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ORIGINAL PAPER

Baby bonus, anyone? Examining heterogeneous responses to a pro-natalist policy

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Abstract

We examine the impact of the Allowance for Newborn Children, a universal baby bonus offered by the Canadian province of Quebec, on birth order, sibship sex composition, income, and education. We find a large response for third- and higher-order births for which the bonus was more generous. Interestingly, though, we find stronger response if there were two previous sons or a previous son and daughter rather than two previous daughters. We also find, in addition to a transitory effect, a permanent effect, with the greatest increase in one daughter-two son families among three-child households. Moreover, we find a hump shape response by income group, with the greatest response from middle-income families. Also, women with at least some post-secondary education respond more to the policy than those with less. These findings suggest that properly structured pro-natal policies can successfully increase fertility among different segments of the population while simultaneously diminishing the effect of gender preferences and fertility disparity related to women's education.

Keywords Fertility · Baby bonus · Fertility incentive · Sex composition · Difference-in-differences

JEL classification J13 · J18 · H31

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1 Introduction

With declining birth rates in most of the developed world, nations are concerned with the burden placed on the working population to support a growing fraction of the retired population. Understanding the potential problems of below-replacement fertility rates raises a number of questions about pro-natalist policies: do they work, who is taking advantage of the incentives provided, and how costly are the programs? Past research finds that tax exemptions on children, child tax credits, and family allowances all increase fertility; however, large increases in these benefits would be needed to reach replacement fertility levels (Zhang et al. 1994). Evidently, the policies are very expensive and if we can observe heterogeneous responses to these incentives then governments could tailor pro-natalist policies to encourage births from certain groups at lower cost.

The Canadian Province of Quebec implemented a universal cash transfer, namely, the Allowance for Newborn Children (ANC), for all babies born from May 1988 to September 1997 to all residents of Quebec. Hereafter, we refer to this transfer as a baby bonus. This quasi-natural experiment has many qualities that allow us to estimate the impact of financial incentives on fertility.[1] First, the structure and payment plan of the pro-natalist policy was announced suddenly in the newspapers, allowing it to be treated as an unanticipated exogenous shock to the people of Quebec (Montreal Gazette 1988a, 1988b; La Presse 1988).[2] The front page of the Montreal Gazette read "Have more babies, Liberals say." Second, the baby bonus reached as high as C$8000 for families having a third child or higher. This is a sizeable benefit and not tied to any other benefits or clawed back at higher income brackets. Parent and Wang (2007) stress the importance of fiscal incentives being large enough to induce an increase in household births. Also, our control group, the province of Ontario did not introduce new child benefit legislation until 1997, allowing for a clean comparison (Battle and Mendelson 1997; Milligan and Stabile 2011). Finally, and most importantly, the ANC is a universal pro-natalist policy implemented specifically in response to low fertility rates. Many baby bonuses are implemented for specific subgroups of the population, usually low-income individuals, to promote horizontal equity. For example, the Canada Child Tax Benefit payment, an in-cash transfer for anyone with a child, is reduced once adjusted family net income is over a threshold income (Milligan 2016b). Since the ANC is universal we are able to examine the heterogeneous response of different subgroups of the population to this pro-natalist policy and, thus, shed light on which women are being induced to have more children and how family formation is being shaped.

Assuming pro-natalist policies do impact fertility, it is important to know whether or not the effect is permanent or transitory. If the effect is transitory, this implies that women only choose to adjust the timing of their births, while this could impart a shift on the age distribution, if the government is trying to increase family size then resources are being wasted on a purely transitory effect. If the effect is permanent, this implies that women did choose to have more babies and, hence, increases completed

[1] There are many papers studying the impact of fiscal incentives on fertility; examples include Ang (2015), Baughman and Dickert-Conlin (2009), Brewer et al. (2012), Cohen et al. (2013), Gonzalez (2013), LaLumia et al. (2015), and Raute (2017).

[2] Unfortunately, the cancelation of the policy is announced well in advance and replaced by universal childcare; this creates a less credible experimental environment at the end of the policy period.

fertility. Past papers are unable to answer whether this baby bonus had a permanent effect because enough time needs to pass to examine the entire childbearing period of each cohort. Using the confidential birth vital statistics and census data, we are able to calculate completed fertility rates for a number of cohorts that were impacted by the ANC, thereby providing the first analysis on whether or not the ANC had a permanent or transitory effect on fertility.

The ANC has been previously studied by Duclos et al. (2001), Milligan (2005), Kim (2012, 2014), and Ang (2015). The latter studies build on Duclos et al. by using an additional data set, which contains demographic information about the mother and the family. All papers find a positive average effect of the ANC on fertility, Duclos et al. using vital statistics, while Milligan and Kim are using the public-use census file to control for individual household characteristics. Unfortunately, the public-use census files contain a small sample and indicate only if a child under the age of six is present on the census day, not the actual age. With access to de-identified individual census records, we know the exact date of birth. Moreover, unlike past papers, a larger sample size, in addition to detailed data, allows us to examine the heterogeneous response to the ANC by parity (birth order), sibship sex composition, income, education, and immigrant status and to estimate meaningful marginal effects. Ang (2015) addresses the effect of the ANC on birth order using the confidential census file, but does not delve into the spacing of births, changes in completed fertility, or family formation as we do and does not delve into the heterogeneous effect on different groups except for birth parity.

