

Full-Day Kindergarten: Effects on Maternal Labour Supply

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Abstract

We examine the effects of offering full-day kindergarten as a replacement for half-day kindergarten on mothers' labour supply using the rollout of full-day kindergarten in Ontario, Canada. We find no effect on the extensive margin but found an effect on the intensive margin. In particular, we find that access to full-day kindergarten increases weekly hours worked and decreases absenteeism among mothers with kindergarten-aged children. This effect is driven by specific sub-groups, namely non-immigrant mothers with low education levels who live in urban areas and have only one child.

I. INTRODUCTION

In recent decades, the importance of high-quality learning and care during the early years of life has received significant attention. As a result, many jurisdictions worldwide have implemented or expanded government-provided or -subsidized programs for younger children before compulsory schooling begins. The reasoning is that public childcare and preschool programs have the potential to promote long-term economic growth in two distinct ways. First, they may better prepare children for school, which can have a cascading effect on their long-run human capital acquisition and subsequent labour market outcomes (e.g., Heckman, 2006). Second, a more immediate effect is that children's caregivers may be able to increase their labour force attachment and therefore their lifetime earnings.

In this study, we evaluate the effects of expanding universal public kindergarten from a half-day (2.5 hours/day) to a full day (6.5 hours/day) on the labour market outcomes of their mothers. Beginning in September 2010 and with a progressive rollout over the following four years, the Canadian province of Ontario implemented a reform of early education to offer full-day kindergarten in public schools to all children aged four and five. Prior to the reform, the majority of children aged four and five in Ontario attended half-day kindergarten. While this rollout was planned rather than randomized, certain factors in its implementation led to variations over time and space that we can use to analyze how universal full-day kindergarten has affected the labour supply of mothers of age-eligible children, based on a difference-in-differences approach.

Our estimation strategy in this paper relies on variation across schools in the timing of the introduction of full-day kindergarten, to isolate its effects on maternal labour market outcomes.

For this strategy to be valid, the introduction of full-day kindergarten must be exogenous to other underlying trends in maternal labour market outcomes that differ between treated schools and untreated schools. To explore this issue, we take two approaches. First, we use an event-study analyses to document that there are no clear pre-trends in the outcome variables. We further explore this issue by examining which school and neighbourhood characteristics predict the timing of introducing full-day kindergarten within particular schools.

This paper is the first to report positive effects on maternal labour outcomes of moving from half-day to full-day kindergarten in a large English-speaking education system. Previous research has found only suggestive evidence (e.g., Cannon et al., 2006; Gibbs, 2014) or focused on non-English speaking systems (e.g., Haeck et al., 2015; Dhuey et al., 2020). This paper adds to the large body of work on the effects of early education programs on parental labour supply, including literature related to childcare subsidies and universal preschool, by providing evidence of the effects of adding additional schooling at the start of primary education.

We find that the implicit subsidy of extending the length of day of universal public school for four-year-old children has no impact on labour force participation at the extensive margin. We do, however, find evidence that some women are able to work longer hours. Specifically, we find that having access to full-day rather than half-day school increases the average number of hours worked per week for mothers with eligible-aged children and decreases their rate of absenteeism from work. This effect is driven primarily by non-immigrant women who live in urban areas, have only one child, and have only a high school education or less.

II. EXPECTED EFFECTS OF FULL-DAY KINDERGARTEN AND LITERATURE

REVIEW

The expansion of universal full-day schooling for four- and five-year-olds (hereafter, full-day kindergarten) was mainly sold to the public in Ontario based on the idea that the program would increase school readiness for all children. However, the evidence to support that claim is mixed. We know that small-scale preschool programs aimed at children in specific demographics (often for two- to four-year-olds) can have large effects on child outcomes, especially among children from disadvantaged families (Waldfogel, 2015) and that these programs often pay for themselves in the long run by improving student achievement and life outcomes (e.g., Heckman et al., 2010). However, the evidence is stronger for short-term effects versus longer-term outcomes (e.g., Puma et al., 2012; DeCicca, 2007). In programs that are rolled out more broadly, such as universally provided preschool for four-year-olds in the United States, outcomes are most improved among children from disadvantaged families (e.g., Havnes and Mogstad, 2011). Some evidence from Canada is less promising. For example, some studies have reported no improvement in school readiness (Haeck et al., 2015) and even negative effects on behaviour, development, and health (Baker et al., 2008) since a universal childcare and kindergarten program was implemented in the province of Quebec.¹ A meta-analysis of the effects of providing universal early childhood education and care arrangements across many jurisdictions revealed mixed results, but also revealed that quality matters critically and that gains are

¹ Kottenlenberg and Lehrer (2013) conducted a long-term examination of the Quebec childcare subsidization expansion and found that most of the negative effects of the reform on children were driven by children from families who only attended childcare in response to the implementation of this policy.

concentrated among populations of disadvantaged children (van Huizen and Plantenga, 2018).

Care for preschool-aged children is subsidized in many ways worldwide, ranging from providing free public universal education programs, increasing parental leave (unpaid and paid), and providing various kinds of subsidy programs that reduce out-of-pocket expenses for parents. Subsidy programs are often targeted at lower-income families, and the literature regarding the impact of these subsidies on maternal labour supply decisions is mixed and generally inconclusive.²

To reconcile these results, one must rely on economic theory and contextual factors. The subsidization of care changes maternal labour supply by changing a mother's budget constraint. For example, a free universal preschool program or childcare subsidy will increase a mother's effective wage rate (wage rate net of cost of care) and this in turn will increase the opportunity cost of not working and remaining at home with the child. Therefore, on the extensive margin (how many people work), the maternal employment rate should not fall. However, for a woman who would have already been working regardless of the subsidization, the effect on hours worked is ambiguous (Cattan, 2016). The contextual factors within a particular country may serve as a moderator of these policy effects;³ these may include, for example, current maternal employment rates and current subsidization rates for childcare. The scope of a policy to increase maternal labour supply may be more limited in countries with very high female employment rates and/or highly subsidized early childcare systems. If affordable childcare (either informal or

² See Cascio et al. (2015) for an informative discussion.

