NBER WORKING PAPER SERIES

MATERNITY LEAVE AND CHILDREN'S COGNITIVE AND BEHAVIORAL DEVELOPMENT

Michael Baker
Kevin S. Milligan

Working Paper 17105
http://www.nber.org/papers/w17105

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2011

We have benefited from comments from Josh Angrist and seminar participants at the 2011 AEA meetings, UC Davis, Laval, Manitoba, Stavanger, Texas and Waterloo. We gratefully acknowledge the research support of SSHRC (Baker Grant, #410-2008-0346, Milligan Grant #410-2006-0928). We thank the staffs of the Toronto and B.C. Research Data Centres for their technical support. This paper represents the views of the authors and does not necessarily reflect the views of Statistics Canada or the National Bureau of Economic Research.

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2011 by Michael Baker and Kevin S. Milligan. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Maternity Leave and Children's Cognitive and Behavioral Development
Michael Baker and Kevin S. Milligan
NBER Working Paper No. 17105
June 2011
JEL No. I18,J13,J32

ABSTRACT

We investigate the impact of maternity leave on the cognitive and behavioral development of children at ages 4 and 5. The impact is identified by legislated increases in the duration of maternity leave in Canada, which significantly increased the amount of maternal care children received in the second half of their first year. We carefully document that other observable inputs to child development do not vary across cohorts of children exposed to different maternity leave regimes. Our results indicate that these changes had no positive effect on indices of children's cognitive and behavioral development. We uncover a small negative impact on PPVT and Who Am I? scores, which suggests the timing of the mother/child separation due to the mother's return to work may be important.

Michael Baker
Department of Economics
University of Toronto
150 St. George Street
Toronto, ON M5S 3G7
CANADA
and NBER
baker@chass.utoronto.ca

Kevin S. Milligan
Department of Economics
University of British Columbia
#997-1873 East Mall
Vancouver, BC V6T 1Z1
CANADA
and NBER
kevin.milligan@ubc.ca

Maternity leave has emerged in many countries as the public policy of choice for improving the lives of mothers and infants after childbirth. In most cases, child development is cited as an important basis for legislative parental leave initiatives. The American *Family and Medical leave Act* states "…it is important for the development of children and the family unit that fathers and mothers be able to participate in early childrearing…".[1] A new Australian initiative aims to provide "…babies the best start in life. The payment will enable more parents to stay at home to care for their baby full-time during the vital early months of social, cognitive and physical development" (Commonwealth of Australia 2009). A recent extension of paid maternity leave in the United Kingdom seeks to "…give children the best start in life…" as the "…evidence confirms the value of consistent one-to-one care in the first year of a child's life." (Employment Relations Directorate 2006, p. 2).

These statements about the impact of maternity leave on child development are primarily based in indirect evidence. There simply aren't many studies of the direct impact of maternity leave. Instead legislation draws on evidence of the impact of maternal employment or non-parental care on child development projected onto the maternity leave statute. There are a number of reasons to wonder if this projection is appropriate.

First, universal leave statutes typically affect a different and larger group of children than the groups studied in these other literatures. For example, studies that exploit instruments for maternal employment, such as welfare reform, tell us something about the impact of maternal employment on the children of mothers who respond to this particular "treatment". Similarly, some of the best, experimental evidence on the impact of non-parental care is for children "at

[1] http://www.dol.gov/esa/whd/fmla/fmlaAmended.htm#SEC_2_FINDINGS_AND_PURPOSES

risk". Unless we assume homogeneous response within the population, it is not clear this evidence can predict the average impact of a maternity leave law.

Second, maternity leaves may affect maternal employment or the use of non-parental care in different ways than those considered in other research. In particular, parental leave can potentially affect child outcomes in two distinct ways. It changes not only the amount of time mothers spend at home with a very young child, but also the timing of the return to work. If certain ages are key for development, a mother/infant separation at those ages could affect how children develop. In contrast, instrumental variables strategies pursued in the literature often focus on more permanent effects of whether a mother works at all during the pre-school years, or over broad periods (e.g., the first or second year).

Third, maternity leaves can affect inputs that are complementary to maternal care and that may have separate effects on child development. For example, there is evidence that maternity leaves, by affecting the duration of maternal care just after birth, can affect the length of time babies are breastfed (e.g., Baker and Milligan 2008a). Again, this renders it more difficult to use the evidence of the impact of parental work on pre-schoolers to predict the impact of expanded parental leave for very young children.

Finally, whether paid or not, maternity leave policies can affect family income. If maternal care is not a perfect substitute for monetary resources, it is important to consider whether the identifying variation in these other literatures involved comparable impacts on family resources.

These arguments highlight the importance of direct evidence on the impact of maternity leave policy. This is exactly what we offer in this paper. We examine the impact of an expansion of the Canadian paid maternity leave programs on measures of children's cognitive

and behavioral development at ages 4 and 5 years. At the end of 2000, Canadian laws were passed that expanded the duration of job-protected, partially compensated maternity/parental leave from approximately 6 months to a full year. Previous research indicates that these changes increased the duration of maternal care children received in the first year of life with an offsetting reduction in unlicensed non-parental care and maternal full time work (Baker and Milligan 2010, Hanratty and Trzcinski 2009). Among women affected by the reform, the timing of the return to work changed from just under 6 months to almost 9 months post birth, on average. This approximately 50 percent increase in parental time at home in the first year of life provides a very strong basis to evaluate directly the claimed impacts of parental leaves on the child development.

Four specific features of our analysis enhance its relevance. First, the extension of leave from 26 to 52 weeks is informative for the many OECD countries that currently have short (i.e., 12-39 weeks) maternity leave entitlements (see Ray 2008). Second, the age-range we examine is the one in which previous evidence suggests that the cognitive impact of early maternal care manifests; an age that matters critically for evaluation of development. Third, the income replacement, provided through the Canadian Employment Insurance system, is relatively modest. It is comparable to the benefits provided in many jurisdictions including Australia (proposed), the United Kingdom, as well as the paid leave programs in California, New Jersey, and Washington and in U.S. states that provide maternity benefits through Temporary Disability Insurance programs (see Brustenev and Vroman 2007).[2] Finally, our primary measure of cognitive development, the Peabody Picture Vocabulary Test (PPVT), is the workhorse of research on the impacts of maternal employment. Because so much research has used this same

[2] The U.S. federal law, the Family and Medical Leave Act, provides up to 12 weeks of unpaid leave.

measure, we can compare our results directly to the existing research that is cited as a rationale for maternity leave reforms. Combined, these factors mean that we can study children at an interesting age using a standard evaluation instrument for a reform that spans the experience of many countries.

Our analysis makes use of the National Longitudinal Survey of Children and Youth (NLCY). This is a nationally representative survey of Canadian children that provides an array of developmental indicators. We focus on cognitive markers—PPVT, Know Your Numbers, Who Am I?—as well as four behavioral indices.

We find that the expansion of parental leave—and the resulting extra time mothers spent with their child in his/her first year of life—had no positive impact on indices of children's cognitive and behavioral development; this despite the fact it had substantial impacts on the maternal care and non-licensed non-parental care children received in their first year, as well as how long they were breastfed. For our behavioral indices we can rule out all but very modest improvements. For our cognitive measures the estimated impact of the reform is small, negative and statistically significant for PPVT and Who Am I?. This latter result highlights the relatively neglected issue of how changes in maternity leave laws affect the timing of the mothers' return to work. Specifically, it is consistent with the hypothesis that some ages are better than others for abrupt changes in the parent-child relationship.

Previous Literature

As noted in the Introduction there are relatively few direct evaluations of the impact of maternity/parental leaves on children's outcomes. Baker and Milligan (2010) examine the effect of the same policy reform analyzed here on behavior, parental inputs and a measure of motor and social development at ages up to 24 months. They find little evidence of an impact at those ages.

The present study is distinguished by looking at indicators of cognitive development that are not observable at the younger ages of the previous study. This is important because previous research indicates that the impact of early maternal employment/childcare does not manifest until older ages, and because cognitive development has been a key focus of previous research.[3]

Most other studies examine the longer term impacts of maternity leave. Dustmann and Schonberg (2008) investigate changes to Germany's paid leave program that increased paid leave from 2 to 6 months in the late 1970s, and from 6 to 10 months in the mid 1980s.[4] They find little evidence that this expansion of leave affected children's selective school attendance or wages. Rasmussen (2010) examines an increase in paid parental leave, from 14 to 20 weeks, in Denmark in the mid 1980s. She finds no impact on children's high school enrollment and completion, or on grade point average. Liu and Skans (2010) investigate an extension of paid parental leave from 12 to 15 months in Sweden in the late 1980s. They report no average impact on children's test scores and grades at age 16, although there is a positive effect for the children of well-educated mothers. Finally, and in contrast, Carneiro et al. (2010) find the introduction of 4 months of paid leave in Norway in the late 1970s did have positive impacts on children's educational attainment; most notably a reduction in the high school dropout rate.

When interpreting this evidence of long term impacts it is important to pay attention to the amount and timing of the increase in maternal/parental care the leave reforms induced. The evidence in Dustmann and Schonberg (2008) indicates that the primary impacts of the German reforms on maternal care are within the bounds of the legislated increases in leave: between 2 and 6 months for the reform in the late 1970s and between 6 and 10 months for the reform in the

[3] For example, Brooks-Gunn et al. (2002) find that the cognitive impact of maternal employment in the children's first year of life manifest by 36 months but not at earlier ages.
[4] A third reform considered in the analysis is an increase in unpaid leave from 18 to 36 months in the early 1990s.

mid 1980s. In Rasmussen's (2010) study there is an increase in care of 40 days off a pre-reform base of just under 18 weeks. The reform Liu and Skans (2010) investigate led to an increase in maternal care matching the change of the parameters of the law—about 3 additional months at the beginning of the second year. Even in the absence of paid leave women in Norway took 8 months off work post birth, so the change in time input Carneiro et al. (2010) analyze is in the last third of the child's first year. Therefore, Dustmann and Schonberg's (2008) first reform and Rasmussen's (2010) reform speak to changes in maternal care in the first 6 months, Dustmann and Schonberg (2008)'s second reform and Carneiro et al.'s (2010) reform concern care in the second 6 months and Liu and Skans' (2010) reform impacts care in the third 6 months.

Aside from any concerns of time, place and other characteristics of each reform, the results of these different studies would be directly comparable if we knew that children's outcomes were monotonically affected by increases in maternal care at different ages over the first years. We are not aware of any research that causally establishes this relationship. This is an important and relatively neglected dimension of maternity leave analysis, because as noted in the Introduction leave expansions affect both the duration of maternal care and the timing of the mother's return to work.

There are a few studies that provide evidence of the developmental impact of the timing of a mothers return to work in the first year.[5] Baydar and Brooks-Gunn (1991) report a statistically significant negative effect for employment by the second quarter of the first year and a statistically significant positive effect for employment in the fourth quarter among children whose mothers worked in the first year. Han et al. (2001) report employment in the first three

[5] Berger et al. (2005) report that children whose mother return to work within 12 weeks of birth have more externalizing behavior problems than those whose mothers take longer leaves. See Lucas-Thompson et al. (2010) for a review of studies that track the timing of the return to work over the first few years.

quarters of the first year has a negative cognitive impact while the impact of returning to work in the fourth quarter is statistically insignificant (although in some cases the point estimates are comparable). Brooks-Gunn et al. (2002) report a statistically significant negative impact of maternal employment by the 9th month of the first year on cognitive development at age 36 months. Estimates for employment by the 3rd, 6th and 12th months are also negative but smaller in magnitude and not statistically significant. Finally, some of the specifications that Baum (2003) estimates indicate return to work in the first quarter after birth has a negative effect on PPVT scores relative to return in the succeeding three quarters. Therefore, this evidence is mixed, as well as in many cases vulnerable to bias from unobserved differences across the children of mothers who choose to return to work at different points in time.