Since we know the sex of older siblings in the household, we ask whether the sex of the two older children influences the decision to have a third, something suggested by the large literature on parental preference. To our knowledge, this is the first paper to examine the effect of cash transfers on sibship sex composition. There is a primary preference for one-of-each-sex with a secondary preference for a son in North America and other developed countries as opposed to a strong primary preference for sons in developing countries (e.g., Andersson et al. 2006; Angrist and Evans 1998; Freedman et al. 1960; Ost and Dziadula 2016, and Williamson 1983). We find evidence that the baby bonus is able to alleviate some of these sex preferences through the large cash incentive for higher parity births. Specifically, we find that a third birth is more likely when there are two previous sons or a previous son and daughter than if both are daughters. Also, we find that parents having a previous son are more likely to have another child with the baby bonus comparing to having a previous daughter. That is consistent with studies in both Canada and the USA that find a gender preference for sons exists (Almond et al. 2013; Dahl and Moretti 2008). Our results remain the same under various specifications and sensitivity tests. We also find that the baby bonus produced more three-child households with one daughter and two sons.

In addition to finding heterogeneous responses to the ANC by parity and sibship sex composition, we also find a hump shape response by income group and a positive response by maternal education. We also confirm, both graphically and through regression analysis, that the baby bonus created both a transitory and permanent effect; Quebec women chose not only to have their children sooner but also to have more children. Thus, the increase in completed fertility rates implies that the ANC was successful in its endeavor to increase fertility.

The next section of the paper discusses theoretical considerations, while Section 3 explains the institutional background of the ANC. Sections 4 and 5 examine the two datasets and the empirical methods respectively. In Section 6, we discuss our results, followed by a conclusion in Section 7.

2 Theoretical considerations

According to Becker (1960), policy changes that increase incomes, reduce the price of an additional child, or both would be expected to increase fertility. However, that view was revised: such policy changes may not lead to an increase in the number of children if there is a meaningful trade-off between child quantity and quality (Becker and Lewis 1973; Becker 1981). Furthermore, a price change would alter quality unless quantity and quality are strong complements in parental utility functions. Consequently, theoretical considerations lead to ambiguous predictions of fertility responses to reforms. This also illustrates why heterogeneous responses to a pro-natal policy are inevitable and need to be included in theoretical models.[3] The traditional quantity-quality trade-off model is proving less clear-cut for the developed world and not empirically evident (Angrist et al. 2010). By way of example, highly educated women do not necessarily plan to have fewer children than their less educated counterparts (Esping-Andersen 2009; Kravdal and Rindfuss 2008).

Cash transfers may not encourage more births if parents already reach or exceed their optimal number, as may be common in developing countries (Palermo et al. 2016). However, if they would like to have more children, as may be more common in developed countries, cash transfers might have positive effects on fertility. Some research finds that highly educated women's desired number of children is greater than their actual number. For example, Testa (2014) finds a positive association between women's level of education and lifetime fertility intentions at both the individual and country levels. While highly educated people intend to have more children than less educated women (Heiland et al. 2008), they ultimately have fewer (Bongaarts 2001; Quesnel-Vallee and Morgan 2003). Such findings are consistent with a negative relationship between maternal education and fertility and imply that the marginal effect of an incentive such as a baby bonus may be higher for more educated women. This is not to say that highly educated women would have more children than those less educated, but their marginal effect in response to a baby bonus may be higher. Consistent with recent literature, we also find that more highly educated women respond to the ANC more than those less educated.[4]

According to Cigno and Ermish (1989) a rise in child benefits would increase completed fertility, but the tempo of fertility and the amount spent on each child would fall. While the empirical finds little evidence on an impact on completed fertility, many papers find that tempo effects rise. That is consistent with Parent and Wang's (2007)

[3] New theoretical models are accounting for observed heterogeneous effects. For example, to account for the effect of a child-care policy on fertility, Yakita (2018) allows for responses to differ by level of maternal education.

[4] Shang and Weinberg (2013) study the case in the USA. Raute (2017) finds that an earning-dependent maternity leave benefit in Germany increases fertility most among the middle and upper end of the education and income distributions.

model of fertility decisions with liquidity constraints: the child benefit must be substantial to induce a rise in completed fertility. As Cigno and Ermish (1989) note, if the assumption of access to the capital markets does not apply, as in the case of young couples, child benefits would be expected to raise the tempo of childbearing. Interestingly, we find both an increase in quantum and tempo effects from the baby bonus, suggesting that the cash incentive we analyze was strong enough to increase completed fertility as well as shorten the time between births.