³ Cascio et al. (2015) provide an overview of five studies on maternal labour supply responses due to changes in policies within different countries.

privately paid childcare) is already widely available, increased subsidization might lead to little or no increase in maternal labour supply because this will only crowd out other forms of non-parental care. However, if low maternal employment is driven by a lack of affordable childcare, increased subsidization may encourage more mothers to work and in turn increase their attachment to the labour force in the long term. With regard to the present investigation, the context is as follows: as of 2014, Canada had the eighth-largest female labour force participation rate in the OECD at 77.76 percent (OECD, 2019a), but was in the mid-range in terms of net childcare costs (OECD, 2019b).⁴

The literature most relevant to this study is the body of work focusing on the maternal labour supply effects of universal kindergarten programs for five-year-olds and universal preschool programs for four-year-olds in the United States, along with work focusing on the expansion of kindergarten programs in the United States and Canada from half-day to full-day programs. Research has revealed that in the United States, the expansion of the primary school system to include half-day programs for five-year-olds increased the maternal labour supply most in terms of single mothers (Gelbach, 2002; Cascio, 2009; Fitzpatrick, 2012). More recent research has focused on the expansion of universal preschool programs for four-year-olds in the United States with mixed results: one study found little effect on labour supply for most women (Fitzpatrick, 2010) while another found some positive effect on labour supply (Sall, 2014).

In another recent trend, governments have been extending the kindergarten school day for

⁴ Ontario's labour force participation rate is close to the national average (Statistics Canada, 2019).

five-year-olds from a half-day to a full day, despite little evidence on whether this move will affect the labour supply decisions of mothers. Cannon et al. (2006) estimated the likelihood that a mother would work full-time if their child attended full-day kindergarten, and found no statistically significant lasting effects when the child moves into the first or third grade. Similarly, Haeck et al. (2015) found no significant labour market response among parents when full-day kindergarten was introduced in Quebec. However, Dhuey et al. (2020) observed small effects on hours worked from the introduction of full-day kindergarten in the Francophone school system in Ontario in the 1990s and early 2000s. Additionally, in a policy paper prepared for the US Department of Labor, Gibbs (2014) focused on changes implemented in the state of Indiana; a triple-difference analysis strategy yielded evidence suggesting an increase in maternal employment.⁵

III. KINDERGARTEN REFORM IN ONTARIO

Ontario has four different publicly funded school systems/boards: English Public, English Catholic, French Public, and French Catholic. Additionally, approximately five percent of students in Ontario attend private schools of mostly religious of Protestant denominations (Card et al., 2010). Schools are administered by school boards, which receive funding from the province. Every school board in Ontario is governed by a Board of Trustees, generally elected via municipal elections every four years.⁶ Each school board also has a director of education who

⁵ DeCicca (2007) also presents descriptive statistics that suggest that the percentage of mothers in the labour force is higher when children have access to full-day kindergarten.

⁶ Exceptions include First Nation Trustees and Student Trustees, Hospital Board Trustees, and the Centre Jules-Leger Consortium, but these unelected bodies make up a very small fraction of Trustees in the system.

serves as secretary on the Board of Trustees. All school board staff report either directly or indirectly to the director of education. As governors of the school board, the two most important responsibilities of Boards of Trustees are the development and monitoring of multi-year strategic plans and the hiring and performance management of directors of education. The Board of Trustees also approves the school board's budget each year. School boards receive funding from the province almost entirely based on an educational funding formula, and the Board of Trustees is responsible for ensuring the school board has a balanced budget that reflects their strategic plan. During the rollout of the changes under consideration here, it is possible that there was competition between schools within a school board that may have affected the timing of the implementation but there is no evidence, antidotal or empirical, that this occurred – it is also very unlikely because the rollout was planned to be swift and universal.

Parents can choose the school system to which they send their children, with some restrictions based on language and religion. To attend the French Public or French Catholic system, at least one of the child's parents must be a French-language right-holder; approximately four percent of students attend schools operated by the French Public or the French Catholic Boards (Card et al., 2010). To enrol a child in a Catholic primary school (English or French), parents must be willing that the child will be educated in a faith-based school and must request admittance by the school board. Catholic families are always given priority, but some boards allow non-Catholic families to send their children to Catholic schools if enrolment permits;

others have strict rules regarding religion, particularly in primary schools.⁷ Overall, the vast majority of Catholic school students are Catholic, and there is little movement of students between different types of school boards after entry into kindergarten. Each school board defines school catchment areas, and prospective students are guaranteed a place in the school that corresponds to their assigned school catchment area. The boundaries of English Public and English Catholic boards typically coincide in more heavily populated areas.⁸

For children in Ontario, mandatory schooling starts in grade one at the age of six years. Nevertheless, 90 percent of all children in Ontario attend publicly funded kindergarten, which is universally offered through the public school system for two grades: Junior Kindergarten for four-year-olds, and Senior Kindergarten for five-year-olds. The percentage of children attending both years of kindergarten is similar and has stayed stable since 2006 regardless of it being half or full-day programs.⁹ The school entry cut-off date is January 1st of the year, but delayed entry or retention in early grades is virtually non-existent.¹⁰

⁷ For examples, see enrollment requirements for Toronto Catholic District School Board (2017) or Catholic District School Board of Eastern Ontario (2017).

⁸ In our analysis, we exclude ‘specialty schools’ in school boards that have significantly larger or overlapping catchment areas. These schools generally have specialty programs that draw students from across the school board.

⁹ These numbers are based on Statistics Canada population estimates (Statistics Canada, 2016a) and Ontario Ministry of Education enrollment data (Ontario Ministry of Education, 2020): 89 percent of all children attended Junior Kindergarten and Senior Kindergarten in both 2006 and 2011 (Statistics Canada, 2006 and Statistics Canada, 2011a).

