Effects of the 2001 Extension of Paid Parental Leave Provisions on Birth Seasonality in Canada

Janice Compton and Lindsay M. Tedds*
September 30, 2014

VERY Preliminary, please do not cite.

Abstract

It is well known that there exists a strong seasonal pattern in births and that that pattern differs across geographic regions. While historically this seasonal pattern has been linked to exogenous factors, modern birth seasonality patterns can also be explained by purposive choice. If birth month of a child is at least partially purposefully chosen by the parents then, by extension, it can also be expected that this can be influenced by anything that changes the costs and benefits associated with that choice, including public policy. This paper explores the effect that the 2001 extension of paid parental leave benefits on birth seasonality in Canada. Overall we find strong results that the pattern of birth seasonality in Canada changed after 2001, with a notable fall in Spring births and an increase in late Summer and early Fall births. We discuss the potential effects of this unintended consequence, including those related to health and development, educational preparedness and outcomes, and econometric modelling.

Keywords: birth seasonality, policy determinants, parental leave, Canada

JEL Codes: J13, J38, H30

*Contact information: J. Compton, Department of Economics University of Manitoba, 15 Chancellors Circle Winnipeg, MB, R3T 5V5, Canada. E-mail: comptonj@cc.umanitoba.ca. L. Tedds, School of Public Administration, University of Victoria, PO Box 1700 STN CSC, Victoria, BC, V8W 2Y2, Canada. Email: ltedds@uvic.ca.

1. Introduction

It is well known that there exists a strong seasonal pattern in births and that that pattern differs across geographic regions.[1] This display of birth seasonality has been linked to such exogenous factors as the photoperiod, climate, holidays, nutrition, urbanization, and other socio-cultural and environmental factors (see Trovato and Odynak (1993) for a detailed discussion of these factors). More recently, researchers have been documenting changes in the historical seasonal patterns within countries since the advent of contraception, suggesting that modern birth seasonality patterns can also be explained by purposive choice (e.g. Van de Kaa 1987, Werschler and Halli 1992, Bobak and Gjonca 2001, Cassels 2002, Haandrikman and Van Wissen 2008). If birth month of a child is at least partially purposefully chosen by the parents then, by extension, it can also be expected that this can be influenced by anything that changes the costs and benefits associated with that choice, including public policy.

There is some evidence to suggest that the timing of births can be influenced by public policy. Dickert-Conlin and Chandra (1999) explored the effect that the U.S. child tax benefit system had on birth timing. The child tax benefit system they studied granted a whole year of tax relief to an individual or family that had a child in that tax year, even if the child was born on December 31. The authors found that such a system provided incentives for more children to be born in the last week of December rather than the first week of January. The challenge, however, with this study is that it did not consider if this result was due to well-timed conceptions or induced labour. In addition, policy changes of this type do not have a large effect on birth month but rather births within a small window which may happen to span across specific months. Despite its limitations, the finding suggests the potential for policy determinants of birth seasonality.

[1] For example, later summer and early fall peaks have been documented in the United States (Siever 1985) and southern Europe (Lam and Miron 1994, and De beer 1997), Spring peaks in northern Europe (Lam and Miron 1994, and De beer 1997) and Canada (Trovato and Odynak 1993), and January peaks in the Soviet Union (Anderson and Silver 1988).

Arguably one of the most important policies related to births is paid parental benefits. In Canada, since 1971 new mothers have been entitled to up to 15 weeks of paid maternity leave through the federally operated employment insurance scheme (Marshall 2003, para. 1), a duration that has remained unchanged since its inception in 1971. The rate of benefit and the eligibility requirements though has changed considerably since 1971. The rate of benefit is set at a percentage of weekly earnings up to a set maximum. The benefit rate was regularly dropped throughout the 1971-1994 period, settling at 55% where it has stayed since 1994 (Pulkingham and Van Der Gaag 2004, p.117). Initially, new mothers with at least 20 weeks of insurable work were eligible for maternity benefits (Marshall 2003, para. 1). This changed to 700 hours of insurable work in 1996 and in 2000 the eligibility was dropped to 600 hours (Pulkingham and Van Der Gaag 2004, p.117).

Paid parental benefits were introduced in 1990, when 10 weeks in paid parental leave were added to the maternity leave benefits. Paid parental leave benefits have the same eligibility and rate of benefit as paid maternity leave but are more flexible in that parental leave benefits can be used by either parent or split between them, provided that they meet the qualification requirements (Marshall 2003, para. 1). This paid parental leave was significantly expanded in 2001, when the duration was more than tripled to 35 weeks. In effect, starting in 2001 the maximum paid combination of paid maternity and parental leave available was increased from approximately 6 months to about one year. This represents a significant increase in the amount of paid time off new parents can take related to the birth of a child. This significant increase in paid parental benefits that occurred in 2001 could have an effect on the timing of births in Canada. It has been shown (Cassel 2002) that parents optimize their time off following the birth of a child by coinciding the birth with both parental and employment vacation leave. Following the 2001 parental leave changes, the return to work time increased from 5-6 months to between 9 and 12 months (Marshall 2003), leading to an average increase in the amount of time off work following a birth by 3.5 months (Baker and Milligan 2008, and

Hanratty and Trzcinski 2009). This increase in the amount of time off work due to extended paid parental leave may influence the timing of births in Canada.[2]

Policy influences on birth seasonality raise two issues for economists. First, there have been numerous studies documenting the health and economic outcomes that are influenced by one's month of birth. The effects of birth timing are most prominent in developing nations, where access to clean water and nutrition is seasonal and the absence of functional credit markets may prevent consumption smoothing, but effects are also found in developed countries. For example, there are a number of studies linking season (or month) of birth to a variety of health outcomes, such as schizophrenia (Dalen 1968), longevity (Huntington 1938), sudden infant death syndrome (Leiss and Suchindran 1993), type I diabetes (Samuelsson, Johansson, and Ludvigsson 1999), multiple sclerosis (Templar et al 2008), and epilepsy (Procopio, Marriott, and Williams 1997). Correlations have been found between season of birth and intelligence, height, weight, and self-reported health (Kihlbom & Johansson (2004)) as well as between and elementary school test scores and the number of years of secondary school attendance (Puhani & Weber, 2008). If policy can be shown to significantly influence birth seasonality patterns, this may lead to changes in the distribution of health and development outcomes.

