

Online Appendix for

Full-Day Kindergarten: Effects on Maternal Labour Supply

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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 A.2 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 with their youngest aged four-year-old children assigned to a school that offers full-day kindergarten in a given year to mothers of youngest children ineligible for full-day kindergarten (two-year-olds or six-year-olds) assigned to the same school during the same year.

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

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 A.5 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. The results are similar if we use the population of all mothers with six-year-olds. 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.

Table A.1. Mothers' labour market outcomes, characteristics of mothers, neighborhood and schools

	All years	By year of full-day kindergarten adoption									
		2009		2010		2011		2012		2013	
		FDK	No FDK	FDK	No FDK	FDK	No FDK	FDK	No FDK	FDK	No FDK
Mothers' labour market outcomes											
Labour force participation	0.763 (0.425)	0.790 (0.400)	0.760 (0.430)	0.770 (0.420)	0.720 (0.450)	0.700 (0.460)	0.750 (0.430)	0.780 (0.410)	0.760 (0.430)	0.790 (0.400)	0.850 (0.360)
Employed	0.705 (0.456)	0.740 (0.440)	0.680 (0.470)	0.720 (0.450)	0.660 (0.470)	0.660 (0.470)	0.690 (0.460)	0.710 (0.450)	0.740 (0.440)	0.740 (0.440)	0.800 (0.400)
Full-time employment	0.791 (0.407)	0.720 (0.450)	0.800 (0.400)	0.790 (0.400)	0.770 (0.420)	0.810 (0.400)	0.760 (0.420)	0.830 (0.370)	0.800 (0.400)	0.810 (0.390)	0.720 (0.450)
Weekly hours worked	33.330 11.010	32.010 16.930	32.830 9.880	34.330 14.080	32.380 11.390	33.900 13.310	32.000 11.120	34.660 9.640	34.130 10.070	34.280 10.420	31.970 11.500
Weekly earnings (log)	6.607 (0.727)	6.480 (0.660)	6.640 (0.710)	6.510 (0.780)	6.610 (0.720)	6.530 (0.670)	6.580 (0.820)	6.660 (0.630)	6.690 (0.710)	6.690 (0.740)	6.540 (0.930)
Mothers' characteristics:											
Age	36.200 (5.400)	35.630 (4.640)	36.910 (5.240)	35.560 (5.950)	35.710 (5.440)	35.570 (5.980)	36.180 (5.150)	36.370 (5.120)	36.750 (5.230)	36.210 (5.070)	36.850 (5.330)
Only has one child	0.285 (0.451)	0.290 (0.460)	0.270 (0.440)	0.400 (0.490)	0.300 (0.460)	0.300 (0.460)	0.280 (0.450)	0.240 (0.430)	0.310 (0.460)	0.290 (0.450)	0.220 (0.420)
Immigrant	0.377 (0.485)	0.300 (0.460)	0.380 (0.490)	0.350 (0.480)	0.380 (0.490)	0.370 (0.480)	0.360 (0.480)	0.400 (0.490)	0.470 (0.500)	0.340 (0.470)	0.440 (0.500)
High school or lower education	0.229 0.420	0.320 0.470	0.210 0.410	0.230 0.420	0.240 0.430	0.340 0.470	0.170 0.380	0.240 0.430	0.150 0.350	0.190 0.390	0.170 0.380
Neighbourhood characteristics											
% individuals holding a BA+ degree	0.307 (0.189)	0.260 (0.190)	0.300 (0.180)	0.290 (0.170)	0.300 (0.180)	0.280 (0.170)	0.310 (0.180)	0.310 (0.200)	0.370 (0.200)	0.340 (0.210)	0.360 (0.210)
Labour force participation of male without children	0.850	0.840	0.870	0.840	0.860	0.840	0.850	0.850	0.840	0.840	0.780