¹⁰ Although we are aware of no official statistics on delayed entry or retention in early grades in Ontario, there is the possibility that some parents of children born in the fall (before the January 1st cut-off) elect to have their children start a year later, a phenomenon known as ‘redshirting.’ This practice is banned in many school boards and all available evidence suggests that it is quite rare (McDiarmid, 2013).

The full-day universal kindergarten reform in Ontario was rolled out in English Public and English Catholic school boards over a period of five years (2010–2014). Ontario also has approximately 600 French Public and French Catholic schools; these are not included in the present analysis because they had previously implemented full-day kindergarten (Dhuey et al., 2020), but French-language speakers are not excluded from the analysis. The primary objective of the reform was to reduce the number of ‘at risk’ children, i.e., children who are identified as having low readiness for school (Pascal, 2009). Breaking the cycle of poverty by increasing investment in education so that children born into poverty would not remain there was touted as a secondary aim in government publications (Government of Ontario, 2010). A 2009 Ontario provincial government budgetary report stated that it would cost \$1.5 billion to fully implement this full-day kindergarten reform, and that approximately 265,000 children aged four and five would benefit from this reform per year (Government of Ontario, 2010). The final cost, according to the Ontario Ministry of Education (2014), was 2.138 billion.

The rollout started with schools that had immediate capacity to double their kindergarten classroom space, and it also prioritized schools with high-needs students based on the percentage of low-achievement and low-income students at each school.¹¹ Figure 1 presents the cumulative implementation of full-day kindergarten in Ontario from the announcement date in September 2009 to full implementation in September 2014. In September 2010, 16.2 percent of English Public and English Catholic schools started to offer full-day kindergarten, followed by 5.7

¹¹ Prior to the rollout, many students attended half-day kindergarten, either in the morning or the afternoon.

percentage points more in 2011, 25.4 percentage points more in 2012, 24.7 percentage points more in 2013, and the remainder in 2014.

The initial implementation of the reform caused some friction, as some schools lacked the physical capacity to accommodate their kindergarten cohorts for a full day, and the initially planned rollout was based on forecasted renovation completion in schools that had to retrofit existing rooms or build new ones.¹² Additionally, the reform became a major point of contention in the period leading to the 2011 provincial elections, with the Conservative Party promising to cancel it altogether. Due to this uncertainty, September 2011 saw a rollout much smaller than initially planned. Following a Liberal victory in the election, the time to project completion increased to five years rather than three years as originally planned (Pascal, 2009).

Concurrent with this rollout, the Ministry of Ontario started to require that school boards offer before- and after-school programs (for children aged 4–12) where demand from parents and families was ‘sufficient.’ School boards or third-party providers were permitted to operate these programs, and school boards determined whether demand was ‘sufficient’ by assessing demand as well as the viability of before- and after-school programs; thus, schools and school boards had considerable latitude with regard to the provision of before- and after-school childcare.¹³ Our analysis of the introduction of full-day kindergarten may reflect a composite effect of the

¹² Few mentions of this can be found in official government documents, but it was widely reported in the news at the time; see e.g., Hammer (2010).

¹³ See Ontario Ministry of Education (2019) for more details on policies and guidelines.

increased length of the school day along with the increased probability of before- and after-school childcare.

Overall, the initial rollout plans were not random. However, actual implementation differed considerable from planned implementation, mainly due to capacity constraints (ability to open new classrooms) and political upheaval due to the provincial election. Although capacity was considered during planning, even optimistic estimates of the cost of the reform suggested that at most 35 percent of schools would be able to open immediately, with the rest requiring some level of investment (Pascal, 2009). As noted above, children living in the assigned catchment area of a school are guaranteed access if they request it, so schools scheduled to start offering full-day universal kindergarten for four- and five-year-olds could only do so if they had the capacity to enrol all potential students. Figure 2 presents the rollout in the largest school board in our sample, the Toronto District School Board, illustrating the geographic variation within the board in terms of the timing of implementation.

IV. DATA AND DESCRIPTIVE STATISTICS

The data used in this analysis come from several sources. We combine survey data from the monthly Canadian Labour Force Survey (LFS), administrative data from the Ministry of Education, student test scores from Ontario Education Quality and Accountability Office (EQAO), as well as geo-spatial data provided by individual school boards and by Canada Post.

The Statistics Canada monthly Labour Force Survey collects information on labour market outcomes. We focus on mothers surveyed between September 2008 and August 2014.¹⁴ The main advantage of these data is that we are able to precisely assign treatment year using academic rather than calendar year, which has been problematic in previous research (Gelbach, 2002). To do this, we aggregate all respondents that are surveyed between September of a given year to the following August; the academic year 2010, for example, runs from September 2010 to August 2011.¹⁵

We also use data collected by the Ontario Ministry of Education regarding when each primary school began offering full-day kindergarten and a measure of school capacity, as well as data from the Ontario Education Quality and Accountability Office (EQAO), an independent agency that administers provincial testing and provides information on grade three reading and math scores at the school level. The EQAO data used in this analysis also include information on the percentage of students in each school who need special education support and the percentage of students in each school whose first language at home is neither of Canada's official languages (English and French).

We use two important geo-spatial data sources to link all our data together: school catchment areas and postal codes. First, we hand-collected school catchment area data for all schools in

¹⁴ Here, 'mother' is defined as the female adult household member who either answered the survey or was identified by the survey respondent as his spouse who lives in the household (our sample does not include any same-sex couples).

¹⁵ Due to data limitations, we are not able to identify repeated sampling, and treat each respondent as independently sampled. However, the Labour Force Survey is designed to be used this way, as outlined in its methodology section (Statistics Canada, 2016b).

Ontario, and then matched catchment areas to postal code data. For the vast majority of our data, the school catchment area is much larger than the postal code area, so we match many postal code areas to a given school catchment area,¹⁶ as shown in Appendix Figure 1. Each specific school catchment area in a school board includes many postal codes, and catchment boundaries generally follow postal code boundaries. Next, we link the kindergarten full-day implementation year to each postal code, which allows us to assign each mother who lives in a particular postal code to a kindergarten full-day implementation year. We are able to match 250,676 postal codes with 3322 schools (English Public and English Catholic) in Ontario, a match rate of 89.8 percent.