Second, since school-leaving laws require that individuals remain in school until they reach their 16th birthday, month of birth is correlated with the probability that an individual will finish high school. This correlation is strong enough that month of birth is often used as an instrument in econometric studies of the returns to education (e.g. Leigh & Ryan, 2005). This use of birth month as an instrumental variable in econometric analyses is based on the assumption that birth month is exogenous to personal characteristics

[2] We do not posit that the change in 1971 or 1990 had any effect on birth seasonality in Canada because it has been shown (Baker and Milligan 2008) that such short extensions in paid leave only increase the proportion claiming the paid leave, not the length of leave taken.

and family background.[3] Buckles and Hungerman (2014) show that this exogeneity assumption is faulty because, at least in the U.S., month of birth of a child differs significantly for married and unmarried women, and by age category. Notably, children born in the winter months are more likely to be born to unmarried and teenaged mothers than those born in the spring and summer months. The authors show that these demographic patterns in seasonality account for a large portion of birth month differences in educational attainment and wages. The results of this study demonstrate the invalidity of birth seasonality as an instrumental variable. If policy can be shown to affect birth seasonality patterns, this argument against using birth month as an instrumental variable is strengthened.

The purpose of this paper is to investigate the effects that the 2001 extension of paid parental leave benefits on birth seasonality in Canada. Overall we find strong results that the pattern of birth seasonality changed after 2001, with a notable fall in Spring births and an increase in late Summer and early Fall births. We provide two pieces of evidence to suggest that the changing pattern is due to the EI extension: first, we show that birth seasonality in the Northern U.S. do not change following 2001; and second, the changing pattern in Canada is not found for unmarried or teen mothers in Canada, groups who are least likely to plan births. The paper is organized as follows: in section 2 we review the historical patterns of birth seasonality in Canada and show the change in pattern following 2001. A comparison with aggregate data from the Northern US confirms that the pattern shift occurred only in Canada. In section 3, we use the microdata files of the Canadian Vital Statistics Data to determine that the pattern shift occurred for those groups of women most likely to be affected by the policy. Moreover, using multinomial logit regressions, we show that the changing pattern of seasonality continues to hold when demographic controls are included in the regression. Section 4 concludes with a discussion of the results.

[3] See (Buckles and Hungerman, 2014) for an extensive list of examples of studies that have used birth month as an instrumental variable.

2. Patterns of Birth Seasonality in Canada

2.1 Historical Patterns

The seasonality of births in Canada has been documented in a few studies. Cowgill (1966) included Canada in a large international comparison of birth seasonality and notes a Spring peak of births in Canada along with a small secondary peak in September. This is contrasted with that which exists in the United States, which displays a major peak in September. However, as Canada is but one on many countries included in her study, there is little detail provided in support of this observation, including the source for the birth data. Halli (1989), the first study to focus exclusively on Canada, uses data from the 1984 Canadian Fertility Survey to document a spring peak in births in Canada.

The Halli (1989) results are confirmed in two Canadian studies based on vital statistics data. Werschler and Halli (1992) use data from Canadian vital statistics for the period 1980-1989 (excluding the territories) and find further support for a spring peak in Canada. They also document that there is little regional variation in this seasonal pattern. In an effort to explain this pattern, they compare the seasonal patterns in Canada to that of the northern U.S. states, which share similar climate, temperature, photoperiod, cultural, and socioeconomic factors. The northern U.S. states show a strong peak in August and September and a trough in the spring months, leaving the authors to conclude that the shown seasonal differences cannot be the results of oft referred to exogenous factors.

The most comprehensive study of Canadian birth seasonality was done by Trovato and Odynak (1993). They compiled data on birth from vital statistics data for the years 1926[4]-1989. They show that since 1926, births in Canada have peaked in Spring with a secondary rise in September, and that this pattern has remained stable over this extended period of time and is similar across all provinces. Much like Werschler and Halli (1992), they are unable to provide a convincing explanation for this pattern and why it differs from the U.S.

[4] 1926 represents the first year that complete and continuous vital statistics data for all the provinces is available.

2.1 Current Patterns

To determine if this previously observed pattern in birth seasonality, namely Spring peaks in births, extends beyond 1989, we obtain the total number of births by month for the period 1990-2011.[5] To extract the seasonal component, we calculate a centered-12-month moving average and normalized to 100%, as is standard in the literature.[6] Figure 1displays the seasonal pattern of births since 1990. The 1990s (1990-2000) are shown by the grey dotted line and the post-2000 years (2001-2011) are shown by the black line. The 1990s continue to display the seasonal birth pattern documented in the previous literature: namely, a peak that occurs in the month of May. As noted previously, parental leave was extended for births occurring in 2001 or later. We see that in 2001, the pattern of birth seasonality matches that for the 1990s, but starting in 2002 we begin to see a shift in the pattern of birth seasonality: namely, a shift from the spring months to the late summer months.