A discrepancy between theory and empirics can be caused by differing designs of child benefits and how family policies are constructed is of great importance. Many create "speed premiums" which essentially encourage women to space their births closer together in order to take advantage of a benefit (see Bjorklund 2006; Lalive and Zweimuller 2009; Neyer and Andersson 2008). Since women in developed countries have a strong preference for two children (Berrington 2004), the Quebec government tailored its baby bonus to encourage fertility by offering more generous transfers at higher parity births. Thus, we find large differential effects by parity, specifically for third and higher births. By contrast, Cygan-Rehm's (2016) finding of no differential birth order response to a German reform is not surprising, given that the payments were the same across parities. Naturally, the timing and number of births differ for women with different levels of education and family income, due to differing opportunity costs and thus differing marginal prices for children.

As argued in the Becker and Lewis (1973) seminal paper, parents trade-off the number of children they have with the quality of those children. If families trade-off quality for quantity (Mogstad and Wiswall 2016; Pop-Eleches 2006) and low-income families are sensitive to these pro-natalist policies, then these baby bonuses may worsen intergeneration inequality. That is, if low-income parents are induced to have more children through pro-natalist policies, then the quantity-quality trade-off suggests that these parents invest less in their children. Building on the quantity-quality theory, Becker and Tomes (1976) outline a U-shape model for the desired number of children as a function of income. This means that at low income levels, the overall income elasticity of demand for children is negative, whereas at high income levels it is positive. Their model predicts that an exogenous shock reducing the price of children would have low-income mothers spend extra income on children they already have rather than having more children because the substitution and the income effects work in opposite directions. This suggests that a baby bonus may not induce low-income families to have more children. On the other hand, the fixed baby bonus may not translate into a large enough percentage increase in income to induce high-income families to have another child. Thus, we expect the marginal effect of the baby bonus to decline at the upper end of the income distribution. In alignment with the theory, we find a hump shape response to the ANC by income group: there is little response among low-income families, mid-income families respond the most, and high-income families respond the least. This result contrasts with Milligan's (2005) finding of an overall positive response to income.[5]

[5] Milligan (2005) estimates a probit regression with the variable "family income." He finds an overall positive coefficient, whereas we subgroup family income and estimate the same model to find the marginal effects of each income subgroup. Here, we are able to find a hump shape response for family income.

Recent work by Riphahn and Wiynck (2017) examines the 1996 German child benefit program and finds that there is no fertility effect for low-income couples. Further evidence from the UK found no increase in births among single women when a reform targeted at low-income households was implemented in 1999 (Brewer et al. 2012). Also, Moffitt (1994) and Hoynes (1995) find that the US Aid to Families with Dependent Children (AFDC) benefits had no impact on fertility for single mothers. It appears that the low price response among low-income women may be because they spend any additional income on the children they already have rather than increasing the size of the family. Milligan (2005) also comments that more educated women may have more "planned" pregnancies and so are more responsive to price signals. Finally, in Cigno's (1986) theoretical model with endogenous fertility, if the wages of husbands and wives are positively correlated and families are differentiated only by earning ability, child benefits do not lead to greater inequality. If earning ability is highly correlated with education level, our result matches this case where higher child benefits do not increase the number of low-income children.

3 Institutional background

The ANC was a non-taxable in-cash transfer to all legal residents of Quebec that had a newborn, or adopted a child under the age of five, between May 1, 1988, and September 30, 1997. The amount of the benefit depended on the parity (birth order) of the child.[6] The amount and exact timing of these payments are in Table 1. Also, the value of the benefit for third- or higher-order children continuously rose over the policy period. By the end of the policy, parents of three or more children received C$8000, which, according to Milligan (2005), accounts for around 30% of the direct cost of the first 5 years of a child's life. Not surprisingly, the policy became expensive to continue, costing over C$1.4 billion between 1989 and 1996 according to Milligan (2002).[7] In September 1997, with the termination of the universal ANC, the provincial government instead implemented a universal C$5 a day childcare policy to encourage mothers' participation in the labor force. Also, the ANC was replaced with a new means-tested family allowance focusing on low-income families (Milligan and Stabile 2011).

Using the Canadian Tax and Credit Simulator (Milligan 2016a), we calculate the total family benefits across different birth parities for different income levels in Quebec and Ontario from 1985 to 2000.[8] We observe total family benefits in the first year a child is born, across different birth parities, in Quebec and Ontario for a family income of C$20,000 and C$60,000, respectively.[9] Both figures show that

[6] The baby bonus was paid to all births that were registered; we find no evidence of differences in ANC take-up rates by income.

[7] We confirm this calculation.

[8] The total family benefits include all refundable credits from federal government and provincial government. See Figs. 4 and 5 for the comparison of family benefits between Ontario and Quebec families.

[9] In simulation, if applicable, we assume that the second child is 6 years old and the third child is 10 years old.