Administrative data from the Ontario Ministry of Education and EQAO are linked to each school using board and school identifier numbers. Labour force information is linked to the postal code based on each survey respondent's residential address. We are able to assign a postal code to respondents for 93 percent of households in our sample, and then use this geographic identifier to link households to school catchment areas. The remaining seven percent did not provide a postal code when surveyed or the postal code could not be matched to a school.

Through this process, we are able to identify the academic year (from 2010 to 2014) during

¹⁶ In rural areas, postal codes can cover a very large area, and in some cases one postal code area encompasses multiple catchment areas. The matching rule is that a postal code is matched to a catchment area if the catchment area covers at least 75% of the postal code area. Our results are similar if we exclude postal codes that encompass two or more catchment areas and are available upon request.

which the vast majority of households were first offered full-day kindergarten in Ontario.¹⁷ Our final dataset includes 25,500 mothers, and 1340 schools.¹⁸

We restrict our sample to mothers aged 18–55 years at the survey date with their youngest own child aged four years. We only know the age of the youngest child in years at the time the survey data were collected. We exclude mothers of three- and five-year-olds from the sample: admission to school in Ontario is based on the age of the child in January, meaning that some children start junior kindergarten at three years, and consequently start grade one at five years; the status of these children (with regards to treatment) is uncertain.

The descriptive statistics in Table 1 show that the average labour force participation among mothers across year is 76.3 percent, with the overall average employment rate of 70.5 percent for this group. The data reveal that of the mothers in our sample, 79.1 percent work full-time conditional on employment, and the average weekly hours worked is 33.3, with the log of weekly earnings of 6.61. Absence from work refers to whether an individual who is working full-time is absent from work at any point during the reference week. According to Statistics Canada (2015), roughly a third of these absences are due to personal or family responsibilities. In our sample, we find that 20.4 percent of mothers with a four-year-old are absent from work at some point in the reference week. Reducing absenteeism is one of the ways that policymakers believe

¹⁷ The remaining schools are French Public and French Catholic schools, which rolled out kindergarten over a different schedule, in the late 1990s, as well as English Public and English Catholic schools who started offering full-day kindergarten in the academic year 2014, as we did not have data for the full academic year due to a large structural change in the Labour Force Survey.

¹⁸ Sample sizes for the Labour Force Survey are rounded to comply with confidentiality requirements of Statistics Canada Research Data Centre.

that providing full-day kindergarten can help the labour force: children spending more time in primary education is expected to result in lower absenteeism among parents. According to one study, “improving the availability of childcare [preschool] could save employers billions of dollars from avoided employee absences” (Brown et al., 2013, page 5).

The average mother in our sample is 36 years old and has two children: 37.7 percent of mothers are immigrants, 22.9 percent have not completed education at a level that exceeds high school, and 8.1 percent are single. At the neighbourhood level, 30.7 percent of respondents (or adult household members) have at least a bachelor’s degree, 85.0 percent of childless males are in the workforce, and 89.1 percent of respondents live in urban areas. The average school matched to the mothers in our sample has a 67.1 percent pass rate on EQAO math, a 61.1 percent pass rate on EQAO reading, 15.7 percent of students have special needs, and 25.0 percent of students do not speak an official language (English or French) at home.¹⁹ The average school capacity measure is 91.2 percent, which indicates that the average school has room for 8.8 percent more students based on the number of students allocated for each school.

There is some variation in all our outcome measures across time, as can be seen in Table 1, but overall there is no clear pattern. Appendix Table 1 presents the summary statistics by year and by whether the household was assigned to a treated school (FDK) or a non-treated school (NO FDK). As shown in the table, for each year, the schools that were treated generally scored

¹⁹ The EQAO results are matched to schools with a lag, meaning, for example, that the results from the academic year 2010 are assigned to the schools as their results for the academic year 2011; we did it this way to reflect the fact that if we think parents might select a school based on EQAO results, they would be unable to predict the current year’s result before enrolling their children

lower on the EQAO standardized exams and had a larger fraction of students who do not speak English nor French at home. Appendix Table 2 provides some background summary statistics of the labour market outcomes and mothers, neighbourhood, and school characteristics by subgroup.

V. EMPIRICAL STRATEGY

The goal of this research is to estimate how moving from half-day to full-day universal kindergarten affects the labour market outcomes of mothers with eligible-aged children. We use a difference-in-differences (DD) estimation strategy with pooled cross-sectional data spanning from 2008 to 2014 that exploits the rollout of the kindergarten reform.

We estimate using the following equation:

$$Y_{ist} = \alpha + \beta FDK_{st} + X'_{it}\delta + S'_{st}\phi + N'_{st}\eta + T_t + C_s + \varepsilon_{ist} \quad (1)$$

where Y_{ist} denotes the maternal labour market outcomes for individual i assigned to school s in school year t , which include indicator variables for maternal labour force participation, employment, full-time employment and absenteeism as well as the number of weekly hours of work, and the log of weekly earnings. FDK_{st} is the treatment status and corresponds to an indicator variable equal to one if a mother's household is assigned to a school that offers universal full-day kindergarten in a given year and zero otherwise for schools in the English Public Board. X'_{it} is a vector of individual-level maternal control variables: mother's age, marital status, immigration status, level of education, and number of children. S'_{st} is a vector of time-varying school-level controls: a capacity

measure indicating the ratio of existing students to available space in each school, the percentage of students in the school who met provincial standards in math and reading in grade three EQAO tests in the previous academic year, the percentage of students in the school whose first language is neither English nor French, and the percentage of students in the school with special needs.²⁰ N'_{st} is a vector of neighbourhood-level controls made up of the percentage of university-educated residents, labour force participation rate of childless males, and a rural-urban indicator.²¹ We also include school year fixed effects (T_t) to capture unobserved shocks common to all schools in Ontario in a given school year along with school fixed effects (C_s) to capture unobserved differences common to a geographic area associated with each school. School year is defined as starting in September of each year, and ε_{ist} is the usual error term.²²

We estimate linear probability models (for the probability of maternal labour force participation, employment, full-time employment, and absenteeism) and ordinary least squares models (for the number of weekly hours, and the log of weekly earnings) as our main

²⁰ EQAO tests are administered to all children in the province in grade three and are scored on a scale from one to four; the provincial standard for passing is three or higher.

