Education Finance & Policy 43rd Annual Conference, Portland, OR (3/2018)

“Licensure Requirements and Regional Equilibrium in Teacher Labor Markets”
Association for Education Finance and Policy 42nd Annual Conference, Washington, DC (3/2017)

“Decentralized Governance and the Quality of School Leadership”
APPAM Fall Research Conference, Albuquerque, NM (11/2014)

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August 2018 - Present	Teaching Assistant – University of Illinois at Chicago Duties include grading, tutoring, and instruction. Supervisors: Professor Darren Lubotsky – Director of Graduate Studies
Sept 2017 – July 2018	Research Assistant – National Bureau of Economic Research Duties included data cleaning, generating output including regression estimates, tables and figures, general research and writing drafts. Supervisors: Professor Robert Kaestner – University of Illinois at Chicago; Professor Theodore Joyce – CUNY Baruch College
June 2017 – Aug 2017	Undergraduate Instructor – University of Illinois at Chicago Duties included preparing course material, lecturing, grading. Supervisor: Professor Darren Lubotsky – Director of Graduate Studies, University of Illinois at Chicago
June 2015 – May 2015	Research Assistant – University of Illinois at Chicago Duties included data cleaning, generating output including regression estimates, tables and figures, general research and writing drafts. Supervisor: Professor Ben Ost – University of Illinois at Chicago