It is also important to recall that the impact of parental leave depends on there being a change in parental time at home. Baker and Milligan (2008b) find that shorter leaves mostly generate a 'relabeling' of time away from work rather than an expansion of actual time spent with the mother. Most of the action in return to work happens after the first few months. For example, in Brooks-Gunn et al.'s (2002) U.S. sample from the early 1990s 11 percent of mothers report working 1 month after birth, just over 50 percent report working by 3 months and just under 80 percent report working by 12 months. Therefore, the months between ages 6 and 12 months are perhaps the most relevant to policy that seeks to increase parental involvement in early childrearing, as is so often affirmed in maternity leave legislation.

The Reform

Our analysis is based on a reform of Canadian maternity/parental leave (henceforth maternity leave) laws at the end of 2000.[6] Job-protected, uncompensated, maternity leave is

[6] Many of the details are reported in Baker and Milligan (2008a).

provided by provincial labor standards laws, and historically there has been some variation in its duration across provinces. In contrast, income replacement during the leave is provided through the federal Employment Insurance (EI) system and there is one standard for the country.

Before December 31, 2000, the duration of income replacement in the EI system was 25 weeks, subject to a 2 week waiting period in which no benefits are received. This comprised a 15 week leave reserved for the mother and a 10 week leave that could be shared between the parents. From December 31, 2000 onward, the shared 10 week component of the leave was expanded to 35 weeks, bringing total available leave to 50 weeks. [7]

The legislation enacting the changes was introduced to Parliament on April 7, 2000, and received Royal Assent on June 29, 2000. Over the next six months most provinces announced increases in the duration of job-protected leave to 52+ weeks to commence coincidently with the change in the EI law.[8] In many instances the change was not announced or enacted until November or December 2000.[9] By June 2001, all provinces offered job protection of sufficient duration to accommodate the new 50 week EI standard.[10] The change by province is presented in table 1.

[7] Historically, mothers have taken the vast majority of the leave, although this is (slowly) changing in recent years. Marshall (2008) reports that in 2006, 23 percent of eligible fathers took some parental leave. This average reflects incidence of 56 percent in Quebec (where there is dedicated leave for fathers) and 11 percent in the rest the country. As documented below, observations from Quebec are deleted from our analysis sample.

[8] The changes in provincial mandates were from 29-35 weeks to 52-54 weeks with the exceptions of Alberta, where the change was from 18 weeks to 52 weeks, and Quebec, where the entitlement did not change from a level of 70 weeks.

[9] For example, as late as October 2000 Ontario did not appear on track to make the change but did eventually in December due to public outcry.

[10] Two provinces, Saskatchewan and Alberta, did not change their job protected leave standards until 2001. Unfortunately there are not sufficient observations from these provinces over the 2-6 months of delay to take advantage of this feature of the reform.

Expected impact of the reform

The reform we analyze led to an increase in the maternal care children received in their first year of life. Baker and Milligan (2008a) show this care increased by over 3 months for those affected by the reform, a 50 percent increase over the pre-reform mean of just under 6 months. There was a contemporaneous large decrease in mothers' full time employment of 59 percent (Baker and Milligan 2010). Also the proportion of children in non-parental care fell by 44 percent, almost all of which came out of unlicensed care outside the home. EI benefits available to leave takers replace earnings up to $39,000, at a rate of 55 percent. Baker and Milligan (2010) show that for a woman at median earnings using paid childcare, the after-tax after-childcare replacement rate is close to 100 percent.

The expected impact of the reform flows from any developmental benefits of increased maternal care between ages 6 and 12 months. As noted above there is relatively little previous evidence of the impact of maternal care in this age range. More generally,[11] a number of studies report negative impacts of maternal employment anytime in the first year on cognitive development, although the estimates vary in magnitude (e.g., Bernal 2008, Hill et al. 2005, James-Burdumy 2005 and Ruhm 2004).[12] Waldfogel (2006) in her review of the literature concludes "…children whose mothers work in the first year of life, particularly if they work full time, do tend to have lower cognitive test scores at age three and thereafter." (p. 55) There is also

[11] Lucas-Thompson et al. (2010) provides a summary of some of the research cited here as well as of studies on the developmental impact of maternal employment from other fields.

[12] Ruhm (2004) reports reductions in PPVT scores of 7-8 percent of a standard deviation from maternal employment in the first year, with the largest effects from full time employment. James-Burdumy (2005) and Hill et al. (2005) find maternal employment in the first year has smaller negative effects on math and reading scores measured at ages 5-18 (PPVT and the Peabody Individual Achievement Tests). Finally, Bernal (2008) reports that a full year of full time maternal employment in the first five years of life reduces test scores by 0.13 of standard deviation (PPVT and the Peabody Individual Achievement Tests.

evidence that entrance into non parental care in the first year can have negative cognitive and behavioral effects (e.g., O'Brien Caughy et al. 1994, Greg et al. 2005, Lefebvre et al. 2008, Loeb et al. 2007).[13]

A secondary factor to consider is that increases in maternal time at home post birth facilitate longer periods of breastfeeding. Baker and Milligan (2008a) report that the reform we study increased the amount of time children were breastfed by one month—a one-half month increase in exclusive breastfeeding. The impact of breastfeeding on cognitive development is generally thought to be positive, however, the evidence is mostly observational and a meta analysis has disputed this claim (Der, Batty, and Deary 2006). Recently Kramer et al. (2008b) have revisited this issue offering evidence of the effect based on a controlled experiment in Belarus; the PROBIT study reported in Kramer et al. (2001). They report that the increase in breastfeeding induced in the PROBIT study is related to an increase in cognitive development measured at 6.5 years of age of just over one-third of a standard deviation. The evidence for verbal skills is the strongest. Kramer et al. (2008a) examines the impact of breastfeeding on children's behavior at 6.5 years of age in the same experimental design, finding no effect.

The Data

[13] O'Brien Caughy et al. (1994) report that entrance into daycare before the first birthday was associated with higher test scores (Peabody Individual Achievement Tests) or lower income children and lower test scores for higher income children. For the U.K. Greg et al. (2005) find that children who receive informal care from friends and relatives in the first 18 months of life combined with full time maternal employment have lower cognitive outcomes. In the Canadian context, Lefebvre et al. (2008) report that Quebec's universal, low fee childcare program, which serves children from birth, is related to reductions in PPVT scores of just under one-third of a standard deviation. Finally, Loeb et al. (2007) find that entry into non-parental center based care before the age of one can lead to problem behavior. Magnuson et al. (2007), Baker et al. (2008), and the research summarized in Belsky (2006) provide further evidence that non-parental care can have negative behavioral effects.

The National Longitudinal Study of Children and Youth (NLSCY) is a nationally representative survey of Canada's children. The data we use is a cross section of children up to 5 years of age available biannually starting in 1994/5. There are approximately 2,000 children of each age in each wave. The 2008/09 data are the final wave of the survey.

The survey offers three measures of the cognitive development of children aged 4-5. Each of these measures is based on research and is comparable to measures used in other studies. The first measure is the Peabody Picture Vocabulary Test-revised (PPVT-R), which has been used extensively in previous studies of child development and is well known in the literature.

The second is the Number Knowledge Test, which was developed by a team led by Robbie Case at the Ontario Institute for Studies in Education (Case et al. 1996). The test consists of 30 questions that are used to rank children on a four point scale.[14] It assesses children's understanding of the system of whole numbers, probing their ability to count by rote, quantify small sets of objects, their knowledge of number sequence and their ability to solve simple arithmetic problems. The questions and answers are delivered orally, and no aids (e.g., pencil and paper) are allowed. Unfortunately the raw and standardized scores on the 30 questions are only available later waves.

The third is the "Who am I?" measure, a test developed by a team led by Molly de Lemos at the Australian Council for Educational Research (de Lemos and Doig, 1999). It consists of copying and writing tasks that help reveal children's understanding and use of symbols. The copying exercises are intended to assess abilities in geometry and the writing tasks are intended to investigate knowledge of the use of numbers, letters and words. The test consists of 10

[14] The scale is: 0—the child has not reached the predimensional level, 1—the child has reached the predimensional level (4 year old equivalent), 2—the child has reached the unidimensional level (6 year old equivalent) and 3—the child has reached the bidimensional level (8 year old equivalent).

questions that are each awarded scores between 1 and 4. The overall or total score on the instrument is simply the sum of the scores on the individual questions and therefore ranges in principle between 10 and 40.

We also investigate a number of behavioral indices. These are parent-reported measures based on best practices.[15] They measure, respectively, hyperactivity, anxiety, physical aggression and indirect aggression. Each is built up from a series of questions about the children's reactions to other people and different situations. For each index a higher score implies more problematic behavior. Parent-reported indices are not without their critics. The online appendix to Baker et al. (2008) provides a detailed discussion of these measures.

We select children aged 4 and 5 born in the years 1997-2004. These birth years bracket the changes to the maternity leave laws, yielding four pre-reform cohorts and four post-reform cohorts. Our objective here is to choose cohorts that are temporally adjacent to the reform to control as much as possible for unobserved time effects.

We omit all observations from Quebec, to account for the fact that this province's universal, low fee child care program was extended to children under the age of two in the fall of 2000, and so its effect might be easily confused with the effects of change in maternity leave laws. We also omit children who live in single parent households because concurrent changes in Canada's system of child tax benefits, which disproportionately benefited these families, might

[15] The measures are based on questions drawn from the Ontario Child Health Study, the Montreal Longitudinal Survey, and the Child Behavior Checklist of T. M. Achenbach. The Ontario Child Health Survey questions are based on items in the Child Behavior Checklist (Achenbach and Edelbrock 1983), modified so that that the symptoms canvassed correspond to the classification of psychiatric disorders in DSM-III-R (the Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association) (Boyle et al. 1993). The questions in the Montreal Longitudinal Survey are based on the Social Behavior Questionnaire. This includes 28 items from the Preschool Behavior Questionnaire (Behar and Stringfield 1974; Tremblay et al. 1987), an adaptation of the Children's Behavior Questionnaire (Rutter 1967) and the Prosocial Behavior Questionnaire (Weir, Stevenson, and Graham 1980; Weir and Duveen 1981).

confound the inference. Therefore, our results are for children in two parent/adult households, who are the majority beneficiaries of universal maternity leave policies.[16]

Our sample includes both mothers who were eligible for the leave and those who might not be eligible. Eligibility depends on the number of hours worked in the 12 months before a claim is made, and we do not observe this information in our dataset. Because these ineligible women are in the dataset, simple comparisons of outcomes across mothers/children who were or were not exposed to the reform generate intention to treat estimates, which can be scaled for treatment using the method of Bloom (1984).

An overview of our developmental measures for our sample is provided in table 2. We present the sample means for each measure as well as the means for the pre and post reform children. For each of the cognitive measures there is a decrease in the index with the reform of between 6 (PPVT) and 12 (Who Am I?) percent of a standard deviation. For the behavioral measures, in the reform period there is a decrease in both aggression indices and an increase in anxiety and hyperactivity. For these measures the changes are generally smaller--4 percent of a standard deviation or less.

We also use data from the Labour Force Survey (LFS) for part of the analysis. The primary purpose of this monthly survey is to collect information on the labor force status of Canadians. We make use of the data on labor force status, as well as questions on reasons for not actively seeking work, weekly and hourly earnings and family structure. We again exclude observations from the province of Quebec and from single-parent households.

Age in years is recorded in the LFS, but exact date of birth is not available. By sampling

[16] Alberta and Saskatchewan did not change their maternity leave provisions to match the change in the federal EI rules until after December 2000. We therefore also exclude the very small number of children born in Alberta and Saskatchewan in the months between December 2000 and the point when the provincial maternity leave mandate changed a few months later.

from either the December or January surveys we can identify year of birth with a relatively small amount of error for single year categories.[17] For the December sample, we assume the birthday is in the current year. For the January sample, we assume the birthday was in the previous year. Since the reference week for the monthly survey is the week containing the 15th day. This means our coding will miss people born in the first half of January (for the January sample) or the last half of December (for the December sample). Any impact of this error is attenuated by the fact that our ultimate objective is to divide the cohorts by whether they faced the new maternity leave regime. However, the miscoding between the 2000 and 2001 birth cohorts means that some children will erroneously be designated as "treated" and vice versa. We report results using the December sample, but the results are very similar using the January samples.