Table 1 Benefit payments under the allowance for newborn children

	First child	Second child	Third or higher child
May 1988 to April 1989	C$500 at birth	C$500 at birth	8 quarterly payments of C$375 = C$3000
May 1989 to April 1990	C$500 at birth	C$500 at birth, C$500 on 1st birthday	12 quarterly payments of C$375 = C$4500
May 1990 to April 1991	C$500 at birth	C$500 at birth, C$500 on 1st birthday	16 quarterly payments of C$375 = C$6000
May 1991 to April 1992	C$500 at birth	C$500 at birth, C$500 on 1st birthday	20 quarterly payments of C$375 = C$7500
May 1992 to Sept. 1997	C$500 at birth	C$500 at birth, C$500 on 1st birthday	20 quarterly payments of C$400 = C$8000

Each cell reports the payments made for a child born within the specified period. Source: Milligan (2005)

total family benefits are significantly higher in Quebec than Ontario during the baby bonus and the largest for third or higher birth parities during the ANC policy period. Furthermore, during the sample period, Ontario did not have any provincial baby bonus policies enacted.[10]

During the almost decade-long duration of the ANC policy, two other policies could have potentially affected the number of births in Quebec. First, abortions were decriminalized in Canada following the strike down of Section 251 by the Supreme Court in 1991 with regard to *R. v. Morgentaler* (1988). The fading stigma of abortions can potentially influence fertility; however, the rate of abortion per 100 live births in Quebec showed only a slight increase between 1986 and 1992, from 14.7 to 16.6.[11] Moreover, we check to ensure that there is a parallel trend and that our difference-in-differences model is not contaminated by varying abortion rates between Quebec and Ontario. Second, Quebec was given constitutional power with regard to immigration in the Canada-Quebec Accord of 1991 (Young 1998). If there is a difference in the fertility behavior of immigrants selected by Quebec, then variation from immigrants' fertility is misleadingly assumed to be attributed to the ANC instead. We address this concern and find that the exclusion of immigrants results in the same findings; we conclude that the Canada-Quebec Accord of 1991 does not affect our analysis. We also examine the response of the ANC by immigrant status and find that immigrant and non-immigrant families respond similarly.

4 Datasets

In this section, we first describe the birth vital statistics dataset and discuss our graphical findings. Then we describe the census dataset that we use for regression analysis in Section 3.

[10] In 1997, after our sample period, Ontario introduced a means-tested child care supplement for working parents (Milligan and Stabile 2011).

[11] Source: Statistics Canada. Table 106-9013.

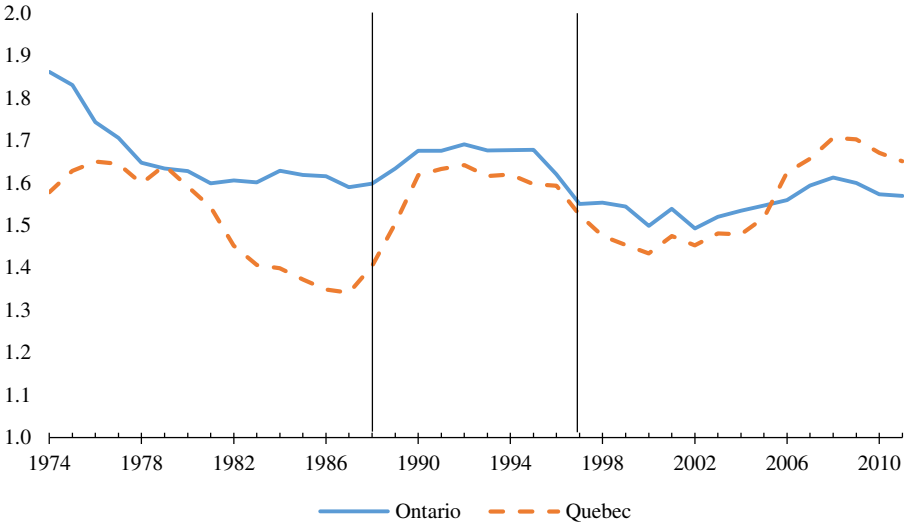

Fig. 1 Total fertility rate, age 15–49. The first vertical bar signifies the start of the ANC policy in May 1988, and the second vertical bar signifies the end of the policy in September 1997. Source: Birth Vital Statistics, 1974 to 2011

4.1 Vital statistics

Using the confidential birth vital statistics from 1974 to 2011, we know the province of each birth, the mother's age, and the parity.[12] With these three critical variables, we are able to look at trends in fertility between Quebec and Ontario to assess the impact of the ANC.[13] Figure 1 shows the total fertility rate (TFR), the cross-section of the sum of age-specific fertility rates in each year from 1974 to 2011, for women between the ages of 15 and 49.[14] The figure makes a very compelling argument for the positive effect the ANC had in Quebec.[15] The TFR in Quebec diverges from Ontario in the early 1980s, remains for 5 years, and then displays a narrowing of this gap starting in 1988.[16] Since the exact structure and payment plan of the baby bonus was not announced until the

[12] With the confidential data, we are able to look at annual TFR for each year of age, whereas past papers using the public-use data have had to use 5-year age intervals.