	(0.141)	(0.170)	(0.130)	(0.120)	(0.140)	(0.150)	(0.150)	(0.130)	(0.150)	(0.160)	(0.210)
School characteristics											
% students in the school who met provincial standards in math	0.671	0.600	0.670	0.650	0.680	0.640	0.690	0.670	0.710	0.660	0.720
	(0.153)	(0.170)	(0.150)	(0.170)	(0.150)	(0.150)	(0.150)	(0.160)	(0.150)	(0.160)	(0.150)
% students in the school who met provincial standards in reading	0.611	0.530	0.610	0.540	0.600	0.560	0.620	0.640	0.660	0.640	0.680
	(0.145)	(0.130)	(0.140)	(0.140)	(0.140)	(0.140)	(0.130)	(0.140)	(0.140)	(0.150)	(0.140)
% special needs students	0.157	0.160	0.140	0.160	0.150	0.190	0.150	0.180	0.140	0.180	0.140
	(0.103)	(0.100)	(0.090)	(0.120)	(0.100)	(0.110)	(0.090)	(0.110)	(0.100)	(0.110)	(0.080)
% students who do not speak official language at home	0.250	0.320	0.240	0.300	0.270	0.260	0.270	0.290	0.280	0.230	0.240
	(0.254)	(0.300)	(0.250)	(0.250)	(0.250)	(0.240)	(0.280)	(0.280)	(0.260)	(0.230)	(0.230)
School capacity measure	0.912	0.770	0.990	0.790	0.940	0.800	0.950	0.840	0.970	0.860	1.020
	(0.375)	(0.190)	(0.600)	(0.220)	(0.310)	(0.250)	(0.300)	(0.390)	(0.350)	(0.280)	(0.300)

Notes: Mothers' labour market outcome, mothers' characteristic, and neighbourhood characteristics data is from the Canadian Labour Force Survey. School characteristics were obtained from the Ministry of Education and the Ontario Education Quality and Accountability Office. The data was linked using geospatial data provided by school boards and from Canada Post. All summary statistics are weighted using sample weights provided by Statistics Canada. The sample includes only mothers (ages 18-55) surveyed between September 2008 and August 2014 whose youngest child is four years old. Because of disclosure rules from Statistics Canada, we are unable to display the summary statistics for absenteeism, single and urban at this level of aggregation.

Table A.2. Mothers' labour market outcomes, characteristics of mothers, neighborhood and schools, by subgroup

	HS and Above	Below HS	Married	Single	Rural	Urban	Multiple Children	One Child
Mothers' labour market outcomes								
Labour force participation	0.810 (0.390)	0.600 (0.490)	0.770 (0.420)	0.670 (0.470)	0.810 (0.390)	0.760 (0.430)	0.750 (0.430)	0.800 (0.400)
Employed	0.750 (0.430)	0.540 (0.500)	0.720 (0.450)	0.570 (0.490)	0.770 (0.420)	0.700 (0.460)	0.690 (0.460)	0.730 (0.440)
Full-time employment	0.790 (0.410)	0.780 (0.410)	0.790 (0.400)	0.750 (0.430)	0.760 (0.430)	0.790 (0.400)	0.780 (0.410)	0.810 (0.390)
Weekly hours worked	33.470 10.390	32.670 13.530	33.300 11.140	33.800 9.050	33.080 12.450	33.370 10.800	33.090 11.320	33.930 10.210
Weekly earnings (log)	6.680 (0.720)	6.260 (0.650)	6.620 (0.730)	6.450 (0.620)	6.640 (0.630)	6.600 (0.740)	6.630 (0.740)	6.560 (0.700)
Absent from work	0.200 (0.400)	0.210 (0.400)	0.200 (0.400)	0.220 (0.410)	0.180 (0.380)	0.210 (0.410)	0.210 (0.410)	0.200 (0.400)
Mothers' characteristics:								
Age	36.630 (4.950)	34.680 (6.430)	36.440 (5.250)	33.230 (6.000)	36.610 (4.990)	36.130 (5.430)	36.720 (4.890)	34.830 (6.270)
Only has one child	0.280 (0.450)	0.300 (0.460)	0.270 (0.450)	0.420 (0.490)	0.150 (0.360)	0.300 (0.460)	-	-
Immigrant	0.370 (0.480)	0.410 (0.490)	0.380 (0.490)	0.290 (0.460)	0.090 (0.280)	0.410 (0.490)	0.360 (0.480)	0.410 (0.490)
High school or lower education	-	-	0.210 (0.410)	0.400 (0.490)	0.230 (0.420)	0.230 (0.420)	0.220 (0.420)	0.240 (0.430)
Single	0.060 (0.240)	0.140 (0.350)	-	-	0.020 (0.160)	0.090 (0.280)	0.070 (0.250)	0.120 (0.330)
Neighbourhood characteristics								
% individuals holding a BA+ degree	0.330	0.240	0.310	0.260	0.180	0.320	0.300	0.320