Single year age categories are available for ages 0, 3, 4 and 5. Ages 1 and 2, however, are grouped together. As a result in the December 2000 or January 2001 surveys, those aged 2 will have been exposed to the original leave regime while those aged 1 will have been born during the reform period. To address this problem we do not sample from the December 2000 or January 2001 surveys for this age group. Denoting cohorts by the birth year of the one year olds, for this age group we use four cohorts before the reform (1997 to 2000) and three cohorts born after the reform (2002 to 2004).

Empirical Framework

We want to estimate the impact of maternal time on children's developmental outcomes. To fix ideas

$$D_i = \alpha + \beta T_i + u_i,$$

[17] January and December are at the trough of the seasonal birth cycle in Canada. Compared to the U.S. the peak in monthly births in Canada occurs earlier than in the U.S., and the relative distance between peak and trough is greater. See He and Earn (2007).

where D_i is the developmental outcome, T_i is the period that the mother provides care after birth and u_i is unobserved determinants of the outcome. As has been noted in many previous papers, OLS estimation of this equation is unlikely to retrieve the causal effect of mother's time on development because $E[T_i, u_i] \neq 0$. For example, mothers who return to work early (low values of T) may have unobserved characteristics that lead their children to have better or worse developmental outcomes. We therefore need to find exogenous variation in *T* to obtain unbiased estimates of β.

Our strategy is to use the variation in time at home induced by the maternity leave reform. Our first stage equation is

(1) $TFY_i = X_i\phi + Z_i\delta + v_i,$

where TFY_i, the number of months the mother is home with her child in the first year of life now replaces T_i as a measure of maternal care,[18] *X* are control variables and *Z* is the instrument based on the reform of the maternity leave system.

We have two candidates for *Z*: 1) a dummy variable indicating that the child was born after the change in maternity leave provisions came into effect (i.e., December 31, 2000), and 2) the number of weeks of job protected maternity leave mandated by a province's labor standards law when the child was born. Relative to the first instrument, the instrument based on weeks of mandated leave potentially exploits inter-provincial differences in pre reform maternity leave

[18] The use of TFY_i rather than T_i provides a neat solution to observations with censored values of T_i because the mother is still at home with the child at the time of the survey. It also ensures that our instrument respects the monotinicity assumption required for IV. As noted by Klerman and Leibowitz (1997), it is possible that some mothers reduce their time at home post birth after an increase in the duration of mandated maternity leave if their optimal leave length is greater than but close to the post reform maximum. Empirically this does not appear to be a significant effect of the reform we investigate (Baker and Milligan 2010). Nevertheless, our instrument should have a monotonic impact on *TFY* as the post reform maximum maternity leave mandate is 12 months.

provisions. However, if the EI entitlement was greater than the local job-protection mandate, it is possible the mandates were not well-enforced or followed. Moreover, the R-squared from a regression of the provincial leave mandates on year effects is 0.88, while the addition of province effects raises the R-squared to 0.95. This suggests that our first instrument captures most of the variation in the second, in addition to the above-noted issues with the observance of provincial statutes. We therefore rely primarily on the first instrument in the analysis.

Our second stage equation is

$$(2) \quad D_i = X_i\lambda + TFY_i\varphi + \varepsilon_i.$$

Our specification of X is partly directed by any residual concerns about omitted variables in the estimation of (2). In particular, the variation in our primary instrument is perfectly correlated with time. Therefore, it is important to control for any secular trends in the developmental outcomes across birth cohorts that might contaminate the estimates. Our primary strategy to address this concern is to use polynomials in time defined at the quarter of birth level. Children born over the eight birth cohorts in our sample (1997-2004) span 32 quarters. We also experiment with other specifications of these time effects and present graphs of the variation in key variables. The other control variables are dummy variables for male children, single month of child's age at the survey date, province, city size, mothers' and fathers' education (4 categories), age (6 categories) and immigrant status, and the presence of up to 2 older or younger siblings.[19]

Note that some additional potential sources of bias are directly addressed by our choice of sample. We omit observations from Quebec and for single parent households due to changes in other policies that might affect developmental outcomes and be picked up by our instruments.

[19] The regressions for age standardized PPVT scores omit the single month of child's age. The results including these age controls are very similar to the ones reported.

An assumption—the exclusion restriction—of our instrumental variables strategy is that the reform of the leave provisions affects child outcomes only through the resulting change in mothers' time at home post birth. At least two dimensions of this assumption deserve comment. First, this means that any other maternal input (such as breastfeeding) that may change because of the extra time at home will be picked up by TFY_i. That is, TFY_i will reflect not just the direct effect of extra maternal time, but also any 'downstream' impacts of the extra maternal time on other inputs. In this sense, care must be taken in interpreting the coefficients in TFY_i. Second, we clearly assume the reform had no impact on child development by some other conduit. Our direct evidence of the impact of the reform on other developmental inputs, reported below, provides some support for this position.

A visual depiction of our identification strategy is provided in figures 1 and 2. Here we graph the variation in our measure of maternal care, TFY_i, and our most well known outcome, PPVT, across the reform. More specifically we graph estimates of year of birth effects, relative to the 1997 birth cohort, from regressions of TFY_i or PPVT on our demographic controls.[20] The cohorts 2001-2004 are exposed to the new regime. Therefore, these figures provide a view of the variation identifying our first stage and the reduced form.

In figure 1 there is clear evidence that the reform increased the amount of time mothers' were at home in the first year. The estimate for all women is an increase of 2.17 months.[21] Evidence in Baker and Milligan (2008a) indicates between 65 and 75 percent of women were eligible for the leave over this period, leading to the reported impact for treated women of between (1/0.75) 2.8 and (1/0.65) 3.3 months.

[20] The polynomials in quarter are not included here given the specification of year of birth effects.

[21] A regression of these year of birth effects on a constant and dummy variable for the reform yields an estimated impact of the reform of 2.173 (0.181). See table 3.

We relate this increase in TFY_i to any corresponding change in our development indicators. In figure 2 we can clearly see there is no evidence of a corresponding improvement in PPVT scores. In fact, it appears that these scores are marginally lower after the new leave provisions come into effect. Later in the paper, we subject this tentative finding to greater empirical scrutiny.

An alternative empirical approach for our investigation is a regression discontinuity design. We have run our analysis in a regression discontinuity framework and find results very similar to those appearing here. We prefer our instrumental variables approach because the number of observations close to the policy-change threshold in these survey data are not sufficient to realize the advantages of a regression discontinuity design.

Differences in Observable Developmental Inputs across Birth Cohorts at Ages 1 through 4

Bernal and Keane (2009) note that few empirical investigations of the relationship of current developmental outcomes to past environments consider the cumulative impact of past developmental inputs. To some extent this is because measures of past inputs are not available in most data sets. One of the strengths of our study is that we can assess the identifying assumption that there are no other changes in other developmental inputs correlated with our instruments. We test the validity of this assumption by investigating differences in developmental inputs between pre and post reform birth cohorts in the years intervening the first year and the age at which our developmental outcomes are measured. To do this, we use both the NLSCY and the LFS. Because we do not observe TFY_i in the LFS, we cannot use our instrumental variables strategy for these data. Moreover, we cannot see quarter of birth, so our strategy for the LFS can only exploit cross-year of birth variation. For these reasons, we investigate any differences in

developmental inputs across birth cohorts using a different empirical strategy than the IV strategy we use for the analysis of cognitive and behavioral development that follows.

We estimate the reduced form relationship between the inputs and our instrument following a two step procedure outlined in Baker and Milligan (2010). Briefly, we regress the developmental input on demographic controls and a full set of year of year of birth effects omitting the intercept. In the second stage we regress the 8 estimated year of birth effects from the first stage on an intercept and the instrument—a dummy variable that equals one for birth cohorts exposed to the new maternity leave provisions. The estimates of the parameter on this dummy variable reported below reveal the average difference in the dependent variable between pre and post reform birth cohorts.

We start with the NLSCY data, investigating measures of maternal care in table 3. The first row contains results for TFY_i at different ages between 13 and 71 months. Absent cohort attrition the estimates of the increase in time at home in the first year should be the same when measured at the different points of age. They are in fact very similar ranging from just under two to two and a fifth months. The estimated year of birth effects underlying these results are reported in table A1 of the appendix. For each group there is a clear break in the estimates between the 2000 and 2001 birth cohorts corresponding to the reform.

In the next row are the results for a 0/1 indicator that the mother has returned to work by the indicated age. At ages 13-24 and 25-39 months there is a marginal decrease in the proportion who have returned to work, although nether estimate is statistically significant. By 48-71 months the point estimate is still negative but very small and again not statistically significant.

The final two rows examine the family circumstances in which the child grew up, through the presence of older and younger siblings. There is little evidence here that the reform had a significant effect on the spacing of births or total fertility to this point in this sample. The estimates for all ages are statistically insignificant. There is perhaps a suggestion of a small increase in the probability of a younger sibling at the older ages.

The NLSCY does not provide good information on economic outcomes contemporaneous with the survey such as employment and income. This is in part due to the fact that the survey questions about these outcomes do not have a fixed reference point.[22] We therefore turn to the LFS to investigate these and other inputs.

The results are reported in table 4, while the underlying year of birth estimates are reported in Table A2 of the appendix. Note that the age groupings are slightly different than those in table 3 but span the same interval from 13 to 71 months.[23] In the first 4 rows are the results for labor force status as of the survey date. While there is little evidence of an impact of the reform on mothers' employment, there is a statistically significant, but small increase in the probability the employment was full time when the child was between 13 and 48 months of age. Note, however, that there is but a faint echo of this result in the estimates for usual weekly hours of work which are all positive, but generally just over 30 minutes a week on average and only statistically significant for ages 36-47 months.[24]

[22] In the case of income, the survey respondent (the person most knowledgeable about the child) supplies information for each member of the family. The reference period for the report is the previous 12 months, which is not a calendar year and varies across respondents depending on which month of the year they are interviewed.

[23] As noted earlier, the year of birth is not directly reported in the LFS. Instead, we identify the year of birth for children by selecting a sample of children in December of each year.

[24] The result for age 36-47 months does echo the larger point estimate for hours for the 25-39 months age group in the NLSCY data

The next rows contain the results for real earnings. The results for ages 13-35 months and 36-47 months are after the period of paid leave has ended, but prior to the measurement of developmental indicators. At these months, the estimates for earnings show little association of family resources with the reform. At ages concurrent with the measurement of developmental progress (48-71 months), however, there is evidence of an increase in the economic family's earnings of just under $70 per week driven primarily by the mothers' weekly earnings.

We create real earnings by converting the earnings reports to 2002 dollars using the Consumer Price Index. In the presence of a general upward trend in wages across years, our estimates here will attribute to the policy what is really just a trend in real wage growth. For this reason, we have also re-estimated these regressions deflating earnings by the growth in the Industrial Aggregate Wage from Statistics Canada's *Survey of Employment Payrolls and Hours* (catalogue 72-002-XIB). As can be seen in Appendix table A3, using these wage-growth adjusted earnings the point estimates at ages 48-71 months are smaller and none of the earnings results are statistically significant.

If the Consumer Price Index-adjusted results are to be given greater weight there is evidence of a modest increase in family resources for the post reform birth cohorts concurrent with the measurement of the developmental indices that we study. We might expect this difference in family resources to lend a small positive developmental advantage to the post reform cohorts. This would attenuate the negative impact on PPVT we observe in figure 2. However, if instead the wage adjusted results are more informative, there is no evidence of an earnings advantage to the post reform cohorts.

In the next 5 rows of table 4 are measures of maternal care that are available in the LFS.[25] First up are indicators that the mothers of these children work part-time, are not available for work or not looking for work because they are caring for their own children. We see little evidence here of a systematic difference in how the children were cared for at ages 13 through 71 months.