[13] From all the Canadian provinces, the province of Ontario is the most comparable to Quebec; they are neighbors, as well as the two most populated provinces in Canada. There are many cities and towns on the border of these two provinces, and in one instance, they even share the same metropolitan area (Ottawa-Gatineau).

[14] See Hotz et al. (1997) for a detailed comparison on total fertility rates (TFR) and completed fertility rates (CFR).

[15] In addition to graphical findings, we estimate a difference-in-differences (DID) model using the TFR as the outcome of interest for Quebec and Ontario with 1995 as the treatment year and 1988 as the comparison year. The DID model results in a 0.11 increase in the number of children born to Quebecois women in the treated year. As Manski and Pepper (2018) point out, such DID estimates require strong assumption on DID invariance. Following Manski and Pepper, we apply a class of the bounded-variation assumptions. We use the data prior to 1988 to calculate the bound parameter of bounded time variation, bounded inter-province variation, and bounded DID variation. The bounded DID estimates are between 0.104 and 0.199. These models are available upon request.

[16] We also compared Quebec to the Rest of Canada and find that it closely mirrors that of Ontario illustrating that the gaps we are observing in Quebec are not just in comparison to Ontario.

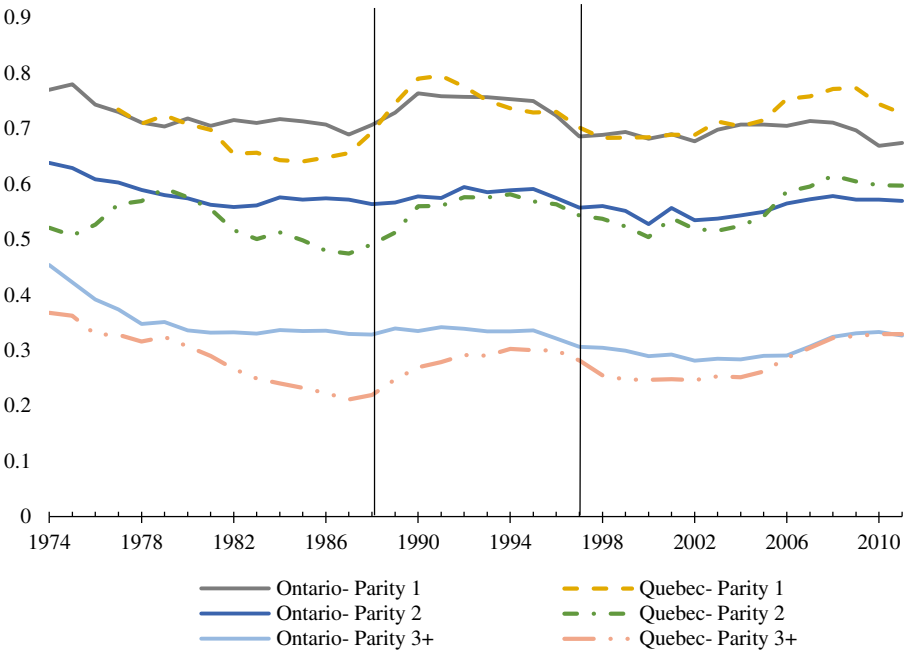

Fig. 2 Total fertility rate by birth order, age 15–49. The first vertical bar signifies the start of the ANC policy in May 1988, and the second vertical bar signifies the end of the policy in September 1997. Source: Birth Vital Statistics, 1974 to 2011

provincial budget speech of May 1988, the slight increase of births in 1988 could not have been affected by the ANC policy. However, Ontario also illustrated an increase in the same year, albeit not as steep as in Quebec. Furthermore, in the previous year's budget speech, the Quebec Minister of Finance, Gérard D. Levesque, announced that family assistance was an important aspect of the new budget, with a specific mention of allowances for families with three or more children being considered (Bernard 1989). Perhaps, some families may have anticipated that a baby bonus of some sort would be implemented shortly.

Although the termination of the ANC is not experimentally ideal due to the introduction of universal childcare and the change in Ontario's child benefit policy, we do see some evidence that Quebec's TFR fell immediately after its cancelation.[17] Figure 2 further decomposes the TFR by birth order. Here, we observe Quebec first-order births surpass Ontario during the policy period. We also suggest that first-order births respond immediately to the policy, followed by second and then third and higher. This illustrates parents having more children during the policy window in order to receive the substantially higher baby bonus for third and higher children.[18]

[17] Although the universal childcare policy is announced to start at the same time the baby bonus is canceled, no new subsidized childcare spaces were created before 2001 (Haeck et al. 2015). In Norway, Havnes and Mogstad (2011) find that formal childcare acts as a substitute for informal childcare (arrangements with relatives, friends, and so forth) instead of encouraging new female labor force participation. Baker et al. (2008) examine childcare use in Quebec and do find some crowding out of existing arrangements is evident.