	(0.200)	(0.150)	(0.190)	(0.170)	(0.130)	(0.190)	(0.190)	(0.180)
Labour force participation of male without children	0.850	0.840	0.850	0.840	0.870	0.850	0.850	0.850
	(0.140)	(0.140)	(0.140)	(0.140)	(0.120)	(0.140)	(0.140)	(0.140)
Urban	0.890	0.890	0.880	0.970	-	-	0.870	0.940
	(0.310)	(0.310)	(0.320)	(0.180)			(0.340)	(0.240)
School characteristics								
% students in the school who met provincial standards in math	0.680	0.630	0.680	0.620	0.670	0.670	0.670	0.670
	(0.150)	(0.160)	(0.150)	(0.160)	(0.140)	(0.150)	(0.150)	(0.160)
% students in the school who met provincial standards in reading	0.620	0.570	0.620	0.560	0.610	0.610	0.610	0.600
	(0.140)	(0.140)	(0.140)	(0.150)	(0.140)	(0.140)	(0.140)	(0.140)
% special needs students	0.160	0.160	0.160	0.180	0.190	0.150	0.160	0.150
	(0.100)	(0.110)	(0.100)	(0.110)	(0.110)	(0.100)	(0.100)	(0.100)
% students who do not speak official language at home	0.240	0.280	0.250	0.240	0.040	0.280	0.240	0.280
	(0.250)	(0.280)	(0.250)	(0.250)	(0.100)	(0.260)	(0.250)	(0.250)
School capacity measure	0.920	0.880	0.920	0.830	0.870	0.920	0.920	0.900
	(0.380)	(0.360)	(0.380)	(0.290)	(0.390)	(0.370)	(0.380)	(0.370)

Notes: Mothers' labour market outcome, mothers' characteristic, and neighbourhood characteristics data is from the Canadian Labour Force Survey. School characteristics were obtained from the Ministry of Education and the Ontario Education Quality and Accountability Office. The data was linked using geospatial data provided by school boards and from Canada Post. All summary statistics are weighted using sample weights provided by Statistics Canada. The sample includes only mothers (ages 18-55) surveyed between September 2008 and August 2014 whose youngest child is four years old.

Table A.3. Determinants of full-day kindergarten start date

	FDK	FDK	FDK	FDK	FDK	FDK
% students in the school who met provincial standards in math	-0.396*** (0.094)	-0.391*** (0.094)	-0.375*** (0.094)	-0.239 (0.151)	-0.231 (0.149)	-0.228 (0.148)
% students in the school who met provincial standards in reading	0.422*** (0.105)	0.391*** (0.106)	0.395*** (0.105)	0.602*** (0.165)	0.591*** (0.166)	0.591*** (0.164)
% special needs students	0.769*** (0.090)	0.770*** (0.090)	0.763*** (0.090)	0.853*** (0.174)	0.837*** (0.173)	0.856*** (0.174)
% students who do not speak official language at home	0.181*** (0.048)	0.139*** (0.051)	0.188*** (0.057)	0.195 (0.171)	0.170 (0.163)	0.166 (0.164)
School capacity measure	-0.145*** (0.033)	-0.150*** (0.033)	-0.147*** (0.032)	-0.456*** (0.133)	-0.456*** (0.127)	-0.460*** (0.124)
Urban		0.035 (0.032)	0.032 (0.033)		0.043 (0.111)	0.029 (0.111)
% individuals holding a BA+ degree		0.093 (0.070)	0.144** (0.072)		0.657*** (0.179)	0.697*** (0.180)
Labour force participation of male without children		-0.045 (0.084)	-0.040 (0.085)		0.036 (0.134)	0.038 (0.136)
Percentage of women with one child			0.016 (0.025)			0.026 (0.040)
Immigrant			-0.067** (0.031)			-0.044 (0.056)
Age			-0.004* (0.002)			-0.002 (0.004)