Next are variables that capture whether the mother has been without work since the child was born. To construct these variables we compare the year the mother last worked to the child's year of birth. For the "year before birth" (YBB) variable we code the mother as not working since giving birth if the date of last employment is the year before the year of birth. For the "year of birth" (YOB) measure we code the mother as not working since giving birth if the date of last employment is the same as the year of birth. Using the YBB method we miss some mothers who have in fact stayed at home since their child's birth. Using the YOB method we code some mothers as having stayed at home, who might have instead returned to work for a short period post birth. That said, the two methods lead to very similar conclusions. There is a very modest increase in staying at home at ages 13-35, and no evidence of an impact of the reform at older ages. Note the estimates for ages 13-35 are of similar magnitude to, but opposite sign of, the estimates for the probability the mother has returned to work for this age group in the NLSCY (table 3).

Finally, in the last two rows we look for changes in family structure through the presence of younger or older siblings. Echoing the results from the NLSCY, there is no evidence here of an impact of the reform on the fertility decisions of mothers in our sample.

[25] The LFS does not provide any direct information on whether the child is in non-parental care.

The results in table 3 and 4 tell largely the same story. There is little systematic evidence in either the NLSCY or LFS data of differences in observable inputs to child development between the pre- and post-reform birth cohorts at ages 1 through 5. This is consistent with our identifying assumption (exclusion restriction): the leave reform had concurrent effects on the amount of maternal care children received at ages 0-12 months, but did not affect other inputs across birth cohorts at older ages. That is, our results on cognitive and behavioral measures can be attributed with some confidence directly to the increase in maternal care in the first year of life and are not observably contaminated by changes in other inputs after 12 months.

OLS estimates of the impact of Mother's Care on Developmental Outcomes at Age 4 and 5

Our empirical strategy uses the change in maternal care induced by the change in maternity leave mandates to identify its impact on child development. To provide context we first present OLS estimates of the impact of this care. Perhaps the simplest way to capture the intuition behind much legislation—that maternal care has a monotonically positive impact on development—is to specify a linear impact of TFY_i.

In the first column of table 5 are the estimated coefficients on a linear specification of TFY_i, from regressions of the indicated developmental measure on TFY_i and our demographic controls including a quartic in time measured by quarter, using data for the 1997-2004 birth cohorts.[26] While all the point estimates are of the expected sign—and increase in TFY_i leads to increases in cognition and reductions in problem behavior—only the estimate for hyperactivity is statistically significant.

[26] Results are very similar using a cubic. Using 32 quarter of birth dummy variables the results are very similar except for PPVT and anxiety for which the point estimates are larger but still statistically insignificant.

In the next three columns we report the results of a second specification in which we relax the linearity assumption by specifying the quarter in which the mother returned to work over the first year as separate dummy variables. The coefficients from these three dummy variables (with a return in the first quarter being the excluded dummy) are reported for each dependent variable. While there is little new here in terms of statistical significance, the point estimates for many outcomes suggest the linear specification was inappropriate. For PPVT the point estimates indicate some advantage to delaying the return to work until the third quarter after birth—the impact of the reform we study—although the impact for delay until the fourth quarter is half as large, suggesting selection may be at play.

As discussed earlier, there are few estimates of the impact of maternal care across different time periods within the first year. It is more common to estimate its impact across the first few years of life. As a point of reference, we present the estimates from a third specification in the final three columns, specifying dummy variables for a return in each of the first three years of life, children whose mothers return to work in the fourth year or later serving as the reference group. There are statistically significant results for PPVT, Know Your Numbers and the hyperactivity measure. The estimates for PPVT are resonant of Ruhm's (2004) finding that maternal employment in the second and third years has a relative positive association with cognition. The results for the numbers test could signal cognitive gains for early exposure to early childhood enrichment. The positive estimates for the hyperactivity index (as well as for most other behavioral indices) could signal the behavioral problems associated with early entry to non parental care cited above. Of course an alternative interpretation of any of these results is the selection of mothers across different times of labor market re-entry.

IV estimates of the impact of Mother's Care on Developmental Outcomes at Age 4 and 5

In table 6 we present the IV estimates of the impact of maternal care. In the second column are the results using the dummy variable for treatment as the instrument and conditioning on the demographic controls and the quartic in time. The *F*-statistics for the instrument from the corresponding first stage regressions are reported in the first column. The instrument is very significant in each first stage regression.

The estimates for the cognitive outcomes contrast sharply with the OLS results. Each is now negative and the estimates for PPVT and Who Am I? are statistically significant. The estimate for PPVT indicates a one month increase in maternal care over the range we study leads to a decrease in this score of 8½ percent of a standard deviation. The result for Who Am I? is a decrease of 19 percent of a standard deviation. Note that the estimate for PPVT echoes the visual inference presented in figures 1 and 2.

The estimates for the behavioral measures agree in sign with the OLS results, but each is small and statistically insignificant. In each case except indirect aggression, the estimated standard error is 5 percent or less of the standard deviation of the corresponding measure. This indicates the power to detect changes in the indicators of at least 8 to 9 percent of a standard deviation at the 5 percent level.[27] Therefore, any improvement in behavior undetected by our empirical strategy would by implication be quite small.

In the third and fourth columns we experiment with the control for time effects, by specifying, in turn, a cubic in time, and a quadratic in time specified separately for the pre and

[27] For indirect aggression the largest effect undetected would be 11 per cent of a standard deviation.

post reform time periods.[28] The point estimates for the cognitive measures and the hyperactivity index are robust to these innovations although for the pre/post reform quadratic specification the standard errors are much larger. For the remaining behavioral measures, however, the point estimates vary in sign and magnitude with the controls for time.

In the fifth column we use our second instrument, weeks of mandated job protected leave, which varies at the provincial level. As explained above this instrument exploits variation in the change in leave mandate by province (see table 1). The estimated impacts for the cognitive measures are all now larger, but so are the standard errors, so that only the result for Who Am I? remains statistically significant. The estimates for the behavioral indices change less systematically and in some cases are markedly different from the results using the first instrument (e.g., aggression and hyperactivity).

Finally in the last column we draw a sample that is likely to contain a higher proportion of mothers exposed to and eligible for the changes in maternity leave under the reform—the sample of mothers who returned to work in the year following giving birth.[29] Intuitively we might expect more precise estimates from this sample. In most cases the standard errors are indeed smaller. The negative estimates for PPVT and Who am I? are still negative and statistically significant, although for the latter measure the impact is attenuated.

To try to shed more light on the meaning of the negative cognitive impacts in table 6, in table 7 we report estimates separately for some sample splits that can be supported by the sample sizes of our data. In the first two columns are estimates separately for male and female children. While the point estimates for many of the developmental measures suggest different impacts by

[28] The second stage collapses when we specify a quintic in time. The model is not identified using quarter of birth dummy variables that perfectly predict the instrument.
[29] The choice to return with the first year is potentially affected by the reform, although as reported in Baker and Milligan (2010) empirically this impact is negligible.

sex, only the results for PPVT and Who Am I? attain statistical significance. For PPVT the results suggest the impact is borne almost exclusively by males while for Who Am I? the impact is shared across the sexes.

In the second two columns we report estimates separately by mothers' education, defining one group by up to a high school diploma and the other by any post secondary education or training. While the split by sex in the sample is roughly 50/50, the split by mothers' education is roughly 25/75. The only statistically significant result by this split is for Who Am I?, indicating the impact is borne by the children of more educated mothers, who as noted represent that majority in this sample.

Discussion

The results presented in Tables 6 and 7 provide little evidence that the Canadian maternity leave reforms had a measurable positive impact on the cognitive and behavioral outcomes of children. We believe this is a significant conclusion in and of itself. Firstly, as noted in the introduction, a positive impact is assumed in legislation enacting maternity leave in many developed countries. Secondly, the reforms did have a substantial impact on the maternal care children receive in their first year of life, with consequent impacts on inputs thought significant to development such as full time maternal employment, non-licensed non-parental care, breastfeeding and exclusive breastfeeding duration.

This conclusion is consistent with most evidence of the impact of maternity leave on developmental outcomes at older ages (Dustmann and Schonberg 2008, Liu and Skans 2009, Rasmussen 2010). Each of these studies has a credible identification strategy based on sharp changes in maternity leave laws. What makes the results here of particular interest is the large change in maternal care, the measurement of children's outcomes at ages 4 and 5 and the

detailed evidence on developmental inputs in the years between the change in maternal care and the behavioral and cognitive measurement. The stated target of maternity leave policies is often the developmental outcomes of children at ages just prior to school entry. It is precisely at these ages that we find no positive effect.

The point estimates for some of our measures of behavioral development (i.e., anxiety and hyperactivity) suggest an impact of the reforms in the expected direction—better behavior.[30] Therefore, one could argue that the change in maternal care we study is still too small to have a detectable impact on behavior and/or our samples too small to precisely capture a small effect. However, note the magnitude of the improvement for these measures is sensitive to the specification of time controls and the choice of instrument.

The results for our cognitive measures are not of the expected sign, and are statistically significant for PPVT and Who Am I?. In interpreting the negative impacts on the cognitive measures it is important to note that they are small. The impact of PPVT is less than 9 percent of a standard deviation, while the impact on Who Am I? is less than 20 of a standard deviation.

We argue that the relative impacts by sex add credibility to the inference. PPVT captures skills in vocabulary, a precursor to reading. As reported by Fryer and Levitt (2010) males persistently score lower in reading tests in the primary years, as early as at fall enrollment in kindergarten. It is therefore perhaps not surprising that for these skills it is males who suffer the greater consequence to an "upset" to developmental progress in the early years.

Who Am I? is a preschool mathematics assessment tool (Doig 2005). While males are found to score higher in math in many developed countries, Fryer and Levitt (2010) report that at the kindergarten level there is not a significant difference in math skill between the sexes.

[30] Some of the point estimates for the aggression measures also indicate improvement with the reform, but in general the results for the measures are quite unstable.

Therefore, there is not a strong reason to expect any impact of the reform on Who Am I? scores to differ by sex.

A remaining question is why an increase in maternal care could have a negative, albeit small, impact on cognition. It is certainly true that there are observational studies that find early childhood education has positive impacts on cognition for which maternal care is often a substitute. However, it is not obvious what sort of critical early childhood instruction is provided to children of these very early ages when in non parental care.

We think a more promising avenue starts at the widely held, but to our knowledge not well researched, assumption that child development is monotonically increasing in the amount of maternal care in the first year. Importantly, parental leave expansions not only change the duration of maternal care but also the timing of the date of separation. It is possible that these two effects push against each other at certain ages. More care may be better, but the developmental consequences of mothers' return to work may vary in an unrestricted way over the first year. Simply put, that there may be better and worse times to make this transition over the first year from a developmental perspective.

The reform we analyze increased the maternal care in the first year by about 3 months for the treated, changing the return to work on average from just short of 6 months post birth to just shy of 9 months. Developmental psychologists observe that some key milestones are achieved in the second 6 months of life. Potentially important here are the development of stranger anxiety and separation anxiety.[31] Stranger anxiety, which is generally observed to emerge around 6-8 months, is the tendency of the child to express distress and wariness at the approach of a stranger. In earlier months such an approach might be met instead with a smile and curiosity.

[31] Our brief discussion of these milestones follows Scher and Harel (2009).

Separation anxiety refers to a child's distress from being separated from his/her parent or primary caregiver. It is thought to relate to the development of object permanence—the appreciation that objects and people continue to exist when out of sight—and emerge around the 8th month.

At a mothers' return to work, a child is separated from a parent and in many cases introduced to a stranger. Relative to a return to work before 6 months, a return between 6 and 12 months places these events in precisely the interval in which a child develops anxiety about them. More precisely, the impact of the maternity leave reform we study potentially increases the stress a child experiences when attaching to a new non parental caregiver.

Neither the direct impact on stress indicators nor any consequences for cognitive and behavioral development of the mechanism we investigate have, to our knowledge, been directly investigated (see Gunnar and Quevedo 2007 for a general discussion of stress and development in infancy). There is evidence that maternal stress transmitted to the child in utero (O'Dinnell et al. 2009, Bergman et al. 2010) or post natally through breast milk (Glynn et al. 2007) can negatively impact cognitive behavioral development (see also Glover 2011 and the references therein). Also, after the emergence of "separation protest", entry into non parental care leads to persistent elevation of cortisol levels (Ahnert et al. 2004). Furthermore the expression of stranger or separation anxiety may increase parental stress that may in turn have consequences for the child.