²¹ Here, we define neighbourhood as a forward sortation area (FSA): an area that is characterized as having the same first three digits in the postal code. Neighbourhood variables were calculated from the Labour Force Survey (aggregated at the FSA level). School characteristics were obtained from the Ontario Ministry of Education and EQAO.

²² Given the structure of the data, one might be concerned about possible bias of the standard errors caused by serial correlation. To address these concerns, we cluster our error terms at the school level, that is, we allow for arbitrary serial correlation and heteroscedasticity for mothers whose households are assigned the same school based on their geographic location.

specifications.²³ In this model, the β is the parameter of interest and can be interpreted as the change in maternal labour market outcomes associated with having access to the universal full-day kindergarten program in a local English Public school. In the difference-in-differences specification, identification of β comes from the deviation from the trend in labour supply outcomes of mothers with eligible-aged children whose household is assigned to a school with full-day kindergarten relative to mothers with eligible-aged children whose household is assigned to a school where full-day kindergarten is not offered. If we believe that the deviations from trend are unrelated to all other unobserved characteristics, then the effect we observe is causal.²⁴

β can be interpreted as an intent-to-treat (ITT) effect, because we observe only whether a mother's household is assigned a school that offers full-day kindergarten, not whether her child actually attends full-day kindergarten that year. The ITT estimate represents a lower bound on the effects of the treatment on the treated (the effect of having a child in full-day rather than half-day kindergarten).

A mother can decline treatment in three ways: by sending her child out of catchment to a school that does not yet offer full-day kindergarten, by keeping her child home an extra year, or

²³ We also ran the specification with a probit model and obtained similar results; the results are available upon request.

²⁴ Some research in this area has used a triple difference framework to estimate the effect on labour supply. Unfortunately, in the context of this policy rollout, we do not have a natural control group that is fully untreated by the policy. However, we ran a triple difference model using mothers with two-year-olds and untreated six-year-olds as the control group as a robustness check (see Section VIB) and obtained similar results. It is important to note that using children in other Canadian provinces as a comparison group is unlikely to improve on these results, as labour trends and childcare policies differ markedly by province.

by sending her child to a school in a different type of school board.²⁵ A challenge to our identification relates to the possibility that mothers use the availability of kindergarten as the reason to send their child to a specific school, thus selecting into treatment. Parents in Ontario can send their children to a school that is not their assigned school, if the particular school requested has space to accommodate more children. Each board has slightly different rule regarding optional attendance but most follow these general rules. During the end of the calendar year, school boards review preliminary enrolment projections and decide whether each school in their board is open or closed to optional attendance. Parents are then allowed to apply for the following September enrolment in December and January to only schools that are accepting optional attendance students. Applications for junior- and senior-kindergarten are often not approved until the third week of September after the final school enrolment numbers are confirmed. Therefore, there is a lot of uncertainty around placement into non-assigned schools which lasts into the school year. Unfortunately, there are no published numbers on the percentage of kindergarten children attending a school that is not their assigned school. However, antidotal evidence regarding this issue suggests that the numbers are small. Additionally, policies on attending different schools are idiosyncratic to each school board and many boards do not even allow optional attendance for kindergarten because it is not compulsory. Bussing is not available to students who utilize optional attendance. Selecting into optional attendance, if available,

²⁵ We are not concerned with the case that some mothers might not know about the availability of full-day kindergarten in their assigned school, which is extremely unlikely. The reform itself was very widely publicized, and roughly 90 percent of children in Ontario attend kindergarten, based on Statistics Canada population estimates (Statistics Canada, 2006; Statistics Canada, 2011a).

would require students to travel farther to attend school, so they would be reliant on parents for transportation; we posit that few mothers trying to optimize their labour market opportunities would select into transporting their child to and from school.

We cannot ensure that mothers were not selecting into given locales given the fact that the specific area offered full-day kindergarten. Thus, it is possible that the provision of full-day kindergarten did not lead to changes in labour market outcomes, but rather that mothers who already want to work select into areas that offer full-day kindergarten, meaning that mothers who are less likely to work full time anyway are more likely to live in areas without full-day kindergarten. This is a limitation of this study, but it is unlikely that mothers would move residence or engage in optional attendance for the purpose of employment and thereby optimize maternal labour supply. This is also supported by the fact that actual implementation differed greatly from planned implementation, so the particular schools that were expected to offer full-day programming often changed at the last moment, and the difficulties involved in the implementation were widely known to the public. Overall, it is unlikely that a mother would move or engage in optional attendance based on the planned implementation schedule.

Nevertheless, we do include controls for observable characteristics that may be associated with selection into treatment in that context (e.g., more educated mothers might be better informed and have stronger labour force attachments) and find that the results are robust to the inclusion.

We also include controls for the determinants of rollout (high-needs schools as defined by the Ministry of Education were targeted first, conditional on capacity; high needs are defined based on a combination of low test scores and low income). As shown in Figure 2, which

presents the rollout of the reform for the Toronto District School Board, the largest in Ontario, there was no obvious systematic geographic pattern in the timing of implementation, with early- and late-implementation schools spread relatively evenly over the whole city. This lack of apparent pattern is consistent across our dataset, so it is likely that the capacity constraint provided a level of randomness to the implementation that supports our quasi-experimental strategy.