[Figure 1 here]

Of course, it is impossible to determine from Figure 1 if the change is statistically significant, due to time effects, or a sudden shock in any one or combination of exogenous factors previously discussed and which are correlated with the change in parental leave policy. In order to determine if the observed change in birth seasonality is potentially due to the parental leave policy change or these other factors, we run the following OLS regression:

$$NB_m = B_o + \sum_{y=1}^{Y} \gamma_y \, Year + \sum_{c=1}^{11} \lambda_c \, Month + \delta EI + \sum_{c=1}^{11} \phi_c \, EI * Month + \varepsilon_t \qquad (1)$$

5 Data for 1991-2011 were obtained from Statistics Canada, CANSIM table 102-4502. Data prior to 1991 were obtained from the Statistics Canada Vital Statistics publication, which for the 1989-1992 period was called Health Reports. Supplement. No. 14, Births.

6 If there is no seasonal pattern then the centered 12-month moving average takes a value of 100. The data shown in Figure 1 are corrected for both the number of days per month and leap years,

NB_m represents the centered moving average of number of births per month, Year is a set of year dummies, Month is a set of monthly dummies, EI is a dummy variable that takes a value of one in the year 2001 and onwards and represents the parental leave policy change, and EI*Month is an interaction variable between the EI policy variable and the Monthly dummy variables. If there was a significant change in birth seasonality following the parental leave policy change then we would expect to see the coefficients on the interaction terms, ϕ_c, being significant. Given the pattern change observed in Figure 1, specifically we would expect to see negative coefficients on the spring months and positive coefficients on the late summer months. Similar to Werschler and Halli (1992) we compare the results obtained from equation 1 to comparable data from the northern U.S. States[7] in an effort to isolate the change observed in Canada to the policy change as opposed to any shared exogenous shocks.

The results are presented in table 1. Only the coefficients on the interaction terms, ϕ_c, are reported as these are the coefficients of interest. These coefficients are interpreted as a percentage change in births for the noted month following the parental leave policy change. The results for Canada for the period 1990-2011 are reported in column 1 and the results for the northern U.S. for the period 1990-2004 are reported in column 2. Column 3 and 4 report the regression results for the period 1973 onwards. The results in Table 1 clearly show a change in births seasonality following the parental leave policy change regardless of the time period included. In Canada, the spring months of March, April, and May all show notable declines following the policy change, whereas the summer months of July, August, and September and the fall months of October and November all show substantial increases. For the northern U.S., there are no statistically significant changes in birth seasonality post-2000 regardless of the time period included. This implies that the changes observed in Canada post-2000 were unique to that geographic region, giving credence to the supposition that the changes to the parental leave policy affected the timing of births in Canada.

[7] US vital statistics birth data back to 1968 are publicly available for free download from http://www.cdc.gov/nchs/data_access/Vitalstatsonline.htm. State level data is last reported in 2004. We included States above the 42nd parallel: Idaho, Illinois, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New York, North Dakota, Oregon, South Dakota, Washington, Wisconsin and Wyoming. The individual level data is aggregated by month to produce the total number of births by month for these states.

[Table 1 here]

The change in birth seasonality patterns that are being observed in the aggregate birth data presented here could be due to changes in the seasonality patterns within demographic groups or due to changing demographics. Controlling for demographic information is important in this context as it is well known that the demographic profile of new mothers has changed over this period. Notably, not only are there are more women over the age of 30 having children, but more women over 30 giving birth are also having their first child. The next section of this paper considers the results from administrative birth data.

3. Vital Statistics Detail Files

The Canadian Vital Statistics Birth detail files contain information on every reported live birth in Canada. The data is obtained from birth registrations in each reporting geographic region. For each live birth the following information is available in the data files: date and place of birth; child's sex, birth weight, and gestational age; parent's age, marital status, and birthplace; mother's place of residence; whether the birth was a single or multiple birth, and parity.[8] We limit the data to all live births from 1973onwards to mother's who were over the age of 12 at the time of the birth and were a resident of one of the ten provinces.[9]

As in previous sections, we compare the Canadian results to comparable data from the northern U.S. States in an effort to isolate the change observed in Canada to the policy change as opposed to any shared exogenous shocks. The U.S. Vital Statistics Birth detail files contain information on every reported live birth in each reporting geographic region in the U.S. The data includes comparable demographic indicators for the

[8] The Canadian Vital Statistics detail files are not publicly available. Instead access to this data was made available through the Research Data Centres. Statistics Canada granted access to the detail files for the years 1974 to 2008 inclusive. We obtained access to the detail files through a pilot project. Starting in Fall 2014, Statistics Canada has made the detail files, updated to the most current year, available to all RDC researchers.

[9] The Territories are excluded to limit variations due to climate within the sample. For the same reason, we focus on the Northern United States in comparisons.

mother's marital status[10] and age, whether it is the mother's first birth, and whether the child is of low birth weight. As with the Canadian data, we limit the data to all live births from 1974 onwards to mother's who were over the age of 12 at the time of the birth and were a resident of one of the 17 northern U.S. states.

With the aggregate data used in the previous section, we only know the actual birth month. The advantage of using the detail files is that information on gestational age can be used to calculate expected birth month. If parents purposefully chose a birth month, it is typically done at the time of conception based on a 40 week gestational period. Of course, many expectant mothers will not meet or will even exceed this gestational period for a variety of reasons, leading to a difference between actual birth month and expected birth month. To control for this variability, the work that follows is based on the on expected month of birth.

3.1 Aggregated Data

We first ran regressions similar to those from equation 1, except the dependent variable in this case is number of expected births per month and not the actual number of births per months.[11] . Only the coefficients on the interaction terms, ϕ_c, are reported as these are the coefficients of interest. These coefficients are interpreted as a change in expected births for the noted month following the parental leave policy change. The results in Table 2 are comparable to the regressions on actual birth month, showing a decline in Spring births and an increase in late Summer and Fall births in Canada. We again found no change in the seasonality pattern in the Northern U.S.

[Table 2 here]

[10] Unfortunately, the legal definition of marriage differs across the two jurisdictions and we are unable to create consistent categories with the data available.
[11] Data are aggregated to monthly totals and not seasonally adjusted as in Table 1. The seasonal adjustment does not affect the results.