While the additional stress from parent/child separation at the 9th month rather than the 5th provides a potential mechanism for the small, negative cognitive effects we find, or an offset of otherwise positive effects, the means to test this hypothesis are not available in our data. However, from a developmental perspective further research on this and associated issues is

clearly critical to initiatives to refine maternity and parental leave provisions in many countries. Among other impacts, maternity leave reform typically affects the timing of mothers' return to work, and therefore of the parent/child separation, over the first year. Our reading of the literature is that open questions remain on how child development varies with the timing of this separation.

Conclusions

We investigate the impact of a change in Canada's maternity leave laws of children's cognitive and behavioral development at ages 4 and 5. The change in the law increased the duration of job-protected, partially-compensated leave from approximately 6 months to one year. This led to large contemporaneous changes in important inputs to children's development: maternal care, maternal full time employment, unlicensed non-parental care, and breastfeeding duration.

We find that these changes had no positive impact on indices of behavioral and cognitive development. For our behavioral indices we can rule all but very modest improvements. Our estimates for the cognitive indices are small, negative, and statistically significant in two of three cases. For example, for PPVT we estimate that a one month increase in maternal care over the range we examine leads to a reduction of less than 9 percent of a standard deviation.

Our results highlight the possibility that child development is not monotonically increasing in the amount of maternal care received in the first year—there may be better and worse times for mothers to make the transition back to work in this period. Because "more is better" appears to be the working assumption of maternity leave laws in many countries, there is clearly a need to better understand the developmental consequences of mothers' return to work over the ages typically spanned by these policies.

References

Achenbach, T. M., and C. Edelbrock (1983), *Manual for the Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT: Queen City Printers.

Ahnert, Lieselotte, Megan R. Gunnar, Michael E. Lamb, and Martina Barthel (2004), "Transition to Child Care: Associations With Infant–Mother Attachment, Infant Negative Emotion, and Cortisol Elevations" *Child Development*, 75(3) 639 – 650.

Baker, Michael and Kevin Milligan (2008a), "Maternal Employment, Breastfeeding, and Health: Evidence from Maternity Leave Mandates," *Journal of Health Economics*, Vol. 27, July, 871-887.

Baker, Michael and Kevin Milligan (2008b), "How does job-protected maternity leave affect mothers' employment?" *Journal of Labor Economics*, Vol. 26, No. 4, pp. 655-691.

Baker, Michael and Kevin Milligan (2010), "Evidence from maternity leave expansions of the impact of maternal care on early child development," *Journal of Human Resources*, 45, Winter, 1-32.

Baker, Michael, Jonathan Gruber, and Kevin Milligan (2008), "Universal Childcare, Maternal Labor Supply, and Family Well-being," *Journal of Political Economy*, Vol. 116, No. 4, pp. 709-745.

Baum, Charles L., (2003) "Does Early Maternal Employment Harm Child Development? An Analysis of the Potential Benefits of Leave Taking", *Journal of Labor Economics*, 21(2) 409-448.

Baydar, N., & Brooks-Gunn, J. (1991). "Effects of maternal employment and child-care arrangements on preschoolers' cognitive and behavioral outcomes: Evidence from the children of the National Longitudinal Survey of Youth." *Developmental Psychology, 27,* 932–945.

Behar, Lenore, and Samuel Stringfield (1974), "A Behavior Rating Scale for the Preschool Child," *Developmental Psychology* 10 (September), pp. 601–10.

Belsky, J. (2006), "Early child care and early child development: Major findings of the NICHD study of early child care," *European Journal of Developmental Psychology*, Vol. 3, No. 1, pp. 95-110.

Berger, L. M., Hill, J., & Waldfogel, J. (2005). "Maternity leave, early maternal employment and child health and development in the US." *Economic Journal*, 115, F29–F47.

Bergman, Kristin, Pampa Sarkar, Vivette Glover, and Thomas G. O'Connor (2010) "Maternal Prenatal Cortisol and Infant Cognitive Development: Moderation by Infant–Mother Attachment", *Biological Psychiatry,* 67 1026–1032

Bernal, R. (2008), "The Effect of Maternal Employment and Child Care on Children's Cognitive Development." *International Economic Review*, Vol. 49, No. 4, pp. 1173-1209.

Bernal R and M Keane, (2009) "Web Appendices to Accompany 'Child Care Choices and Children's Cognitive Achievement: The Case of Single Mothers'", http://economia.uniandes.edu.co/profesores/planta/Bernal_Raquel/documentos_de_trabajo

Blau, F. D., & Grossberg, A. J. (1992). Maternal labor supply and children's cognitive development. *Review of Economics and Statistics*, 74, 474–481.

Bloom. Howard S. (1984), "Accounting for no-shows in experimental evaluation designs," *Evaluation Review*, Vol. 8, pp. 225-246.

Brooks-Gunn, Jeanne, Wen-Jui Han, and Jane Waldfogel (2002), "Maternal Employment and Child Cognitive Outcomes in the First Three Years of Life: The NICHD Study of Early Child Care," *Child Development*, Vol, 73, No. 4, pp. 1052-1072.

Brusentsev, Vera and Wayne Vroman (2007), "Compensating for Birth and Adoption", The Urban Institute.

Boyle, Michael H., David R. Offord, Yvonne Racine, Jan E. Fleming, Peter Szatmari, and Mark Stanford (1993), "Evaluation of the Revised Ontario Child Health Study Scales," *Journal of Child Psychology and Psychiatry* Vol. 34 (February), pp. 189–213.

Carneiro, Pedro, Loken, Katrine and Kjell G. Salvanes, (2010) "A Flying Start? Long Term Consequences of Maternal Time Investments in Children During Their First Year of Life", IZA Discussion Paper No. 5362.

Case, Robbie, Okamoto, Yukari, Griffin, Sharon, McKeough, Anne, Bleiker, Charles Henderson, Barbara, Stephenson, Kimberly Marra, Siegler, Robert S., and Daniel P. Keating, (1996). The role of central conceptual structures in the development of children's thought. *Monographs of the Society for Research in Child Development*, 61,1/2.

Commonwealth of Australia (2009), *Australia's Paid Parental Leave Scheme*, CanPrint Communications Pty Ltd.

de Lemos, M. and Doig, B. (1999), *Who Am I?*: Developmental Assessment: Melbourne. ACER.

Der, Geoff, G. David Batty, and Ian J. Deary (2006), "Effect of breast feeding on intelligence in children: prospective study, sibling pairs analysis, and meta-analysis," *British Medical Journal*, October 4th.

Doig, Brian, (2005), "Developing Formal Mathematical Assessment for 4- to 8-Year-Olds", *Mathematics Education Research Journal*, 16(3) 100–119

Donald, Stephen G. and Kevin Lang (2007), "Inference with Difference in Differences and Other Panel Data," *The Review of Economics and Statistics*, Vol. 89, No. 2, pp. 221-233.

Dustmann, Christian, and Uta Schonberg (2008), "The Effect of Expansions in Leave Coverage on Children's Long-Term Outcomes," Bonn: Institute for the Study of Labor Working Paper No. 3605.

Employment Relations Directorate (2006), *The Maternity and Parental Leave (Amendment) Regulations 2006 and the Paternity and Adoption Leave (Amendment) Regulations 2006, Full Regulatory Impact Assessment*, London: Department of Trade and Industry, June.

Glover Vivette (2011), Annual Research Review, "Prenatal Stress and the Origins of psychopathology: an evolutionary perspective" *Journal of Child Psychology and Psychiatry* 52:4, pp 356–367.

Glynn LM, Davis EP, Schetter CD, Chicz-Demet A, Hobel CJ, Sandman CA (2007), "Postnatal maternal cortisol levels predict temperament in healthy breastfed infants." *Early Human Development* 83(10) 675-81.

Gunnar M, Quevedo K, (2007) , "The neurobiology of stress and development" *Annual Review of Psychology*, 58 145-73.

Han, W. J., Waldfogel, J., & Brooks-Gunn, J. (2001). "The effects of early maternal employment on later cognitive and behavioral outcomes." *Journal of Marriage and the Family*, 63, 336–354.

Hanratty, Maria and Eileen Trzcinski (2009), "Who Benefits from Expanded Paid Parental Leave? Impact of Parental Benefit Expansions in Canada on Mothers' Employment after Birth," *Journal of Population Economics*, Vol. 22, No. 3, pp. 1432-1475.

He, Daihai and David J.D. Earn (2007), "Epidemiological effects of seasonal oscillations in birth rates," *Theoretical Population Biology*, Vol. 72, No. 2, pp. 274-291.

Hill, J., Jane Waldfogel, Jeanne Brooks-Gunn, and W.-J. Han (2005), "Maternal Employment and Child Development: A Fresh Look Using Newer Methods," *Developmental Psychology*, Vol. 41, No. 6, pp. 833-850.

James-Burdumy, Susanne (2005), "The Effect of Maternal Labor Force Participation on Child Development," *Journal of Labor Economics*, Vol. 23, No. 1, pp. 177-211.

Klerman, Jacob Alex and Arleen Leibowitz, (1997), "Labor supply effects of state maternity leave legislation." In *Gender and Family Issues in the Workplace*, eds. Francine D. Blau and Ronald G. Ehrenberg. New York: Russell Sage Foundation.

Kramer, Michael S. Beverley Chalmers, Ellen D. Hodnett, Zinaida Sevkovskaya, Irina Dzikovich, , Stanley Shapiro, Jean-Paul Collet, Irina Vanilovich, Irina Mezen, Thierry Ducruet, George Shishko, Vyacheslav Zubovich, Dimitri Mknuik, Elena Gluchanina, Viktor Dombrovskiy, Anatoly Ustinovitch, Tamara Kot, Natalia Bogdanovich, Lydia Ovchinikova,

Elisabet Helsing for the PROBIT Study Group (2001), "Promotion of Breastfeeding Intervention Trial (PROBIT): A Randomized Trial in the Republic of Belarus" *Journal of American Medical Association*, January 24/31—Vol 285, No. 4, pp. 413-420.

Kramer MS, Matush L, Vanilovich I, Platt RW, Bogdanovich N, Sevkovskaya Z, Dzikovich I, Shishko G, Mazer B for the Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group (2007a), "Does prolonged and exclusive breastfeeding reduce the risk of allergy and asthma? New evidence from a large randomized trial," *British Medical Journal*, Vol. 335, pp. 815-820

Kramer MS, Fombonne E, Igumnov S, Vanilovich I, Matush L, Mironova E, Bogdanovich N, Tremblay RE, Chalmers B, Zhang X, Platt RW for the Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group (2008a). "Effects of prolonged and exclusive breastfeeding on child behavior and maternal adjustment: Evidence from a large randomized trial," *Pediatrics*, Vol. 121, pp. e435-e440.

Kramer MS, Aboud F, Mironova E, Vanilovich I, Platt RW, Matush L, Igumnov S, Fombonne E, Bogdanovich N, Ducruet T, Collet J-P, Chalmers B, Hodnett E, Davidovsky S, Skugarevsky O, Trofimovich O, Kozlova L, Shapiro S for the Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group (2008b). "Breastfeeding and Child Cognitive Development: New evidence from a large randomized trial," *Arch Gen Psychiatry*, Vol. 65, pp. 578-584.

Lefebvre, Pierre Merrigan, Philip and Matthieu Verstraete, (2008) Childcare Policy and Cognitive Outcomes of Children: Results from a Large Scale Quasi-Experiment on Universal Childcare in Canada, CIRPEE, Cahier de recherche/Working Paper 08-23.

Liu, Qian and Oskar Nordstrom Skans (2010) "The Duration of Paid Parental Leave and Children's Scholastic Performance," *The B.E. Journal of Economic Analysis & Policy*, 10(1)_ (Contributions), Article 3.

Loeb, Susanna, Margaret Bridges, Daphna Bassok, Bruce Fuller, and Russell W. Rumberger (2007), "How much is too much? The influence of preschool centers on children's social and cognitive development," *Economics of Education Review*, Vol. 26, No. 1, pp. 52-66.