[18] Milligan (2002) writes that the rate for third and subsequent births in Quebec increased by 35%, from 0.217 per woman in 1987 to 0.294 in 1993, while falling elsewhere in Canada by 3%.

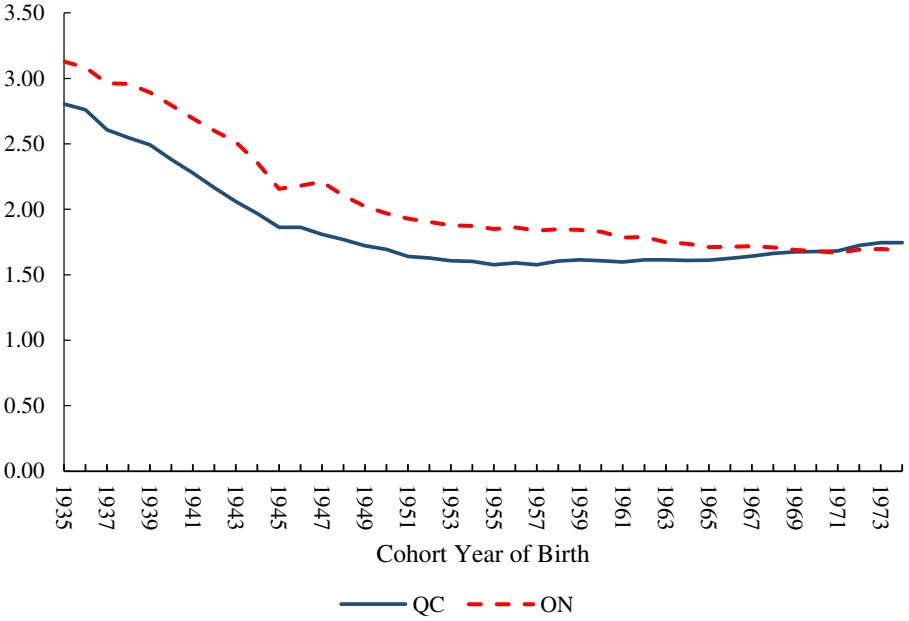

Fig. 3 Completed fertility rate, cohorts aged 15–39. Birth Vital Statistics, 1950 to 2013

Many studies examining family policies usually find a transitory (tempo) effect (see Bjorklund 2006; Cygan-Rehm 2016; Heckman and Walker 1990). It seems far easier to influence when a woman will have a child as opposed to how many. Parent and Wang (2007) examine Quebec after a family allowance that took place in Canada in the 1970s. Here, they find only a transitory effect and specifically no quantum effect. They stress that the price change induced by the reform may simply not have been strong enough to cause a permanent effect. More specifically, with regard to this baby bonus, past work has shown that a transitory effect exists; however, we are the first to explore whether this policy had a permanent effect on fertility as well.[19]

To assess the permanent impact of the ANC policy, we need to look to the completed fertility rates. Figure 3 displays the CFR's for both Quebec (solid line) and Ontario (dashed line) starting from cohorts born in 1935. For the cohorts born from the late 1930s to the late 1950s, the Ontario and Quebec completed fertility rates run in parallel, with Quebec lower by about 0.35 children per woman. These cohorts were either not affected by the policy or were in the latter end of their childbearing years. For later cohorts, the ones that would have been most affected by the ANC, the gap narrows and then disappears altogether for the cohort born in 1970. For younger cohorts, born after 1970, we actually see Quebec's CFR surpass Ontario's by 3.5%. Prior to the policy, Quebec's CFR was on a steady

[19] We also show a transitory effect took place both graphically and in regression analysis. Our graphical results can be seen in the Appendix, Fig. 6. The figure shows the birth cumulative distribution function for each of three cohorts by age of mother and parity, separately for Ontario and Quebec. The difference between Ontario and Quebec is most evident for the third child, where one can observe the "middle cohort" in Quebec having children much earlier than their Ontario counterparts.

decline dipping to around 1.58, after the baby bonus we see Quebec's slope is no longer parallel with Ontario and instead witness its CFR climb to 1.75 indicating a permanent effect of the policy on their completed fertility. Quebec's CFR may well rise higher since there are more cohorts that have been exposed to the baby bonus that cannot presently be calculated.

4.2 Census data

The Canadian Population Census is conducted every 5 years; it provides household information recorded on Census Day. Our main results are based on the 1991 Census and the 1996 Census. We also use the 1986 Census for sensitivity analysis and the 2001 Census to analyze completed fertility rates. With the de-identified files, we observe the exact year a child is born.[20] To create a control group, we choose to examine all married or common-law women from 1987 and 1988 from the 1991 census file. Since the policy was announced in the spring of 1988, any mothers who would have been incentivized by the ANC would have given birth, at the earliest, 9 months later, which falls into 1989. Therefore, the closest control group to the start of the ANC is all married or common-law women in 1987 and 1988. When conducting robustness checks, we change our control group to examine, for example, the number of births that take place in 1984 and 1985 from the 1986 Census. Our treatment group is all married or common-law women from 1994 and 1995 that live in Quebec. We use only 2 years for the treatment group so that the time period is balanced with our control group and for three additional reasons.[21] First, after 7 years of the policy, every family should be familiar with the ANC and would have had time to exploit it should they wish to. That is, the choice of treatment period avoids a heterogeneous information problem (e.g., more educated households know about the policy earlier than others). Second, it is before the cancelation of the policy was announced; thus, residents are unaware of a possible change to the policy. Third, by choosing 1994 and 1995 from the 1996 Census, our income and household characteristics are from 1995, allowing for the most accurate estimates.