However, given the planned aspect of the rollout, we would expect that areas that have more at-risk students and more capacity would adopt full-day kindergarten earlier. Following Hoynes and Schanzenbach (2010 and 2012), we can measure this by taking school and neighbourhood data from 2009 (before the announcement of the program) to predict the timing of the school's adoption of full-day kindergarten. The dependent variable is the year in which the school started full-day kindergarten. Schools that adopted full-day kindergarten in 2010 are given a dependent variable that equals 1, schools in 2011 are assigned 2 for the dependent variable, and so on. The independent variables include all of the school and neighbourhood characteristics listed in Table 1. Table 2 presents the results.²⁶ Negative coefficients indicate that the school and neighbourhood characteristics predict an earlier roll-out date. We find that schools with a higher percentage of students who are special needs or who do not speak either French or English at home implement full-day kindergarten earlier. We also find that the higher the school capacity measure, which indicates less space in the school, as well as schools in neighbourhood with higher percentages of

²⁶ We also ran a different specification in which an indicator for full-day kindergarten implementation is regressed on the time-varying control variables. These results can be found in Appendix Table 3.

individuals who have a BA degree or greater, implement full-day kindergarten later.²⁷ While these results reveal statistically significant effects of school and neighbourhood characteristics in predicting the timing of the introduction of full-day kindergarten, most of the variation remains unexplained.

This analysis focuses on estimating the ITT effect of full-day kindergarten in the English Public system in Ontario. As noted above, the Ontario public schooling system is complex, but the majority of students attend English Public schools. We also estimate the ITT effect of the second-largest school system, English Catholic schools, in Section VC. English Catholic school boards serve roughly 28 percent of students in Ontario (Ontario Ministry of Education, 2016). As noted in Section II, for a child to attend a Catholic primary school, generally one or both parents must be Catholic, but school boards can grant exceptions. Unfortunately, our data do not include any information regarding religion, so we do not know whether a particular child would be eligible to attend a Catholic primary school. We can also run models that include an indicator variable for the year in which the first school (either English Catholic or English Public) assigned to the mother implemented full-day kindergarten. This model measures the ITT of being treated to full-day kindergarten in any English school. Finally, we also use a measure of the share of enrolment of the two schools that is being treated with full-day kindergarten associated with the mother. For instance, suppose the English Catholic school was treated in 2011 and had 50 kindergarten students and the English Public school was treated in 2013 and had 150 students.

²⁷ Corroborating evidence of these trends can be seen in the summary statistics provided in Appendix Table 1.

The FDK variable would equal 0 until 2011, in 2011 and 2012 it would equal 0.25, and in 2013 and beyond it would equal 1.

VI. RESULTS

A. Difference-in-Differences

Table 3 presents the results of estimating equation 1 for the sample of mothers aged 18–55 in Ontario with their youngest child aged four,²⁸ using six different outcome variables: labour force participation, employment, full-time employment, weekly hours of work, log of weekly earnings, and absenteeism. In Panel A, the models only include school year and school fixed effects along with the indicator variable, FDK. We find a marginally significant positive effect on hours worked and a statistically significant negative effect on being absent. Our results confirm that reducing absenteeism is a way in which access to full-day kindergarten may help mothers participate in the workforce.

We expand our model to include maternal-level individual characteristics and find similar results in Panel B as we do in Panel A, but the coefficient in column 4 for weekly hours worked is now statistically significant at the five percent level. Next, we include all the control variables, including school and community level controls in the model in Panel C, and find that the positive effect on hours worked remains stable at 1.84 additional hours a week, which translates into a 5.5 percent increase in weekly hours. We continue to estimate a negative effect on absenteeism (a

²⁸ As noted above, we only use mothers with children with four-year-olds due to data limitations. This will include a mixture of students in junior and senior kindergarten.

roughly 30 percent decline). Because we find no statistically significant increase in weekly earnings, it may be the case that the positive increase in hours is simply reflecting a decrease in absenteeism and not additional hours that are associated with additional income. We find that our results are robust to the inclusion of observable characteristics that may be associated with selection into treatment results, which provides evidence that selection into treatment is not driving the results.

Previous research on childcare subsidies or the provision of new programs has generally found statistically significant positive effects on labour force participation but with considerable heterogeneity. However, studies using more recent data, or data from countries other than the United States, have reported smaller elasticities than those using early data from the United States (Morrissey, 2017). Given the policy context of our quasi-experiment – a province with high maternal labour force attachment overall (Cattan, 2016), it may not be surprising that we find smaller and fewer significant effects on labour force outcomes than earlier studies based in the United States. However, our estimated point estimates are very consistent to the findings regarding French-speaking mothers in Ontario and Quebec (Baker et al., 2008, Dhuey et al., 2020, Haeck et al., 2015). We are not aware of any other studies measuring the effects of full-day kindergarten on material absenteeism from work. However, research has shown that increasing childcare assistance decreases absenteeism (Gullekson et al., 2014), and also that the presence of young children is related to families having more absenteeism and that women lose more days of work than men for personal or family reason (Statistics Canada, 2011b).

B. Robustness Checks

The key identifying assumption in our difference-in-differences model is that mothers assigned to the treatment schools would have labour market trends similar to those of mothers assigned to the control schools, in the absence of the treatment. Our sample includes many schools and years, which allows us to relax the common trends assumption by introducing a degree of nonparallel evolution in outcomes between schools in the absence of a treatment effect. Following Angrist and Pischke (2014), we include school specific linear time trends in Table 3 Panel D. This provides an important check on causal interpretations when using a difference-in-differences model with multi-period data. Using this model, we continue to find a positive statistically significant effect on hours worked, but the significance of the result for absenteeism decreases despite having a similar magnitude as in Panels A–C.