Lucas-Thompson, Rachel G., Goldberg, Wendy A., and JoAnn Prause, (2010) "Maternal Work Early in the Lives of Children and its Distal Association with Achievement and Behavior Problems: A Meta Analysis" *Psychological Bulletin*, 136(6) 915–942.

Magnuson, Katherine A., Christopher Ruhm, and Jane Waldfogel (2007), "Does prekindergarten improve school preparation and performance?" *Economics of Education Review*, Vol. 26, No. 1, pp. 33-51.

Marshall, Katherine (2008), "Father's use of Paid Parental Leave, *Perspectives on Labour and Income*, June, pp. 5-14.

O'Brien Caughy, Margaret, Janet DiPietro, and Donna Strobino (1994), "Daycare Participation

as a Protective Factor in the Cognitive Development of Low-income Children," *Child Development*, 65, 457-471.

O'Dinnell, K., O'Connor, T.G. and V. Glover, (2009) "Prenatal Stress and Neorodevelopment of the Child: Focus on the HPS Axis and the Role of Placenta", *Developmental Neuroscience*, 31, 285-292.

Rasmussen, A.W., (2010) "Increasing the length of parents' birth-related leave: The effect on children's long-term educational outcomes", *Labour Economics*, 17 (1), 91-100.

Ray, Rebecca (2008), *A Detailed Look at Parental Leave Policies in 21 OECD Countries*, Washington DC: Center for Economic and Policy Research, September.

Ruhm, Christopher J. (2004) "Parental Employment and Child Cognitive Development," *Journal of Human Resources*, Vol. 39, No 1, pp. 155-192.

Rutter, Michael (1967), "Children's Behavior Questionnaire for Completion by Teachers: Preliminary Findings," *Journal of Child Psychology and Psychiatry* Vol. 8, pp. 1–11.

Scher, Anat and Judith Harel (2009), "Separation and Stranger Anxiety" in Janette B. Benson and Marshall M. Haith (eds.) *Social and Emotional Development in Infancy and Early Childhood*, Oxford, Academic Press, 380-389.

Schwartz, Kendra, Hannah J.S. D'Arcy, Brenda Gillespie, Janet Bobo, Marylou Longeway, Betsy Foxman (2002), "Factors associated with weaning in the first 3 months postpartum" *Journal of Family Practice*, Vol. 51, No. 5.

Tremblay, R. E., F. Vitaro, C. Gagnon, C. Piche, and N. Royer (1992), "The Prosocial Scale for the Preschool Behaviour Questionnaire: Concurrent and Predictive Correlates," *International Journal of Behavioural Development* Vol. 15, pp. 227–45.

Waldfogel, Jane (2006), *What Children Need*, Cambridge MA: Harvard University Press.

Weir, Kirk, and Gerard Duveen (1981), "Further Development and Validation of the Prosocial Behaviour Questionnaire for Use by Teachers," *Journal of Child Psychology and Psychiatry* Vol. 22, pp. 357–374.

Weir, Kirk, J. Stevenson, and P. Graham (1980), "Behavioral Deviance and Teacher Ratings of Prosocial Behavior," *Journal of the American Academy of Child Psychiatry* Vol. 19, No. 1, p. 68-77.

Table 1: Mandated, Job Protected, Unpaid Maternity/Parental Leave by Province

Province	Weeks Pre Reform	Weeks Post Reform	Date of Change
Newfoundland	29	52	December 31 2000
P.E.I.	34	52	December 31 2000
Nova Scotia	34	52	December 31 2000
New Brunswick	29	54	December 31 2000
Quebec	70	70	
Ontario	35	52	December 31 2000
Manitoba	34	54	December 31 2000
Saskatchewan	30	52	June 14 2001
Alberta	18	52	February 7 2001
British Columbia	30	52	December 31 2000

Notes: The reform of the Employment Insurance benefit entitlement for maternity/parental leave increased the duration of benefits from 25 to 50 weeks effective December 31 2000.

Table 2: Mean Values of Developmental Indicators

Indicator	N	Full Sample	Pre Reform	Post Reform
PPVT	9958	101.87	102.27	101.40
		(15.37)	(15.15)	(15.62)
Know Your	9977	1.37	1.39	1.34
Numbers		(0.58)	(0.59)	(0.58)
Who Am I?	9485	24.77	25.16	24.34
		(6.29)	(6.04)	(6.53)
Aggression	10994	1.64	1.68	1.60
		(1.88)	(1.91)	(1.85)
Indirect	10788	0.52	0.55	0.48
Aggression		(1.08)	(1.09)	(1.07)
Anxiety	10995	1.98	1.95	2.00
		(1.93)	(1.90)	(1.97)
Hyperactivity	10969	3.93	3.87	3.98
		(2.65)	(2.66)	(2.64)

Notes: Full sample are means for the birth cohorts 1997-2004. Pre reform denotes the 1997-2000 birth cohorts, while post reform denotes the 2001-2004 birth cohorts.

Table 3: Estimated impact of longer maternity leave mandates on observable inputs to childhood development from the NLSCY

	Age 13-24 Months	Age 25-39 Months	Age 48-71 Months
Time mother home in first year	1.946** (0.110)	2.206** (0.178)	2.172** (0.181)
Mother returned to work post-Birth	-0.016 (0.021)	-0.012 (0.026)	-0.005 (0.015)
Child has younger sibling(s)	0.001 (0.007)	0.022 (0.016)	0.024 (0.19)
Child has older sibling(s)	-0.012 (0.031)	-0.023 (0.013)	-0.006 (0.015)

Notes: The reported statistics are from an 8 observation regression of the indicated input by year of birth on a constant and a dummy variable for birth cohorts exposed to the new maternity leave provisions. * and ** indicate statistical significance at the 10% and 5% levels respectively.

Table 4: Estimated impact of longer maternity leave mandates on observable inputs to childhood development from the LFS

	Age 13-35 Months	Age 36-47 Months	Age 48-59 Months	Age 60-71 Months
Mother Employed	0.009	0.027	-0.004	-0.010
	(0.009)	(0.015)	(0.011)	(0.008)
Mother Employed Full Time	0.022**	0.047*	0.034**	0.007
	(0.008)	(0.020)	(0.013)	(0.010)
Mother's Usual Weekly Hours	0.659	1.157*	0.771	0.671
	(0.427)	(0.545)	(0.506)	(0.502)
Mother Not in the Labor Force	-0.011	-0.014	-0.002	0.015
	(0.009)	(0.015)	(0.011)	(0.013)
Mother's Real Weekly Earnings	4.552	16.020	40.075*	37.235*
	(17.635)	(35.850)	(18.966)	(17.761)
Mother's Real Hourly Earnings	-0.102	0.212	0.984**	0.775*
	(0.342)	(0.669)	(0.313)	(0.338)
Economic Family's Real Weekly Earnings	6.916	57.595	68.770**	63.805**
	(16.395)	(33.104)	(16.734)	(15.351)
Mother working PT to care for own children	-0.007	-0.016*	-0.004	-0.0008
	(0.015)	(0.007)	(0.009)	(0.0109)
Mother not available for work-caring for own children	0.0014**	0.000	-0.002	-0.0001
	(0.0005)	(0.000)	(0.001)	(0.0007)
Mother not looking for work-caring for own children	0.004	-0.000	0.002	0.003
	(0.003)	(0.003)	(0.004)	(0.003)
Stay at Home Mother (YBB)	0.019**	-0.003	0.003	-0.014
	(0.004)	(0.009)	(0.009)	(0.008)
Stay at Home Mother: (YOB)	0.018**	0.007	-0.002	-0.003
	(0.003)	(0.014)	(0.012)	(0.008)
Mother has younger children	0.002	0.014	0.009	-0.007
	(0.009)	(0.009)	(0.013)	(0.017)
Mother has older children	0.007	-0.016	-0.016	-0.017
	(0.007)	(0.019)	(0.019)	(0.024)

Notes: The reported statistics are from an 8 observation (7 for ages 13-35) regression of the indicated input by year of birth on a constant and a dummy variable for birth cohorts exposed to the new maternity leave provisions. * and ** indicate statistical significance at the 10% and 5% levels respectively.

Table 5: OLS Estimates of the Impact of Maternal Care on Developmental Outcomes

	Estimates for Maternal Care in the First Year				Estimates for Maternal Care in the First Three Years		
	Specification 1	Specification 2			Specification 3		
	Linear	Q2	Q3	Q4	Year 1	Year 2	Year 3
PPVT	0.036	0.147	1.174	0.524	0.423	1.756*	1.053
	(0.068)	(0.972)	(1.011)	(0.937)	(0.593)	(0.941)	(1.401)
Know Your Numbers	0.001	0.009	0.044	0.020	0.043**	0.063**	-0.020
	(0.002)	(0.032)	(0.034)	(0.027)	(0.021)	(0.031)	(0.027)
Who Am I?	0.010	0.071	0.317	0.108	0.013	0.200	-0.041
	(0.024)	(0.315)	(0.351)	(0.308)	(0.205)	(0.273)	(0.516)
Aggression	-0.108	-0.118	-0.152	-0.200*	0.016	0.020	0.032
	(0.086)	(0.111)	(0.118)	(0.103)	(0.071)	(0.111)	(0.155)
Indirect Aggression	-0.005	-0.064	-0.025	-0.078	0.041	0.071	-0.091
	(0.005)	(0.067)	(0.071)	(0.066)	(0.051)	(0.0.72)	(0.104)
Anxiety	-0.000	-0.084	-0.040	-0.045	-0.091	0.110	-0.136
	(0.009)	(0.116)	(0.127)	(0.109)	(0.079)	(0.116)	(0.152)
Hyperactivity	-0.025**	-0.135	-0.129	-0.286*	0.106	0.078	0.494**
	(0.012)	(0.167)	(0.170)	(0.149)	(0.105)	(0.154)	(0.244)

Notes: All estimates are from regressions of the indicated development measure on the demographic controls, a quartic in time (quarter) and the indicated control for the amount of time the mothers remains not at work post birth. The three specifications are 1) linear, 2) the indicated dummy variables for return to work in the second (Q2), third (Q3) or fourth (Q4) quarter of the first year and 3) the indicated dummy variables for return to work in the first (Year 1), second (Year 2) or third (Year 3) year following the birth. * and ** indicate statistical significance at the 10% and 5% levels respectively.

Table 6: Two Stage Least Squares Estimates of the Impact of Maternal Care on Developmental Outcomes

	F-stat for Instrument from First Stage	Sample				
		All Mothers				Mothers Who Return to Work in First Year
PPVT	47.47	-1.313**	-1.250**	-1.030	-1.545	-1.169**
		(0.622)	(0.627)	(0.670)	(1.010)	(0.567)
Know Your Numbers	29.81	-0.008	-0.015	-0.015	-0.071	0.002
		(0.029)	(0.028)	(0.033)	(0.052)	(0.024)
Who Am I?	26.52	-1.204***	-1.054***	-1.044**	-1.539**	-0.568**
		(0.404)	(0.373)	(0.444)	(0.706)	(0.277)
Aggression	36.48	-0.009	0.013	0.019	-0.127	-0.067
		(0.093)	(0.092)	(0.107)	(0.144)	(0.079)
Indirect Aggression	33.75	-0.024	0.013	-0.034	-0.054	0.001
		(0.063)	(0.060)	(0.070)	(0.091)	(0.045)
Anxiety	35.16	-0.035	-0.000	-0.003	-0.023	-0.012
		(0.096)	(0.097)	(0.112)	(0.149)	(0.084)
Hyperactivity	35.81	-0.073	-0.063	-0.094	-0.010	-0.108
		(0.127)	(0.126)	(0.147)	(0.214)	(0.111)
Instrument		Dummy for Treatment	Dummy for Treatment	Dummy for Treatment	Mandated Leave	Dummy for Treatment
Control for Time		Quartic in Time (Quarter)	Cubic in Time (Quarter)	Pre/Post Policy Change Quadratic in Time (Quarter)	Quartic in Time (Quarter)	Quartic in Time (Quarter)