While the evidence suggests that the change is the seasonal pattern in Canada is in response to the parental leave policy change, the available data does not let us test this hypothesis directly. We can, however, provide more indirect evidence in support of this hypothesis by considering the seasonal birth patterns of specific demographic groups. It is unreasonable to assume that the change in parental leave policy affected the timing of birth decisions for every woman. Those most likely to claim the parental leave benefits and those most likely to be planning their births are the women most likely affected by the policy change. Unfortunately, we do not have information related to qualification for parental leave benefits (600 of insurable hours),[12] but we do have information on marital status and age which are indicators, albeit noisy ones, of a planned birth[13].

Columns 2 and 3 of Table 2 show the regression results for married and unmarried births.[14] The change in the seasonality pattern was notably stronger for married women, compared to non-married women. Columns 4 and 5 show the two categories that we consider most and least likely to be affected by the changing policy, respectively: married women aged 25-39, and unmarried women under the age of 19. The results are consistent with the hypothesis, with significant seasonality changes for the former category and no change in the latter. Furthermore, we hypothesized that the EI extension may affect the seasonality pattern for higher-order children more than for first-born children. The rationale being twofold: first, higher-order children are perhaps more likely to be born into a stable relationship than first-born children, and thus more likely to be planned; and second, the seasons in which parents enjoy parental leave may be more important when there are other young children in the household. Columns 6 and 7 show the results for married women aged 25-39, separately for first-born and higher order children. As expected, the EI extension had a larger effect on

[12] According to Baker and Milligan (2008, p. 874): "Data from the Survey of Employment Insurance Coverage (Statistics Canada, 2006) show that the proportion of mothers with children aged less than 1 year who had insured employment in the 12 months preceding childbirth was 70% in 2000, and has fluctuated between 74 and 75% from 2001 through 2005.[10] The proportion of mothers with insurable employment who are eligible for and claim benefits rises from 80% in 2000 and 2001 to roughly 85% in 2002–2005."

[13] Data from the U.S. show that the proportion of pregnancies that are unintended range have been stable across the last two decades and range from 27% for married women to 74% for unmarried women. Pregnancies of teenaged women are most likely to be unintended (82%), compared with 36% for women aged 25-39. There are also correlations between unintended pregnancies and education and race, but these are less pronounced. (Henshaw (1998), Finer and Henshaw (2006), Finer and Zolna (2011)).

[14] Married mothers are defined by the legal definition in place in the jurisdiction of birth. This is less than ideal, as the definition of marital status has changed over the sample period.

the seasonality pattern of higher-order children than first-born children. The results on the US sample showed no significant seasonality change for any marital status or age group sub-sample (not shown).

3.2 Multinomial Logit Regressions on Seasonality Patterns

We next turn to multinomial logit regressions. Given our assumption that parents can choose the birth month of their child, we can model the probability of a birth occurring in each month using a multinomial logit model as follows:

$$\begin{aligned} \Pr ob(Y = j) &= \frac{e^{\beta_j' X_i}}{1 + \sum_{k=1}^{11} e^{\beta_k' X_i}} \quad for \ j = 1,2,\ldots 11 \\ \Pr ob(Y = 0) &= \frac{1}{1 + \sum_{k=1}^{11} e^{\beta_k' X_i}} \end{aligned} \tag{2}$$

where X_i includes demographic, policy, time, and geographic variables. The demographic variables include indicators for the mother's marital status and age, whether it is the mother's first birth, and whether the child is of low birth weight.[15] As before, the policy variable is an indicator that takes a value of one in the year 2001 and onwards and represents the parental leave policy change. The time and geographic variables include a cubic time trend as well as controls for mother's province of residence.[16]

Table 3 reports the relative risk ratios from the multinomial logit model expressed in equation 2 where the reference group (the omitted category) is May births for Canadian births only. The standard interpretation of the relative risk ratios is for a unit change in the predictor variable, the relative risk ratio of a given outcome relative to the reference group is expected to change by a factor of the respective parameter estimate given the variables in the model are held constant. We only report the coefficients on the policy variable in Table 3

[15] This variable is equal to one when the child is less than 2500 grams at birth. Under the assumption that low birth weight is correlated with unintended pregnancies we include this indicator to better isolate planned seasonality patterns.
[16] Due to computing constraints, the MNL models could not be run on the full sample of births from 1973-2008. The results presented are based on a ten percent random sample.

as these are the coefficients of interest. The results show that the relative risk of a late summer and early Fall birth compared to May increased following the parental leave policy change and that these increases are statistically significant. For example, the relative risk for a September birth relative to a May birth increased by a factor of 1.114, holding all other factors constant. Similarly, the relative risk of an early Spring birth compared to May decreased following the parental leave policy. The results in table 3 show that the shift in the seasonality pattern that was presented above using the aggregate birth data continues to hold even when we control for changes in demographics.

[Table 3 here]

We then include the U.S. data. When both Canadian and U.S. data are used, the policy indicator variable is interacted with an indicator for Canada to obtain the results that are of interest. The time and geographic variables include a cubic time trend, an indicator for Canada, as well as controls for mother's province/state of residence. Table 4 reports the relative risk ratios from the multinomial logit model expressed in equation 2 when both U.S. and Canadian data are used. As before, the reference group is May births. We report the coefficients related to the indicator variable for Canada, the indicator variable for the parental leave change (post EI), and the indicator for the post -2000 time period interacted with the indicator for Canada. It is these coefficients, the ones reported in the third row, which are of primary interest. The results are very similar to those reported in Table 3 and show that the shift in the seasonality pattern that was presented above using the aggregate birth data continues to hold even when we control for changes in demographics and exogenous factors. The remaining coefficients show that this result is unique to Canada in the post-reform era.