Single			-0.020 (0.032)			-0.002 (0.049)
High school or lower education			0.039 (0.026)			0.042 (0.043)
School fixed effects?	no	no	no	yes	yes	yes
Observations	2700	2700	2700	2700	2700	2700
F test	31.33	22.48	25.84	8.25	16.12	16.9

Notes: ***p<0.01; **p<0.05; *p<0.1. Standard errors in parenthesis clustered at the school level. The number of observations are rounded to the nearest 100 according to vetting requirements of the Statistics Canada Research Data Centre. The level of observation is at the school level. FDK is an indicator variable for full-day kindergarten implementation. Labour force participation, employed, full-time employment, and absent from work are all indicator variables. Weekly hours of work is measured as the usual number of hours worked per week and the weekly earnings (log) is the log of the weekly earnings.

Table A.4. Difference-in-differences estimates of the impact of full-day kindergarten on maternal labour market outcomes with heterogeneous effects

	Labour force participation	Employed	Full-time	Hours worked	Log (earnings)	Absent
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Regression coefficients:</i>						
FDK	-0.010 (0.057)	0.002 (0.057)	-0.009 (0.065)	-0.622 (1.727)	-0.075 (0.103)	0.015 (0.067)
FDK * Urban	0.057 (0.058)	0.061 (0.060)	0.066 (0.066)	1.628 (1.843)	0.100 (0.110)	0.052 (0.068)
FDK * One child	0.013 (0.044)	0.015 (0.049)	0.048 (0.042)	1.398 (1.256)	-0.003 (0.080)	-0.020 (0.038)
FDK * H.S. education	0.017 (0.057)	0.018 (0.061)	-0.095 (0.066)	-3.814** (1.628)	0.031 (0.100)	-0.049 (0.052)
FDK * Single	0.058 (0.048)	0.069 (0.047)	0.069 (0.035)	1.865 (1.079)	0.142 (0.103)	0.069 (0.039)
FDK * Immigrant	0.058 (0.044)	0.060 (0.049)	0.066 (0.042)	1.843 (1.256)	0.110 (0.080)	0.068 (0.038)
<i>Marginal effects of FDK:</i>						
Rural (urban=0)	-0.025 (0.060)	-0.019 (0.060)	-0.023 (0.066)	-0.58 (1.764)	-0.099 (0.113)	0.012 (0.067)
Urban (urban=1)	0.012 (0.034)	-0.006 (0.034)	0.055* (0.032)	2.037** (0.938)	-0.020 (0.067)	-0.063** (0.030)
Only one child (one child=1)	0.018 (0.042)	0.005 (0.047)	0.078* (0.045)	2.632** (1.211)	-0.022 (0.082)	-0.069* (0.036)
Multiple children (one child=0)	0.003 (0.037)	-0.012 (0.037)	0.033 (0.032)	1.347 (1.000)	-0.032 (0.072)	-0.048 (0.032)

H.S. graduate or less (H.S. education=1)	0.001 (0.052)	-0.034 (0.055)	0.084 (0.063)	3.691** (1.661)	0.081 (0.095)	-0.084** (0.042)
Some college or above (H.S. education=0)	0.01 (0.034)	0.001 (0.034)	0.036 (0.030)	1.307 (0.889)	-0.052 (0.069)	-0.048 (0.031)
Married (single=0)	0.013 (0.034)	-0.002 (0.034)	0.045 (0.031)	1.715* (0.920)	-0.033 (0.065)	-0.053* (0.029)
Single (single=1)	-0.052 (0.062)	-0.066 (0.071)	0.061 (0.072)	1.866 (1.799)	0.022 (0.152)	-0.075 (0.073)
Non-immigrant (immigrant=0)	0.021 (0.030)	0.015 (0.033)	0.077** (0.035)	2.310** (0.924)	-0.013 (0.068)	-0.061* (0.031)
Immigrant (immigrant=1)	-0.015 (0.053)	-0.043 (0.051)	-0.014 (0.035)	0.414 (1.197)	-0.064 (0.103)	-0.041 (0.040)
Number of observations	22500	22500	18900	16200	14000	12400