Another way to assess the difference-in-differences identification is to directly examine the timing of the shifts in outcome variable relative to the introduction of full-day kindergarten. Using an event study approach, we can trace out the trends in outcomes year-by-year prior to and after the introduction of full-day kindergarten. More specifically, we can estimate using the following model:

$$Y_{st} = \alpha + \sum_{j=-4}^4 \beta_j 1(\theta_{st} = j) + S'_{st} \phi + N'_{st} \eta + T_t + C_s + \varepsilon_{st} \quad (2)$$

where θ_{st} denotes the year relative to the introduction of full-day kindergarten. All coefficients are measured relative to the omitted coefficient ($\theta_{st} = -1$). Using these estimates, we can produce event study graphs for all our outcome variables. Figure 3 plots the event-year coefficients, with 95 percent confidence intervals indicated by the dashed lines. Unfortunately,

our data are not ideal for this type of analysis. First, we are unable to use a balanced panel, because due to small sample sizes we do not have observations for each school in each year. Additionally, because of the recent adoption and lag in data release, we do not consistently have four years of data post-introduction for all schools. Therefore, we can find no statistically significant event-year coefficients, and they become noisier the farther past the introduction year.

We continue to explore the robustness of our estimates by implementing a triple difference model (DDD). This is not our preferred specification because our data make it difficult to find an appropriate control group. However, running this model may help to alleviate concerns that deviations from trend might not be exogenous to unobserved characteristics. Therefore, we can estimate a DDD comparing mothers of four-year-old children assigned to a school that offers full-day kindergarten in a given year to mothers of children ineligible for full-day kindergarten (two-year-olds or six-year-olds) assigned to the same school during the same year.

$$Y_{ist} = \alpha + \beta_1 FDK_{st} + \beta_2 4yroid_{st} + \beta_3 FDK_{st} * 4yroid_{st} + X'_{it}\delta + S'_{st}\phi + N'_{st}\eta + T_t + C_s + \varepsilon_{ist} \quad (3)$$

In the DDD specification, the parameter of interest is β_3 ; it identifies the marginal effect of the policy on the treatment group (mothers of four-year-olds) relative to the control (mothers of two-year-olds or six-year-olds). In this case, identification of β_3 comes from the deviation from trend in labour supply outcomes of the treated group relative to the untreated group within an assigned school.

Table 4 lists the results from the triple-differences model. Panel A includes the estimates using two-year-olds as the control group. The coefficient on the interaction term in column 4 for the dependent variable hours worked is statistically significant and positive. This indicates that mothers with four-year-old children who were treated with full-day kindergarten work on average 1.96 more hours per week than mothers with two-year-old children who lived in the catchment area assigned to a school that was treated with full-day kindergarten. For the mother of a four-year-old who is eligible to attend, the total effect of being able to access full-day kindergarten is an increase of 1.69 hours per week (-0.27 hours from the main effect and 1.96 hours from the interaction effect), a five percent increase. We also find a marginally significant effect on full-time employment that may be driven by the increased hours. Interestingly, the coefficient on FDK when using absence as a dependent variable (column 6) is statistically significant, but the interaction is not. This indicates that mothers with either a two-year-old or a four-year-old who is assigned to a school treated by full-day kindergarten both experience a decrease in absenteeism, but the decrease is not differential for mothers of a four-year-old. This may be due to some other factor correlated with the roll-out of full-day kindergarten that is decreasing absenteeism, but it also may be that two-year-olds are not an ideal control group. Many two-year-olds will eventually be treated by full-day kindergarten and their mothers may be adjusting their labour supply or childcare arrangements given the upcoming treatment, or possibly four-year-olds moving into kindergarten freed up childcare spots for two-year-olds. However, it is also the case that full-day kindergarten is expected to be bundled with improved

before- and after-school childcare. Therefore, this may also be prompting mothers of two-year-olds to adjust their labour supply due to increased future availability of childcare.

Panel B uses un-treated six-year-olds as the control group. This is unfortunately also not an ideal control group, as some six-year-olds in the population would have been treated in earlier years, assuming that they are living in the same location as when they were aged four.²⁹ When we exclude mothers whose six-year-olds were potentially treated, we find similar results as in Panel B, except that statistical significance is lost for full-time and hours worked. We continue to find negative and statistically significant results for absenteeism, indicating that mothers with either a two-year-old or a non-treated six-year-olds who are assigned to a school with full-day kindergarten will both experience a decrease in absenteeism. Again, six-year-olds are not an ideal control group in this policy rollout due to the potential of increased availability of before- and after-school childcare in the individual schools.

C. Other specifications

As noted in Section III, our preferred specification is to use the treatment of full-day kindergarten in English Public school boards to estimate the ITT effects because most students in Ontario attend these schools. However, English Catholic school boards also serve approximately 28 percent of students in Ontario. Therefore, we can run a specification to estimate the ITT of access to full-day kindergarten in English Catholic school boards. Panel A in Table 5 displays the

²⁹ Results are similar if we use the population of all mothers of six-year-olds.

coefficient for the indicator variable that equals 1 if the English Catholic school to which the household is assigned offers full-day kindergarten in that school year. The significance and the magnitude of the coefficient on hours worked is smaller than for English Public school treatment (Table 3, column 4) but the coefficient on absenteeism continues to be negative and significant. Panel B presents the results of a model that includes an indicator variable that equals 1 as soon as the first school (either English Public or English Catholic) associated with a particular postal code offers full-day kindergarten. This measures the effect of access to full-day kindergarten regardless of school board. The results are similar to the results shown in Panel A for the ITT effect of access to full-day kindergarten in English Catholic boards. Finally, Panel C presents the results of a model that captures the treatment intensity of the availability of full-day kindergarten in both English Public and English Catholic school boards. Here, we create an intensity measure based on the share of enrolment of the two schools that are being treated with full-day kindergarten and how this is associated with the mother. The point estimate on the intensity variable for hours worked is similar in magnitude to the point estimate of our preferred model and a negative effect on absenteeism is still present regardless of the specification. Summarizing all the specifications, we consistently find that access to full-day kindergarten increases weekly hours worked and decreases absenteeism.

C. Heterogeneity

We next explore whether having access to full-day English Public kindergarten affects mothers differently based on their observable characteristics. We estimate heterogeneous effects

two separate ways in Table 6. For each outcome variable of interest, we run two different models. First, we subsample on the following observable characteristics of the mother: being a single mother (Single), having been born outside Canada (Immigrant), living in an urban area (Urban), having only one child (One child), and having a high school or lower education level (H.S. education). We run our difference-in-differences model from equation 1 and report only the coefficient on FDK. Then, we also run models in which we interact the variable of interest (FDK) with the observable characteristic indicator variables. In these models we report the coefficient for FDK, the coefficient for the interaction, and the coefficient for the observable characteristic indicator variables along with the F-statistic.