[Table 4 here]

The post-2001 change in birth seasonality is also unique to women who are most likely to consider the parental leave policy change in the birth timing decision. Table 5 reports multinomial regress results by marital status and age group, again with both Canadian and U.S. data included. As in the full sample results presented in Table 4, the post-2001 seasonality changes are isolated to Canada for all subgroups. Table 5 clearly shows that the resulting change in birth seasonality seen in Canada following the parental leave change is isolated to married women, and women over the age of 24.

[Table 5 here]

Overall, the results provide evidence that there was a change in the seasonal pattern of births in Canada following the parental leave policy change in 2001. This change in the seasonal pattern holds even when controlling for changes in demographic composition and exogenous factors. Although not a definitive test of causality, we provide two pieces of evidence to suggest that the policy may have induced the change in seasonality: (1) the seasonality change did not occur in the Northern U.S. states and (2) seasonality patterns did not change significantly for those mothers least likely to respond to the parental leave policy change in birth planning—unmarried mothers and mothers under the age of 24.

4. Discussion

The main conclusion of this paper—that the parental leave extension of 2001 altered the seasonality pattern of births in Canada—has a number of implications. Notably, the results point to an unexpected consequence of the parental leave policy extension—the change in birth seasonality—which may have several knock on effects.

First, the change in birth seasonality itself may lead to various health and development differences that may be influenced by birth season. On the negative side, some studies have shown that children born in the Fall have a lower life expectancy than those born in the Spring. This may be due to the combination of breast-feeding duration (which tends to be higher in the summer) and the susceptibility of viral infections of the respiratory tract. Some recent research in child development show that children born in Spring crawl and walk earlier than babies born in late summer and fall. The authors expect that this head-start in development may have long-run effects on cognitive abilities. (Eaton et al, 20--) Children in the spring have higher birthweights, on average, than those born later in the year. On the other hand, rates of multiple sclerosis (Templer et al., 1992, and Willer et al., 2005).and schizophrenia (Torrey et al. 1997, and Saha et al 2006) are higher among children born in April and May (in the Northern Hemisphere)[17].

Second, as the shift in the seasonal patterns following the parental leave extension has resulted in more births at the end of the calendar year, this may lead to changes in educational preparedness and educational outcomes. As many provinces are using calendar year entry for kindergarten[18], the change in birth seasonality results in younger students in kindergarten. If younger students are at a disadvantage academically, the changing distribution may have a negative effect on grade level achievement. To gauge the size of the effect—for the decades before 2001, the proportion of children born in the last four months of the year (Sept-Dec) has hovered around 32 percent. In the years following the EI extension, the proportion has risen almost two full percentage points. The corresponding fall occurs primarily in early year (Jan-April) births. Although the effect is not large, small declines in early year test scores and school readiness may be expected.

However both of the above affects (medical and school readiness) may be offset by the observation that the changing seasonality pattern comes primarily from married women between the ages of 24-39. Prior to the parental leave extension, Canadian children born in Oct-Dec were significantly less likely to be born to a married woman compared to children born in January.[19] Following the EI extension, children born late in the year are no less likely to be born to a married woman compared with those born in January. To the extent

[17] This argument is based on Vitamin D exposure early in life. The use of Vitamin D supplements is now strongly encouraged for young children, so this finding may not be continued.

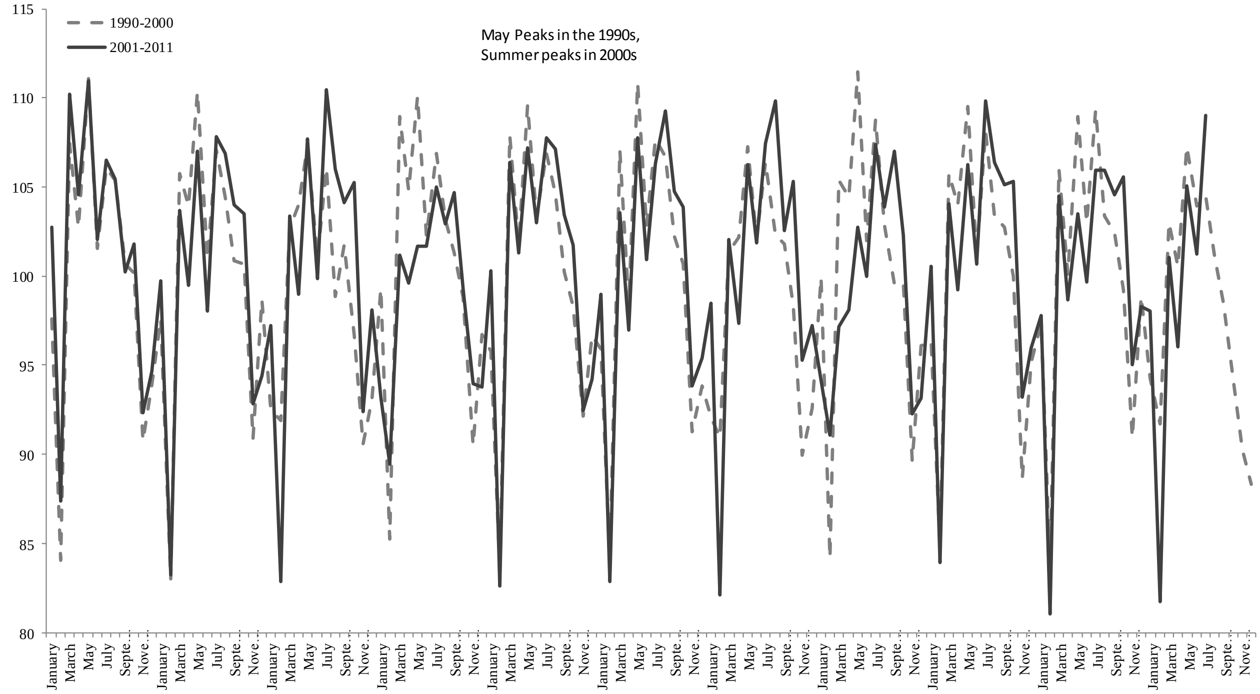
[18] Those with calendar year entry requirements are NF, NB, ON, MB, AB and BC.