Notes: ***p<0.01; **p<0.05; *p<0.1. Standard errors in parenthesis clustered at the school catchment level. FDK is an indicator variable equal to one if the school the household is assigned to offers full-day kindergarten in a particular year. Each regression includes a constant, school year fixed effects, school fixed effects, as well as individual, school, and neighborhood control variables. All models use the appropriate sampling weights provided by Statistics Canada. The number of observations are rounded to the nearest 100 according to vetting requirements of the Statistics Canada Research Data Centre. Labour force participation, employed, full-time employment, and absent from work are all indicator variables. Weekly hours of work is measured as the usual number of hours worked per week and the weekly earnings (log) is the log of the weekly earnings.

Table A.5. Triple differences of the impact of full-day kindergarten on maternal labour market outcomes

	Labour force participation	Employed	Full-time	Hours worked	Log (earnings)	Absent
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Two-year-old control group						
FDK	-0.005	0.000	0.008	-0.269	0.049	-0.074***
FDK*four-year-old child	(0.026)	(0.028)	(0.024)	(0.701)	(0.044)	(0.019)
four-year-old child	0.029	0.025	0.040*	1.957**	-0.048	-0.007
	(0.028)	(0.030)	(0.024)	(0.762)	(0.048)	(0.020)
<i>F Statistic:</i>	0.025	0.021	-0.014	-0.445	-0.019	-0.001
	(0.018)	(0.019)	(0.017)	(0.504)	(0.034)	(0.013)
FDK*four-year-old child+FDK=0	1.02	0.95	3.82*	5.27**	0.00	16.70***
Number of observations	53300	53300	43800	36500	31600	28200
Panel B: Non-treated six-year-old control group						
FDK	-0.007	0.000	0.003	0.192	0.053	-0.075***
FDK*four-year-old child	(0.028)	(0.031)	(0.030)	(0.937)	(0.056)	(0.019)
four-year-old child	0.029	0.010	0.039	1.047	-0.064	0.031
	(0.035)	(0.038)	(0.032)	(0.964)	(0.062)	(0.021)
<i>F Statistic:</i>	-0.062***	-0.042*	0.001	-0.437	0.088**	-0.001
	(0.020)	(0.022)	(0.020)	(0.592)	(0.041)	(0.013)
FDK*four-year-old child+FDK=0	0.58	0.11	2.21	2.06	0.03	4.60**
Number of observations	33909	33900	28600	24700	21500	22000

Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. Standard errors in parenthesis clustered at the school level. FDK is an indicator variable equal to one if the school where the household lives is assigned to offers full-day kindergarten in a particular year. Each regression includes a constant, school year fixed effects, school fixed effects, as well as individual, school, and neighborhood control variables. All models use the appropriate sampling weights provided by Statistics Canada. The number of observations are rounded to the nearest 100 according to vetting requirements of the Statistics Canada Research Data Centre. Labour force participation, employed, full-time employment, and absent from work are all indicator variables. Weekly hours of work is measured as the usual number of hours worked per week and the weekly earnings (log) is the log of the weekly earnings. The sample includes only mothers (ages 18-55) surveyed between September 2008 and August 2014 whose youngest child is four years old along with mothers whose youngest child is two (six) years old.