We limit our sample to married or common-law females between the age of 15 and 34, who have not changed provinces in the last 5 years prior to Census day, who are residents of Canada, and who have positive income as defined below.[22] Only 11% of births from Quebec women under the age of 35, who have not changed provinces in the last 5 years, were to single women. We remove single mothers for two reasons: (1) we are trying to create a homogeneous group of women to compare and (2) due to the way we define income all single mothers'

[20] The main shortcoming of Milligan's (2005) study of the ANC is that the public-use census does not provide year of birth. This meant that the ANC policy period overlaps the 1991 census window, making it difficult to disentangle which births are part of the policy period. Also, the public-use census file has a very small sample size and does not allow for a thorough examination of heterogeneous effects like the confidential census file.

[21] As a robustness check we also use a 3-year and 5-year window. See Section 6.2 for more detail.

[22] We limit the sample to women aged 34 to ensure we can identify all children; there is a concern that if the woman is older than 34 years of age she may have children living outside the home.

income calculation would be misleading in our model.[23,24] We define income to be equal to the spouse's wage and self-employment income plus all investment income from both the spouse and woman.[25,26] Female wages are excluded because of the endogeneity between female labor force participation and fertility decisions. In addition to income, we observe birth order and whether or not the family lives in an urban versus rural neighborhood in Quebec or Ontario.[27] We also control for age, education level, mother tongue, and immigrant status of both the woman and her spouse. Table 2 shows proportions of the weighted sample for all variables of each census file.

5 Empirical methods

To start, we replicate Milligan's (2005) difference-in-differences model to ensure continuity before examining heterogeneous responses and testing for permanent and transitory effects. After replicating Milligan's (2005) model with our data, we estimate the same model by subsampling different sibship sex compositions, income groups, maternal education, birth order, and immigrant status. We first estimate the following equation with Milligan's specification and then proceed to run the same equation but with the abovementioned subgroups of the population:

$$\text{Had a child}_{ijt} = \beta_0 + \beta_1 \text{Quebec}_j + \beta_2 \text{Census1996}_t + \beta_3 \text{Quebec}_j \times \text{Census1996}_t + X'_{ijt}\beta + \varepsilon_{ijt} \quad (1)$$

For Eq. (1), i indexes the individual females, j indexes jurisdictions, and t indexes time. The dependent variable indicates whether a child is born. Dummy variables are included to control for time effects, Census1996_t, and Quebec fixed effects, Quebec_j. The interaction of the two, $\text{Quebec}_j \times \text{Census1996}_t$, is our main variable of interest and accounts for any differential trend in fertility among residents of Quebec relative to those in Ontario. These models are estimated using probit regression and all standard errors (ε_{ijt}) are adjusted for heteroscedasticity.[28] Average marginal effects are reported

[23] As a robustness check, we examine the effect of the baby bonus on all single women. See Section 6.2 for more detail.

[24] Another reason we only look at married women is because we do not want to model the relationship between the decision to be married and fertility as studied in Baudin et al. (2015).

[25] We use the Canadian Consumer Price Index (CPI) for each province to convert nominal income into real income in 1992 constant Canadian dollars.

[26] The approach of using husband's income to measure family income has been adopted by many in the literature (see Hotz and Miller 1988; Milligan 2005; Jones and Tertilt 2008).

[27] A household is located in an urban dwelling if it is located in a census metropolitan area (CMA), which is one or more municipalities with at least 100,000 people.

[28] In some instances, we also utilized a triple-difference model; however, we prefer the ease of interpretation provided by subsampling the difference-in-differences model. The triple-difference results match well with our preferred model. Results of the triple-difference are available upon request.