[19] We replicated regressions similar to those in Buckles and Hungerman (2014) for Canada. The results discussed are from from probit regressions on the probability that a child is born to a married mother. Full regression results are available on request.

that marital status of mother may affect school readiness and early year test scores, as well as birthweight and cognitive abilities, the increasing proportion of children born in the latter months of the year may not reduce average achievement. Further research on child outcomes that allows for different seasonality patterns by demographic characteristics is needed to better isolate the effects of seasonality.

Finally, our results argue strongly against using month or season of birth as an instrumental variable. While a number of other papers have shown that seasonal patterns of birth are related to the marital status, age and education of the mother, the relationship between the socio-economic status of mothers and seasonality are less clear. Buckles and Hungerman (2014) argue that the difference in the seasonal patterns by characteristics of the mother is due to the different reaction of married and unmarried women to temperature fluctuations for sexual frequency. We argue that the differences may also be the result of different reactions to policy.

Figure 1: Seasonal Component of Births, 1990-2011, Canada



Source: Statistics Canada, CANSIM table 102-4502.

Table 1: Centered moving average of number of births per month, Canada and the Northern United States

	Canada 1990-2011	Northern US 1990-2004	Canada 1973-2011	Northern US 1973-2004
January Post EI	2.692***	1.557	1.35	-0.861
	[0.002]	[0.121]	[0.103]	[0.549]
February Post EI	-0.144	0.722	-1.02	-1.079
	[0.870]	[0.471]	[0.218]	[0.452]
March Post EI	-1.317	0.186	**-2.423*** **	-1.289
	[0.136]	[0.852]	**[0.004]**	[0.370]
April Post EI	**-2.152** **	0.605	**-2.556*** **	0.255
	[0.015]	[0.546]	**[0.002]**	[0.859]
May Post EI	**-2.355*** **	0.199	**-2.078** **	0.553
	[0.008]	[0.842]	**[0.012]**	[0.700]
July Post EI	**1.664* **	1.42	**1.465* **	0.394
	[0.060]	[0.157]	**[0.073]**	[0.784]
August Post EI	**4.140*** **	2.017*	**3.064*** **	0.72
	[0.000]	[0.060]	**[0.000]**	[0.643]
September Post EI	**4.324*** **	1.088	**3.426*** **	-0.618
	[0.000]	[0.309]	**[0.000]**	[0.690]
October Post EI	**5.653*** **	2.285**	**3.415*** **	0.954
	[0.000]	[0.034]	**[0.000]**	[0.539]
November Post EI	**4.231*** **	0.687	**1.944** **	-0.244
	[0.000]	[0.520]	**[0.022]**	[0.875]
December Post EI	1.747*	0.148	-0.239	-0.115
	[0.051]	[0.890]	[0.777]	[0.941]
Constant	103.6***	102.5***	102.2***	102.2***
	[0.00]	[0.00]	[0.000]	[0.000]
Observations	259	175	463	379
R-squared	0.939	0.948	0.91	0.856

Notes: June is the reference month. P-values are reported below the coefficients in the square brackets. The omitted year is 1990 in columns 1 and 2, 1973 in columns 3 and 4. Coefficient results not reported for year, month, and EI dummy variables.

* Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level

Table 2: Expected number of births per month, Canada, by marital status and age, Canada Vital Statistics Data

	(1) Canada 1973-2008	(2) Northern U.S. 1973-2004	(3) Married All	(4) Not Married All	(5) Married 24-39	(6) Not Married <19	(7) Married 24-39, First Child	(8) Married 24-39, Second or Higher Parity
			Canada, 1973-2008					
January Post EI	-238.1	-730.1	-129.5	-162.9	**254.8***	19.08	-35.75	314.6
	(322.8)	(1,348)	(317.1)	(175.4)	**(149.1)**	(28.94)	(116.4)	(227.5)
February Post EI	-38.75	-620.0	221.8	-151.3	211.4	4.771	-148.4	6.538
	(439.2)	(1,380)	(344.8)	(173.8)	(147.3)	(29.47)	(146.4)	(232.5)
March Post EI	-585.6	-301.7	**-1,154*****	-138.2	**-343.3****	-16.45	**-345.9*****	**-452.4****
	(392.5)	(1,483)	**(301.1)**	(168.0)	**(144.5)**	(29.75)	**(120.6)**	**(220.7)**
April Post EI	**-1,388*****	-159.8	**-577.5***	-115.6	**-381.2****	-31.54	**-330.4*****	-350.5
	(353.8)	(1,382)	**(304.8)**	(176.7)	**(147.9)**	(28.29)	**(127.3)**	(258.7)
May Post EI	**-689.6***	-861.4	-581.9*	109.7	**-427.2*****	-14.54	-177.2	-308.3
	(361.7)	(1,334)	(335.1)	(165.8)	(152.0)	(29.84)	(121.7)	(219.4)
July Post EI	252.0	-261.5	346.7	216.6	188.5	-27.94	76.18	268.5
	(405.5)	(1,344)	(310.0)	(170.6)	(145.2)	(33.54)	(121.0)	(229.8)
August Post EI	**984.7*****	-363.4	**852.8*****	**351.4****	**316.4****	24.28	94.91	**461.7****
	(335.4)	(1,384)	**(290.2)**	**(162.8)**	**(140.9)**	(28.18)	(118.0)	**(223.7)**
September Post EI	**1,962*****	-1,492	**605.6***	**488.1*****	**472.2*****	41.02	71.05	**569.5****
	(433.8)	(1,383)	**(363.6)**	**(173.1)**	**(148.5)**	(29.76)	(116.8)	**(231.1)**
October Post EI	**736.8****	-1,755	**742.1****	196.6	**245.8***	40.47	38.86	351.3
	(350.3)	(1,480)	**(311.1)**	(197.0)	**(143.8)**	(28.29)	(135.2)	(231.1)
November Post EI	**1,136*****	-670.1	**1,287*****	-8.313	**552.3*****	**71.40****	108.4	**543.3****
	(391.9)	(1,334)	**(348.9)**	(173.3)	**(147.8)**	**(32.42)**	(130.6)	**(234.1)**
December Post EI	171.6	-918.9	**727.2****	-130.9	**480.5*****	19.09	-9.094	253.7
	(403.9)	(1,658)	**(287.1)**	(170.6)	**(142.7)**	(30.06)	(130.0)	(238.1)
Constant	31,881***	89,293***	19,650***	12,389***	6,033***	1,210***	6,613***	10,427***
	(276.1)	(1,058)	(253.0)	(142.5)	(115.8)	(22.89)	(95.23)	(176.3)
Observations	413	366	413	413	413	413	413	413
R-squared	0.928	0.985	0.980	0.994	0.987	0.942	0.936	0.947