Figure A.1. Rollout of full-day kindergarten in the Toronto District School Board, by school catchment area

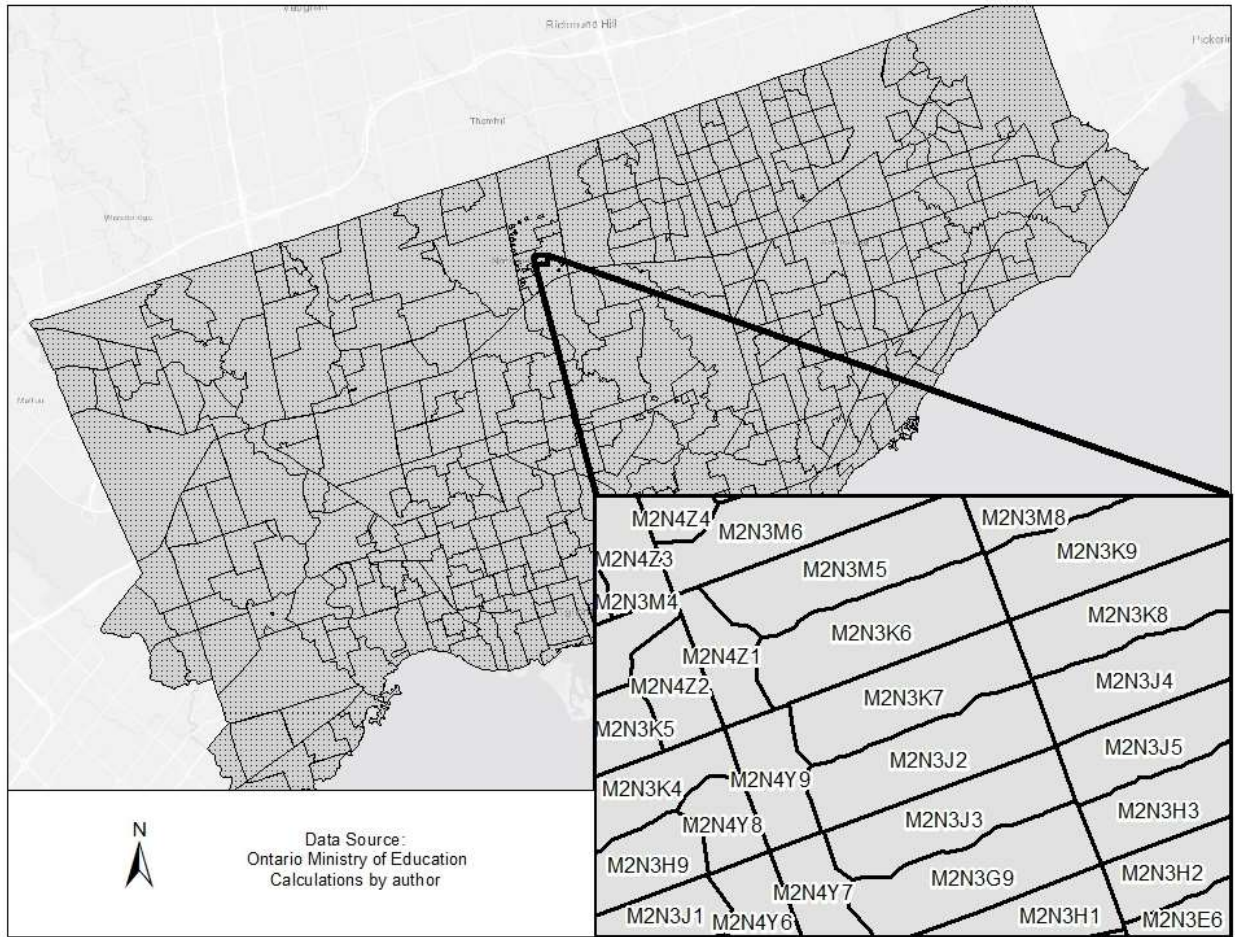
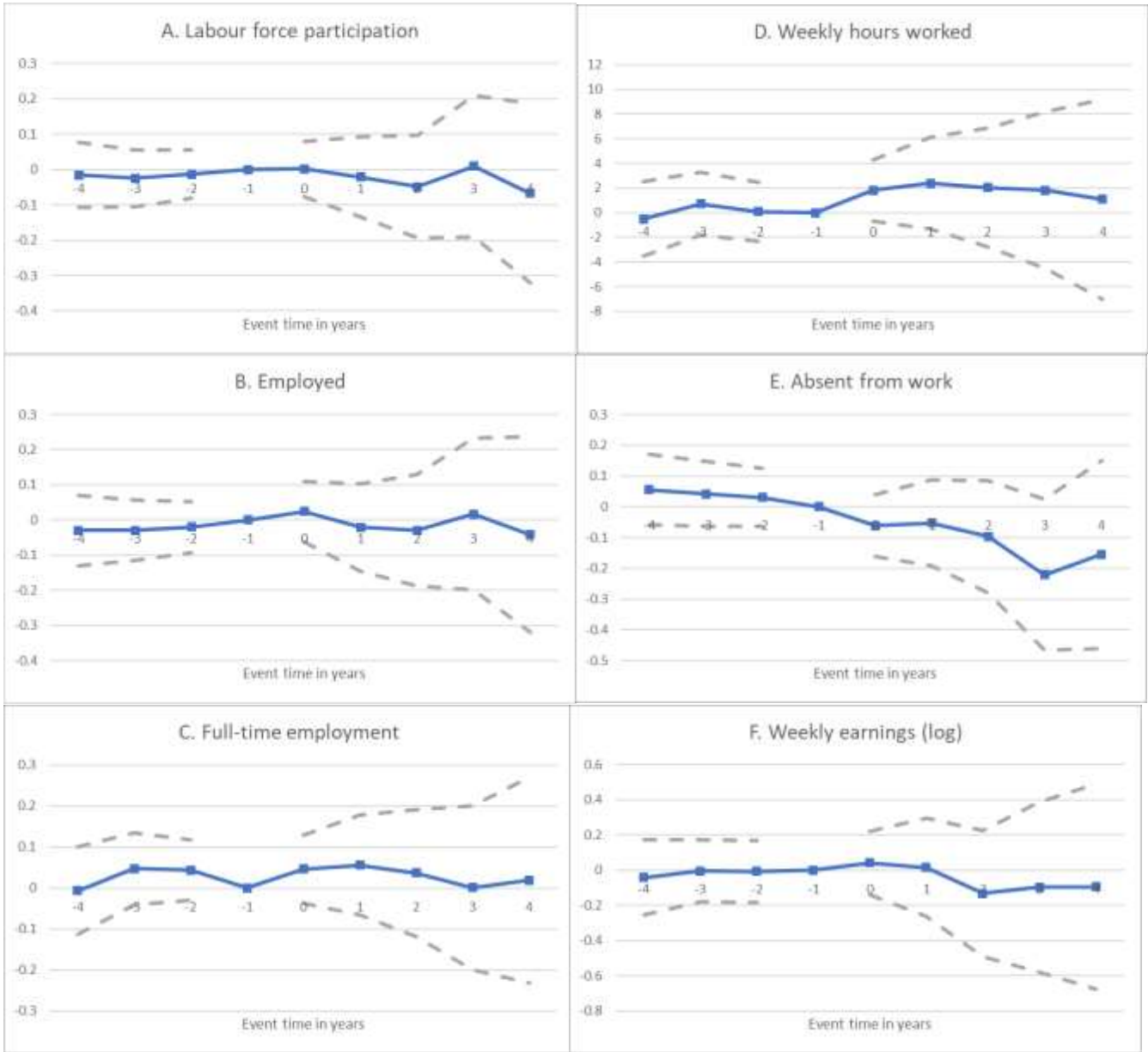


Figure A.2. Event study estimates of the impact of FDK on outcome variables



Notes: The graphs plot estimates and 95 percent confidence intervals from an event study analysis described by Equation (2). Coefficients are defined as years relative to the year the full day kindergarten was implemented in the school. Year 0 is the first year that the school was treated. The sample is an unbalanced sample of mothers linked to schools. Labour force participation, employed, full-time employment, and absent from work are all indicator variables. Weekly hours of work is measured as the usual number of hours worked per week and the weekly earnings (log) is the log of the weekly earnings.