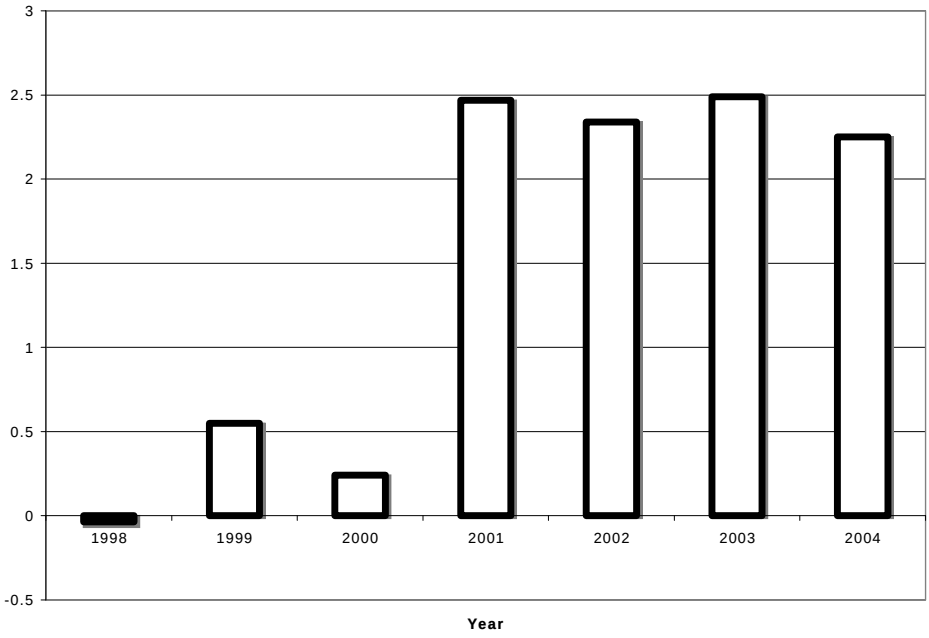
Notes: All estimates are from two stage least squares regressions using the indicated instrument controlling for demographic characteristics and the indicated specification of time effects. The reported *F* statistics are for the TSLS estimates using the dummy for treatment as an instrument and conditioning on a quartic in time. * and ** indicate statistical significance at the 10% and 5% levels respectively.

Table 7: Two Stage Least Squares Estimates of the Impact of Maternal Care on Developmental Outcomes for Selected Subsamples

	Sample			
	Male Child	Female Child	Mother Low Education	Mother High Education
PPVT	-2.114**	-0.259	-1.095	-1.325
	(0.837)	(0.248)	(0.762)	(0.889)
Know Your Numbers	0.007	-0.020	0.020	-0.023
	(0.034)	(0.044)	(0.034)	(0.042)
Who Am I?	-0.998**	-1.261**	-0.140	-2.018***
	(0.432)	(0.627)	(0.330)	(0.740)
Aggression	-0.004	-0.034	0.055	-0.027
	(0.118)	(0.134)	(0.131)	(0.121)
Indirect Aggression	-0.111	0.061	-0.008	-0.053
	(0.089)	(0.090)	(0.089)	(0.082)
Anxiety	-0.059	-0.005	-0.042	-0.017
	(0.119)	(0.143)	(0.143)	(0.123)
Hyperactivity	0.053	-0.223	0.016	-0.086
	(0.167)	(0.177)	(0.202)	(0.159)
Instrument	Dummy for Treatment	Dummy for Treatment	Dummy for Treatment	Dummy for Treatment
Control for Time	Quartic in Time (Quarter)	Quartic in Time (Quarter)	Quartic in Time (Quarter)	Quartic in Time (Quarter)

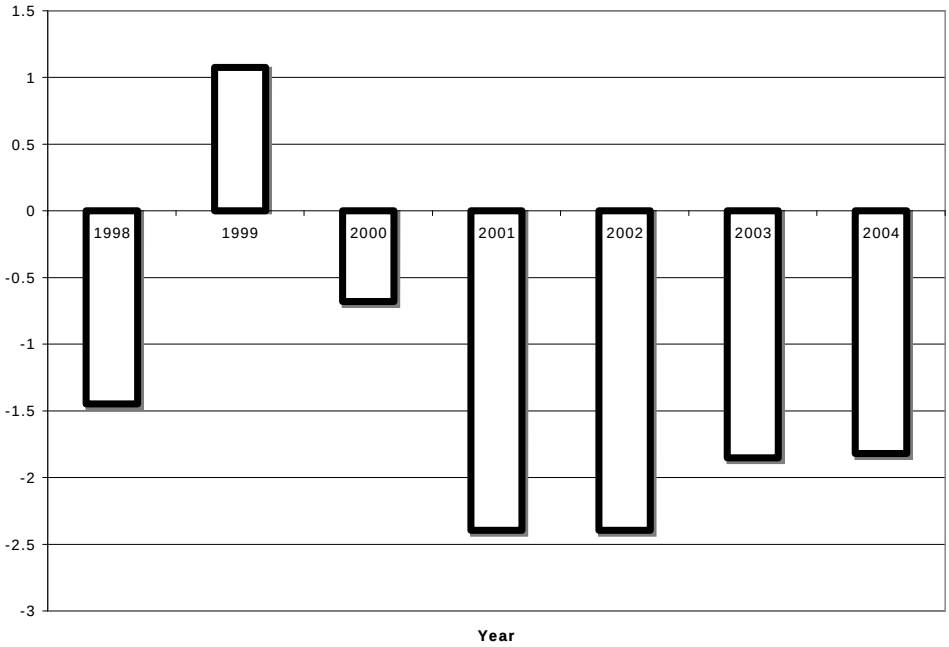
Notes: All estimates are from two stage least squares regressions using the indicated instrument controlling for demographic characteristics and the indicated specification of time effects. "Low Education" is defined by schooling up to a high school diploma. "High Education" is defined as the receipt of any post secondary instruction. * and ** indicate statistical significance at the 10% and 5% levels respectively.

Figure 1: Time Mother at Home in First Year: Estimated Year of Birth Effects Relative to the 1997 Birth Cohort



Notes: Estimates are from a regression of mothers' time at home in the first year on demographic controls and year of birth effects.

Figure 2: PPVT: Estimated Year of Birth Effects Relative to the 1997 Birth Cohort



Notes: Estimates are from a regression of children's age standardized PPVT score on demographic controls and year of birth effects.

Appendix—NOT FOR PUBLICATION

Table A1: Estimates of Measures of Development al Inputs by Year of Birth: NLSCY Data

	N	1997	1998	1999	2000	2001	2002	2003	2004
13-24 months									
Time mother home in first year	8307	8.528 (0.247)	8.118 (0.315)	8.565 (0.282)	8.465 (0.351)	10.583 (0.268)	10.221 (0.337)	10.507 (0.270)	10.230 (0.358)
Mother returned to work post-Birth	8307	0.818 (0.035)	0.882 (0.045)	0.773 (0.040)	0.815 (0.048)	0.770 (0.401)	0.822 (0.050)	0.791 (0.040)	0.814 (0.050)
Child has younger sibling	8307	0.071 (0.023)	0.076 (0.028)	0.078 (0.029)	0.095 (0.031)	0.067 (0.026)	0.083 (0.037)	0.081 (0.027)	0.090 (0.039)
Child has older sibling	8307	0.506 (0.036)	0.479 (0.046)	0.510 (0.041)	0.549 (0.049)	0.548 (0.042)	0.421 (0.053)	0.530 (0.041)	0.441 (0.054)
25-39 months									
Time mother home in first year	8520	8.058 (0.267)	7.809 (0.317)	8.687 (0.304)	8.196 (0.332)	10.479 (0.299)	10.299 (0.316)	10.522 (0.277)	10.201 (0.327)
Mother returned to work post-Birth	8520	0.984 (0.035)	0.988 (0.044)	0.892 (0.043)	1.001 (0.046)	0.933 (0.040)	0.997 (0.045)	0.936 (0.039)	0.959 (0.047)
Child has younger sibling	8520	0.359 (0.034)	0.312 (0.416)	0.332 (0.041)	0.311 (0.044)	0.347 (0.040)	0.322 (0.044)	0.372 (0.039)	0.362 (0.044)
Child has older sibling	8520	0.510 (0.037)	0.547 (0.047)	0.511 (0.044)	0.543 (0.049)	0.527 (0.042)	0.487 (0.050)	0.504 (0.042)	0.516 (0.052)
48-71 months									
Time mother home in first year	10547	7.604 (0.228)	7.566 (0.233)	8.152 (0.241)	7.844 (0.260)	10.073 (0.242)	9.943 (0.268)	10.092 (0.239)	9.854 (0.257)
Mother returned to work post-Birth	10547	0.955 (0.034)	0.995 (0.036)	0.930 (0.037)	0.960 (0.043)	0.944 (0.036)	0.968 (0.043)	0.953 (0.037)	0.952 (0.046)
Child has younger sibling	10547	0.539 (0.037)	0.531 (0.040)	0.518 (0.041)	0.573 (0.048)	0.535 (0.042)	0.556 (0.049)	0.558 (0.042)	0.615 (0.049)

Child has older sibling	10547	0.539 (0.036)	0.554 (0.040)	0.517 (0.040)	0.527 (0.047)	0.571 (0.041)	0.480 (0.049)	0.530 (0.040)	0.514 (0.048)

Notes: Each row presents analysis of the indicated dependent variable. Reported are the regression coefficients on year of birth effects for the indicated cohort. Estimates are conditional on the other demographic controls described in the text. N is sample size. Robust standard errors are in parentheses.

Table A2: Estimates of Measures of Development al Inputs by Year of Birth: LFS Data

	N	1997	1998	1999	2000	2001	2002	2003	2004
Age 13-35 months									
Mother Employed	12260	0.318 (0.033)	0.306 (0.033)	0.0304 (0.035)	0.309 (0.033)	N.A.	0.325 (0.034)	0.331 (0.034)	0.302 (0.034)
Mother Employed Full Time	12260	0.319 (0.034)	0.309 (0.034)	0.314 (0.036)	0.297 (0.035)	N.A.	0.302 (0.035)	0.306 (0.036)	0.291 (0.035)
Mother's Usual Weekly Hours	7801	36.896 (1.341)	36.990 (1.342)	36.981 (1.328)	37.251 (1.368)	N.A.	38.013 (1.373)	36.792 (1.366)	38.204 (1.351)
Mother Not in the Labor Force	12260	0.567 (0.032)	0.570 (0.032)	0.575 (0.034)	0.569 (0.033)	N.A.	0.550 (0.033)	0.550 (0.033)	0.577 (0.033)
Mother's Real Weekly Earnings	6656	253.654 (28.157)	247.433 (28.866)	257.015 (28.414)	260.174 (28.631)	N.A.	243.976 (29.107)	237.206 (29.607)	293.370 (30.350)
Mother's Real Hourly Earnings	6656	6.085 (0.645)	5.762 (0.646)	6.152 (0.656)	6.039 (0.651)	N.A.	5.440 (0.662)	5.685 (0.668)	6.541 (0.695)
Economic Family's Real Weekly Earnings	10309	467.193 (42.459)	502.879 (41.939)	484.022 (43.418)	504.461 (44.104)	N.A.	479.498 (43.088)	485.064 (43.829)	523.017 (44.905)
Mother working PT to care for own children	12260	-0.063 (0.020)	-0.057 (0.020)	-0.083 (0.021)	-0.086 (0.02)	N.A.	-0.077 (0.020)	-0.057 (0.021)	-0.102 (0.021)
Mother not available for	12260	-0.00194 (0.00105)	-0.00155 (0.00115)	-0.00023 (0.00143)	-0.00036 (0.00140)	N.A.	0.00060 (0.00180)	0.00033 (0.0018)	-0.00002 (0.00130)