Notes: The omitted month is June. The omitted year is 1973. Coefficient results not reported for year, month, and EI dummy variables. P-values are reported below the coefficients in the square brackets.

Table 3: Multinomial logit results, Canada

	January	February	March	April	May	June	July	August	September	October	November	December
Post EI Policy Variable	1.022	1.051	0.994	0.974		1.003	0.993	**1.078****	**1.114*****	**1.092****	**1.101****	1.058
	(0.0389)	(0.0400)	(0.0374)	(0.0362)		(0.0372)	(0.0369)	**(0.0401)**	**(0.0415)**	**(0.0412)**	**(0.0420)**	(0.0406)

Notes: Standard errors in paretheses. Based on 477,128 observations. Omitted category is May. Reporting relative risk ratios.

Source: Canadian Vital Statistics detail files, 1974-2008

Table 4: Multinomial logit results, Canada and the U.S.

	January	February	March	April	May	June	July	August	September	October	November	December
Canada	0.931	0.968	0.890**	0.992		0.946	0.878***	0.873***	0.874***	0.905**	0.862***	0.960
	(0.0439)	(0.0459)	(0.0416)	(0.0463)		(0.0443)	(0.0409)	(0.0408)	(0.0409)	(0.0429)	(0.0413)	(0.0455)
Post EI	**0.944****	**0.946****	**0.962***	**0.960***		**0.960***	1.002	0.983	1.035	1.002	**0.947****	0.990
	(0.0225)	**(0.0228)**	**(0.0226)**	**(0.0227)**		**(0.0225)**	(0.0232)	(0.0228)	(0.0242)	(0.0236)	**(0.0227)**	(0.0236)
Post EI*Canada	1.057	1.099*	1.021	1.005		1.057	0.992	**1.094***	**1.098****	**1.090***	**1.168*****	1.062
	(0.0519)	(0.0538)	(0.0494)	(0.0483)		(0.0506)	(0.0473)	**(0.0522)**	**(0.0524)**	**(0.0527)**	**(0.0570)**	(0.0522)

Table 5: Multinomial logit results by marital status, Canada and the U.S.

	January	February	March	April	May	June	July	August	September	October	November	December
						Married						
Post EI*Canada	1.030	1.097	1.080	1.039		1.087	1.047	**1.105***	**1.129****	**1.166****	**1.175*****	**1.115***
	(0.0632)	(0.0670)	(0.0651)	(0.0620)		(0.0644)	(0.0619)	**(0.0655)**	**(0.0668)**	**(0.0700)**	**(0.0715)**	**(0.0686)**
						Unmarried						
Post EI*Canada	0.0952	0.0916	-0.0796	-0.0579		-0.00542	-0.117	0.0559	0.0362	-0.0553	0.126	-0.0303
	(0.0820)	(0.0824)	(0.0817)	(0.0816)		(0.0814)	(0.0808)	(0.0808)	(0.0809)	(0.0819)	(0.0820)	(0.0822)
						Age <24						
Post EI*Canada	1.149	1.181	1.076	0.693*		0.916	0.911	1.056	1.011	0.941	1.187	0.865
	(0.241)	(0.248)	(0.228)	(0.146)		(0.194)	(0.190)	(0.221)	(0.211)	(0.197)	(0.251)	(0.184)
						Age 25-34						
Post EI*Canada	1.053	1.075	1.000	1.028		0.984	0.970	1.077	**1.155****	1.114	**1.127***	1.020
	(0.0740)	(0.0759)	(0.0695)	(0.0711)		(0.0679)	(0.0665)	(0.0741)	**(0.0792)**	(0.0777)	**(0.0792)**	(0.0722)
						Age 35-39						
Post EI*Canada	1.023	1.108	1.021	1.020		1.160**	1.005	1.106	1.049	1.067	**1.183****	1.125
	(0.0769)	(0.0826)	(0.0752)	(0.0745)		(0.0841)	(0.0727)	(0.0802)	(0.0761)	(0.0783)	**(0.0879)**	(0.0844)
						Age 40+						
Post EI*Canada	**1.826****	1.399	1.417	1.400		1.347	**1.797***	1.599	1.164	**1.646***	**2.449*****	1.419
	(0.546)	(0.427)	(0.435)	(0.425)		(0.403)	**(0.540)**	(0.470)	(0.343)	**(0.493)**	**(0.732)**	(0.422)

Notes: Standard errors in paretheses. Married based on 1,027,399 observations, unmarried 500,196. Omitted category is May. Reporting relative risk ratios.
Source: Canadian Vital Statistics detail files, 1974-2008; U.S. Vital Statistics detail files, 1974-2004

References

Anderson, B.A. and Silver, B.D. (1988) The effects of the registration system on the seasonality of births: The case of the Soviet Union. *Population Studies* 42, 303-320.