Panel A presents the results focusing on the effect of the availability of full-day kindergarten on urban mothers. Consistent with the previous results in Table 3, we find no evidence of an effect on participating in the labour force and being employed. Column 6 presents some marginally significant evidence that urban mothers are more likely to work full-time given the availability of full-day kindergarten. However, similar to Table 3, we find strong evidence in column 7 and 8 that urban mothers work on average about two hours more per week. The coefficient for FDK is the effect on rural mothers; it is not significant and close to zero. Interestingly, the interaction term between FDK and urban is not statistically significant but suggests that most of the weight of the average effect of the policy is from urban mothers. We find similarly consistent evidence for being absent from work. Urban mothers are less likely to be absent from work and we see no statistically significant relationship between the availability of full-day kindergarten and being absent from work among rural mothers.

Panel B (mothers having only one child) and Panel C (mothers with a high school or lower education level) both reveal similar patterns in results for working full-time, hours worked, and absenteeism. Panel D (mother's marital status) reveals patterns similar to those in Panels A–C but with slightly more imprecise coefficients.

Panel E presents differences between immigrant and non-immigrant mothers; the results are not consistent across the two different specifications. We find a statistically significant relationship between being an immigrant and working full time, weekly hours, and absenteeism in the sub-model specifications (columns 5, 7, and 11). However, when moving to an interaction model, we find the opposite. Here, we find that the rollout of full-day kindergarten has statistically significant effects on working full time, weekly hours, and absenteeism among non-immigrants. This difference in results from the two models may be related to a variety of reasons. For example, the interaction model is based on the assumption that the residual variance is homoscedastic, which may not be true in this case. Also, the interaction model does not include the full complement of interactions due to sample size constraints.

To explore this issue in more depth, we run models that include all the interactions; the regression coefficients for FDK and FDK interactions are presented in Appendix Table 4. The only statistically significant interaction effect is for mothers with a high school education or lower. Because interpretation of this table is difficult due to the quantity of interactions effects, we include the marginal effects for different observable characteristics. We find a positive and statistically significant effect of access to full-day kindergarten on both full-time work and hours worked among non-immigrant mothers. We also find a statistically significant effect among

mothers who live in an urban area, with 2.04 additional hours worked and less chance of being absent from work. We find similar results for mothers with one child and mothers with only a high school education or lower.

There are a few possible reasons why these effects are concentrated within these groups of mothers. It is possible that mothers in urban areas are more able to change the number of hours worked weekly than mothers in non-urban areas in Ontario because there are different patterns in female employment in rural versus urban environments in Canada, in addition to fewer childcare facilities (Phimister et al., 2001). It could also be that childcare expenses are generally more expensive in urban areas than in rural areas, if material labour outcomes are driven by the lack of affordable childcare. It is possible that childcare subsidies, in the form of full-day kindergarten, increase a mother's effective wage rate more among those with only a high school education or lower, and therefore the subsidization effects their labour market outcomes more.

In terms of other factors, it could be that having only one child signals a stronger connection to the labour force, so even a small childcare subsidy (or a slightly bigger one, such as full-day kindergarten) would be enough to induce mothers to change their labour force participation. It could also be that because full-day kindergarten is only for 6.5 hours a day, a mother working full-time will need before- and after-school care. This is most likely to be financially and/or logistically viable for mothers with one child.

Overall, we see an effect for mothers whose children have access to full-day kindergarten in English Public school boards on the intensive margin in terms of increased hours and decreased absence from work. These effects are found primarily for non-immigrant mothers who have a

low education level, only one child, and live in an urban area. Our results are consistent with much of the literature reporting stronger maternal labour market effects for single and low-income mothers (Cascio, 2009; Dhuey et al., 2020; Fitzpatrick, 2010; Havnes and Mogstad, 2011).

VII. CONCLUSION

The kindergarten reform in Ontario provides all families with four- and five-year-olds access to 6.5 hours of formal early primary education each weekday, an increase from the previous 2.5 hours. Using a robust research strategy, we find a no response in the extensive margin of labour force supply of mothers who were intended for treatment but do find an effect at the intensive margin of increased number of hours worked and decreased absenteeism. We find that access to full-day kindergarten increases hours worked and decreases absenteeism among mothers. This effect is concentrated in specific subgroups: non-immigrant, urban, low-education, one-child mothers. The heterogeneous response we observe is consistent with constraints over many dimensions: monetary, time, and possibly the availability of space or price in early childhood education centres.

Canada has a relatively high maternal labour force participation rate. In 2014, Canada was the eighth-highest of 40 OECD countries (OECD, 2019a). However, Ontario does not have particularly high levels of subsidization for childcare services (OECD, 2019b). These contextual factors serve as a moderator of the policy effects of early care subsidization. Indeed, the results of this study support the idea that increased subsidy increases some maternal labour market

outcomes by making early childcare more affordable. When applying these results in another context, it will be important to consider the economic and contextual factors. For example, larger effects may be found in a similar policy experiment in areas that have lower labour force participation or high childcare costs. Similarly, smaller effects may be found in areas with higher labour force participation and/or lower childcare costs.

A comprehensive analysis of the roll-out of full-day kindergarten, would include the benefits and costs for children, families, childcare, and the educational system. This kind of comprehensive cost benefit analysis is beyond the scope of this manuscript but will be necessary to analyze the full effects of the policy change. Additionally, because the evidence regarding expansion of subsidized programming in early years is mixed, it will be important to explore this issue in other locales. Specifically, if increasing maternal labour supply is the desired policy outcome, it will be necessary to consider expanding early education programs to predict the possible magnitudes of effect on maternal labour supply and possibly consider more targeted subsidies as a way to increase maternal labour supply.

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