work-caring for own children									
Mother not looking for work-caring for own children	12260	0.049 (0.011)	0.0460 (0.012)	0.037 (0.011)	0.046 (0.11)	N.A.	0.051 (0.011)	0.049 (0.011)	0.046 (0.011)
Stay at Home Mother (YBB)	12260	0.232 (0.027)	0.223 (0.027)	0.220 (0.028)	0.226 (0.027)	N.A.	0.238 (0.028)	0.251 (0.028)	0.245 (0.028)
Stay at Home Mother (YOB)	12260	0.288 (0.030)	0.281 (0.030)	0.281 (0.031)	0.284 (0.030	N.A.	0.306 (0.030)	0.297 (0.030)	0.301 (0.031)
Mother has younger children	12260	0.087 (0.022)	0.097 (0.022)	0.100 (0.023)	0.121 (0.022)	N.A.	0.097 (0.022)	0.111 (0.022)	0.102 (0.022)
Mother has older children	12260	0.436 (0.034)	0.445 (0.034)	0.440 (0.035)	0.434 (0.034)	N.A.	0.444 (0.034)	0.458 (0.035)	0.436 (0.035)
Age 36-47 months									
Mother Employed	7212	0.333 (0.046)	0.306 (0.045)	0.350 (0.046)	0.287 (0.046)	0.334 (0.045)	0.361 (0.046)	0.342 (0.046)	0.342 (0.046)
Mother Employed Full Time	7212	0.338 (0.047)	0.284 (0.046)	0.334 (0.048)	0.298 (0.047)	0.318 (0.047)	0.379 (0.047)	0.358 (0.047)	0.380 (0.048)
Mother's Usual Weekly Hours	4660	36.624 (1.538)	36.189 (1.573)	37.084 (1.481)	37.730 (1.620)	36.858 (1.557)	38.256 (1.523)	38.742 (1.541)	38.477 (1.541)
Mother Not in the Labor Force	7212	0.551 (0.044)	0.558 (0.043)	0.525 (0.044)	0.586 (0.044)	0.554 (0.043)	0.522 (0.044)	0.536 (0.044)	0.555 (0.044)
Mother's Real Weekly Earnings	3956	234.691 (35.373)	184.638 (36.381)	219.695 (35.625)	216.194 (36.980)	140.180 (35.228)	232.851 (37.653)	237.540 (35.392)	301.794 (41.796)
Mother's Real Hourly Earnings	3956	5.330 (0.862)	4.887 (0.875)	5.142 (0.864)	4.712 (0.891)	3.448 (0.856)	5.248 (0.913)	5.542 (0.863)	6.556 (1.005)
Economic Family's Real Weekly Earnings	6105	426.848 (55.266)	402.964 (54.529)	419.352 (54.206)	374.958 (56.370)	408.173 (54.128)	417.076 (56.489)	483.459 (54.305)	536.048 (59.987)
Mother working PT to care for	7212	-0.055 (0.028)	-0.044 (0.027)	-0.041 (0.028)	-0.069 (0.028)	-0.059 (0.027)	-0.076 (0.028)	-0.070 (0.027)	-0.069 (0.029)

own children									
Mother not available for work-caring for own children	7212	0.0053 (0.0066)	0.0032 (0.0060)	0.0022 (0.0059)	0.0038 (0.0069)	0.0042 (0.0061)	0.0039 (0.0061)	0.0041 (0.0061)	0.0039 (0.0063)
Mother not looking for work-caring for own children	7212	0.041 (0.016)	0.047 (0.016)	0.039 (0.015)	0.042 (0.015)	0.043 (0.015)	0.047 (0.016)	0.037 (0.015)	0.041 (0.016)
Stay at Home Mother (YBB)	7212	0.125 (0.032)	0.133 (0.031)	0.132 (0.031)	0.161 (0.032)	0.133 (0.032)	0.131 (0.032)	0.138 (0.032)	0.142 (0.033)
Stay at Home Mother (YOB)	7212	0.134 (0.035)	0.140 (0.034)	0.138 (0.034)	0.176 (0.035)	0.168 (0.035)	0.129 (0.035)	0.170 (0.036)	0.154 (0.036)
Mother has younger children	7212	0.392 (0.045)	0.386 (0.044)	0.379 (0.045)	0.399 (0.045)	0.409 (0.045)	0.402 (0.045)	0.381 (0.045)	0.418 (0.046)
Mother has older children	7212	0.333 (0.047)	0.368 (0.046)	0.339 (0.047)	0.333 (0.047)	0.358 (0.046)	0.340 (0.048)	0.333 (0.047)	0.284 (0.048)
Age 48-59 months									
Mother Employed	7390	0.307 (0.045)	0.308 (0.046)	0.274 (0.046)	0.289 (0.047)	0.287 (0.047)	0.322 (0.047)	0.299 (0.047)	0.285 (0.047)
Mother Employed Full Time	7390	0.360 (0.046)	0.335 (0.047)	0.363 (0.047)	0.363 (0.048)	0.354 (0.048)	0.398 (0.048)	0.409 (0.048)	0.393 (0.048)
Mother's Usual Weekly Hours	4881	38.832 (1.583)	37.560 (1.537)	38.517 (1.522)	39.426 (1.586)	38.693 (1.615)	38.851 (1.572)	40.049 (1.602)	39.747 (1.605)
Mother Not in the Labor Force	7390	0.591 (0.044)	0.583 (0.045)	0.616 (0.045)	0.622 (0.046)	0.605 (0.046)	0.582 (0.046)	0.613 (0.046)	0.603 (0.046)
Mother's Real Weekly Earnings	4090	265.279 (37.296)	283.608 (37.900)	308.877 (37.594)	295.398 (38.489)	284.338 (39.454)	317.194 (39.714)	360.138 (39.892)	344.403 (41.302)
Mother's Real Hourly Earnings	4090	5.444 (0.866)	5.952 (0.879)	5.928 (0.873)	5.540 (0.894)	5.859 (0.931)	6.647 (0.928)	7.056 (0.934)	7.114 (0.964)
Economic Family's Real	6253	559.121 (58.937)	557.879 (60.565)	562.003 (62.168)	554.990 (61.231)	597.476 (63.634)	594.713 (63.265)	652.842 (65.849)	655.453 (64.198)

Weekly Earnings									
Mother working PT to care for own children	7390	-0.092 (0.025)	-0.072 (0.026)	-0.104 (0.027)	-0.094 (0.027)	-0.082 (0.027)	-0.083 (0.027)	-0.106 (0.027)	-0.104 (0.028)
Mother not available for work-caring for own children	7390	0.0103 (0.0060)	0.0073 (0.0047)	0.0082 (0.0051)	0.0082 (0.0051)	0.0048 (0.0046)	0.0063 (0.0048)	0.0056 (0.0049)	0.0103 (0.0079)
Mother not looking for work-caring for own children	7390	0.0390 (0.013)	0.045 (0.014)	0.039 (0.013)	0.038 (0.013)	0.038 (0.014)	0.043 (0.012)	0.050 (0.015)	0.037 (0.013)
Stay at Home Mother (YBB)	7390	0.120 (0.030)	0.145 (0.031)	0.151 (0.031)	0.133 (0.031)	0.147 (0.032)	0.142 (0.032)	0.149 (0.032)	0.122 (0.031)
Stay at Home Mother (YOB)	7390	0.137 (0.033)	0.162 (0.034)	0.178 (0.034)	0.142 (0.034)	0.165 (0.035)	0.140 (0.034)	0.164 (0.035)	0.140 (0.034)
Mother has younger children	7390	0.503 (0.047)	0.491 (0.047)	0.475 (0.047)	0.487 (0.048)	0.462 (0.048)	0.506 (0.048)	0.506 (0.048)	0.516 (0.048)
Mother has older children	7390	0.299 (0.046)	0.332 (0.047)	0.325 (0.047)	0.350 (0.047)	0.325 (0.048)	0.280 (0.047)	0.294 (0.048)	0.294 (0.048)
Age 60-71 months									
Mother Employed	7298	0.312 (0.047)	0.299 (0.047)	0.291 (0.048)	0.276 (0.047)	0.287 (0.047)	0.289 (0.047)	0.276 (0.048)	0.282 (0.047)
Mother Employed Full Time	7298	0.293 (0.049)	0.304 (0.048)	0.302 (0.049)	0.294 (0.048)	0.296 (0.049)	0.315 (0.049)	0.281 (0.049)	0.324 (0.049)
Mother's Usual Weekly Hours	4883	39.112 (1.943)	39.828 (2.087)	39.624 (1.973)	39.682 (2.000)	39.765 (2.036)	41.172 (1.972)	39.080 (2.005)	40.885 (2.007)
Mother Not in the Labor Force	7298	0.568 (0.045)	0.582 (0.045)	0.600 (0.046)	0.625 (0.045)	0.613 (0.045)	0.602 (0.046)	0.610 (0.046)	0.609 (0.046)
Mother's Real Weekly Earnings	4059	246.962 (45.265)	249.835 (44.928)	255.831 (46.459)	260.728 (46.310)	266.617 (46.141)	294.670 (50.156)	262.435 (47.441)	226.552 (50.345)
Mother's Real	4059	5.502	5.236	5.662	5.628	5.991	6.076	5.797	7.198

Hourly Earnings		(0.945)	(0.919)	(0.976)	(0.956)	(0.951)	(1.0269)	(0.994)	(1.065)
Economic	6136	520.139	485.211	521.289	483.284	556.58	594.963	540.154	570.037
Family's Real		(67.890)	(65.344)	(67.920)	(67.159)	(69.612)	(72.920)	(68.413)	(71.717)
Weekly Earnings									
Mother working	7298	-0.046	-0.075	-0.085	-0.080	-0.066	-0.071	-0.057	-0.087
PT to care for		(0.029)	(0.029)	(0.030)	(0.029)	(0.030)	(0.030)	(0.032)	(0.029)
own children									
Mother not	7298	0.0043	0.0052	0.0066	0.0053	0.0055	0.0043	0.0069	0.0043
available for		(0.0060)	(0.0068)	(0.0060)	(0.0058)	(0.0061)	(0.0060)	(0.0061)	(0.0059)
work-caring for									
own children									
Mother not	7298	0.039	0.040	0.037	0.039	0.040	0.041	0.035	0.051
looking for work-		(0.011)	(0.011)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.012)
caring for own									
children									
Stay at Home	7298	0.115	0.122	0.138	0.111	0.112	0.120	0.098	0.099
Mother (YBB)		(0.029)	(0.030)	(0.031)	(0.029)	(0.031)	(0.030)	(0.030)	(0.030)
Stay at Home	7298	0.151	0.165	0.176	0.149	0.164	0.165	0.153	0.145
Mother (YOB)		(0.033)	(0.034)	(0.036)	(0.033)	(0.035)	(0.034)	(0.035)	(0.035)
Mother has	7298	0.629	0.667	0.650	0.686	0.622	0.657	0.673	0.656
younger children		(0.047)	(0.048)	(0.050)	(0.048)	(0.049)	(0.049)	(0.050)	(0.049)
Mother has older	7298	0.232	0.301	0.287	0.255	0.261	0.196	0.288	0.260
children		(0.048)	(0.047)	(0.049)	(0.047)	(0.048)	(0.049)	(0.049)	(0.048)

Notes: Each row presents analysis of the indicated dependent variable. Reported are the regression coefficients on year of birth effects for the indicated cohort. Estimates are conditional on the other demographic controls described in the text. N is sample size. Robust standard errors are in parentheses. N.A. not applicable.

Table A3: Estimated impact of longer maternity leave mandates on family real earnings from the LFS - Estimates based on a wage deflator

	Age 13-35 Months	Age 36-47 Months	Age 48-59 Months	Age 60-71 Months
Mother's Real Weekly Earnings	8.726 (14.752)	0.700 (29.318)	16.400 (15.069)	10.846 (12.998)
Mother's Real Hourly Earnings	0.034 (0.254)	-0.246 (0.494)	0.256 (0.218)	-0.016 (0.239)
Economic Family's Real Weekly Earnings	15.516 (16.575)	27.920 (21.972)	11.041 (7.430)	11.875 (20.207)

Notes: The reported statistics are from an 8 observation regression of the indicated input by year of birth on a constant and a dummy variable for birth cohorts exposed to the new maternity leave provisions. The wage deflator is according to Industrial Aggregate Wage from Statistics Canada's *Survey of Employment Payrolls and Hours* (catalogue 72-002-XIB). * and ** indicate statistical significance at the 10% and 5% levels respectively.