Baker, Michael and Kevin Milligan (2008) How does job protected maternity leave affect mothers' employment? *Journal of Labor Economics*, Vol. 26, No. 4, pp. 655-692.

Bobak, M. and Gjonca, A. (2001) The seasonality of live birth is strongly influenced by soci-demographic factors. *Human Reproduction* 16, 1512-1517.

Buckles, Kasey S. and Daniel M. Hungerman (2013) Season of Birth and Later Outcomes: Old Questions and New Answers. *The Review of Economics and Statistics*, Vol. 9, No, 3 (July 2013), 711-724.

Cassels, P-G. (2002) Changing seasonality of births in Sweden 1900-1999. In Carling, J. (ed.) Nordic Demography: Trends and Differentials. *Scandinavian Population Studies,* vol. 13. Unipub forlag/Nordic Demographic Society, Oslo.

Cowgill, U.M. (1966) The Season of Birth in Man. *Man* 1(2), 232-240.

Dalen, P. (1968) Month of birth and schizophrenia. Acta psychiatrica Scandinavica 43(203)m 55-60.

De Beer, J. (1997) Meeste kinderen in zomer geboren [Most children born in summer]. *Maandstatistiek van de Bevolking* 45(5), 6-9.

Dickert-Conlin, S. and Chandra, A. (1999) Taxes and the timing of births. *Journal of Political Economy* 107(1), 161-177.

Finer, Lawrence B. and Stanley K. Henshaw (2006) Disparities in Rates of Unintended Pregnancy in the United States, 1994-2001. *Perspectives on Social and Reproductive Health*, Vol. 38, No. 2 (June 2006), 90-96.

Finer, Lawrence B. and Mia R. Zolna (2011) Unintended pregnancy in the United States: Incidence and disparities, 2006. *Contraception*, Vol 84 (2011), 478-485.

Haandrikman, K. and Van Wissen, L.J.G. (2008) Effects of the fertility transition on birth seasonality in the Netherlands. *Journal of Biosocial Science* 40(5), 655-672.

Halli, S.S. (1989) The seasonality of births in Canada. *Journal of Biosocial Science* 21(3), 321-327.

Hanratty, M. and Trzcinski, E. (2009) Who Benefits from Paid Family Leave? Impact of Expansions in Canadian Paid Family Leave on Maternal Employment and Transfer Income. *Journal of Population Economics* 22, 693-711.

Henshaw, Stanley (1998) Unintended Pregnancy in the United States. *Family Planning Perspectives*, Vol. 30, No. 1 (Jan – Feb 1998), 24-29.

Huntington, E. (1938) Season of birth. New York: John Wiley and Sons.

Lam, D.A. and Miron, J.A. (1994) Global patterns of seasonal variation in human fertility. *Annals of the New York Academy of Sciences* 709, 9-28.

Leiss, J.K., and Suchindran, C.M. (1993) Age and season of birth in sudden infant death syndrome in North Caroline, 1982-1987: No interaction. *American Journal of Epidemology* 137(2), 207-212.

Marshall, K. (2003) Benefiting from extended parental leave. *Perspectives on Labour and Income* 4(3). http://www.statcan.gc.ca/pub/75-001-x/00303/6490-eng.html

Puhani, P.A., and Weber, A.M. (2008) Does the early bird catch the worm? Instrumental variable estimation of educational effects of age of school entry in Germany. In Dustmann, C., Fitzenberger, B., and Machin, S. (eds.) *The Economics of Education and Training*. Heidelberg: Physcica-Verlag.

Procopio, M., Marriott, P.K., and Williams, P. (1997) Season of birth: aetiological implications for epilepsy. *Seizure* 6(2), 99-105.

Saha, S., Chant, D.C., Welham, J.L., McGrath, J.J., 2006. The incidence and prevalence of schizophrenia varies with latitude. *Acta Neurologica Scandinavia* 114, 36—39.

Samuelsson, U., Johansson, C., and Ludvigsson, J. (1999) Month of birth and risk of developing insulin dependent diabetes in south east Sweden. *Archives of Disease in Childhood* 81(2), 143-146.

Siever, D. A. (1985) Trend and variation in the seasonality of U.S. fertility, 1947-1976. *Demography* 22, 89-100.

Statistics Canada, 2006. Employment Insurance Coverage Survey, *The Daily*, November 1st.

Templer, D.I., Trent, N.H., Spencer, D.A, Trent, A., Corgiat, M.D., Mortensen, P.B., and Gorton, M. Season of birth in multiple sclerosis. *Acta Neurologica Scandinavia* 85(2), 107-109

Torrey, E.F., Miller, J., Rawlings, R., Yolken, R.H., 1997. Seasonality of births in schizophrenia and bipolar disorder: a review of the literature. *Schizophrenia Research* 28, 1—38.

Trovato, F. and Odynak, D. (1993) The seasonality of births in Canada and the provinces, 1881-1989: Theory and analysis. *Canadian Studies in Population* 20, 1-41.

Van de Kaa, D. J. (1987) Europe's second demographic transition. *Population Bulletin* 42(1).

Werschler, T. and Halli, S. (1992) The seasonality of births in Canada: A comparison with the northern United States. *Population and Environment* 14, 85-94.

Willer, C.J., Dyment, D.A., Sadovnick, A.D., Rothwell, P.M., Murray, T.J., Ebers, G.C., 2005. Timing of birth and risk of multiple sclerosis: population based study. *British Medical Journal* 330, 120.