Table 2 Census summary statistics

	Quebec			Ontario		
	1986	1991	1996	1986	1991	1996
Had a child	0.239	0.207	0.268	0.269	0.236	0.282
Zero older children	0.497	0.633	0.488	0.460	0.603	0.471
One older child	0.232	0.194	0.243	0.225	0.193	0.234
Two or more older children	0.272	0.174	0.270	0.316	0.205	0.296
Female: 15–24 years old	0.207	0.176	0.160	0.192	0.136	0.112
Female: 25–29 years old	0.390	0.369	0.333	0.379	0.378	0.333
Female: 30–34 years old	0.404	0.455	0.507	0.430	0.487	0.556
Female: allophone	0.051	0.053	0.074	0.093	0.143	0.169
Female: francophone	0.869	0.880	0.862	0.031	0.056	0.052
Female: anglophone	0.081	0.063	0.065	0.877	0.799	0.780
Female: high school dropout	0.259	0.211	0.156	0.277	0.198	0.148
Female: high school diploma	0.231	0.193	0.166	0.216	0.216	0.170
Female: some post-secondary	0.420	0.479	0.504	0.386	0.445	0.494
Female: university degree	0.089	0.118	0.176	0.120	0.142	0.189
Female: immigrant	0.054	0.048	0.059	0.180	0.161	0.196
Immigrant (either parent)	0.086	0.079	0.091	0.272	0.244	0.272
Male: immigrant	0.070	0.062	0.071	0.214	0.186	0.208
Male: 15–24 years old	0.102	0.084	0.074	0.096	0.065	0.054
Male: 25–29 years old	0.317	0.286	0.242	0.299	0.280	0.231
Male: 30–34 years old	0.355	0.374	0.382	0.352	0.386	0.408
Male: 35–39 years old	0.177	0.189	0.226	0.195	0.196	0.232
Male: 40–44 years old	0.038	0.047	0.053	0.043	0.053	0.055
Male: 45 and older	0.011	0.021	0.024	0.016	0.022	0.022
Male: allophone	0.051	0.062	0.075	0.091	0.155	0.174
Male: francophone	0.867	0.870	0.854	0.030	0.055	0.050
Male: anglophone	0.083	0.065	0.067	0.880	0.788	0.774
Male: high school dropout	0.268	0.245	0.205	0.273	0.225	0.179
Male: high school diploma	0.163	0.155	0.158	0.145	0.163	0.157
Male: some post-secondary	0.439	0.463	0.476	0.430	0.456	0.487
Male: university degree	0.131	0.137	0.162	0.151	0.156	0.177
Live in urban area	0.765	0.762	0.762	0.826	0.820	0.835
Income: under C$19,999	0.262	0.261	0.331	0.191	0.178	0.242
Income: C$20,000–39,999	0.449	0.461	0.429	0.407	0.428	0.413
Income: C$40,000–59,999	0.227	0.209	0.182	0.308	0.289	0.248
Income: C$60,000–79,999	0.042	0.046	0.038	0.065	0.068	0.061
Income: C$80,000 and higher	0.019	0.022	0.019	0.030	0.036	0.033
Sum of weights	476,435	468,445	377,825	610,005	589,105	510,670

Each entry is the proportion of the weighted sample for each variable of each census file. For variable Had *a child*, we use periods from 1984 to 1985 for census 1986, from 1987 to 1988 for census 1991, and from 1994 to 1995 for census 1996. Observations are weighted and are rounded to the nearest multiple of 5

to allow for easier interpretation of the estimates.[29] These marginal probabilities are interpreted as the marginal probability of having a child for a change in the independent variable of interest.[30]

The variables included in X_{ijt} relate to the individual woman, her spouse, and her household. Age dummies signify whether the woman is between 15 to 24, 25 to 29, or 30 to 34 years of age, immigrant status, and, mother tongue.[31] Highest level of education is one of the subgroups we model for heterogeneous responses; we categorize education as high school dropout, high school diploma, some post-secondary, and a bachelor's degree or more. Similar variables are included for the spouse[32]; the only difference is age, for which the categories are 15 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, and 45 and older. Real annual family income excluding the woman's wage is categorized as under C$19,999, C$20,000 to C$39,999, C$40,000 to C$59,999, C$60,000 to C$79,999, and C$80,000 and over. We also account for the number of children already in the household: none, one, and two or more. A dummy variable is included to signify whether the household lives in an urban area.

To show how the ANC affected the timing of births, we modify the outcome variable in Eq. (1) to be a binary indicator to signify two or more births within 3 years, two or more births within 5 years, and three or more births within 5 years; the probit estimates will show whether the ANC affected the timing of births and for which subgroups. It is important also to examine how the policy affected the total number of children born to each mother. For married or common-law women aged 35 to 39 from the 1991 and 2001 censuses, we estimate both linear and probit models similar to Eq. (1); the dependent variable in the linear model is the total number of children born to each woman and the outcome variable in the probit models is a binary indicator signifying that the woman had n children in total, where $n = 1$, 2, or 3 or more in each separate model.[33] In addition to examining the total number of children in a household, we further examine the sex composition of a three-child family. The dependent variable in each separate probit model is: had three sons, three daughters, one son and two daughters, and one daughter and two sons. Table 3 contains summary statistics from the 1991 and 2001 censuses for married women aged 35 to 39 in both Ontario and Quebec.[34]

[29] Special care is taken into calculating average partial effects instead of partial effects evaluated at the mean. We observe individual's characteristics to calculate an individual probability and then average all those probabilities, as opposed to mean marginal effects, where the mean for each variable is plugged in to calculate a probability. We calculate the marginal probability using the method described in Ai and Norton (2003).

[30] The approach of using "probability of having a child" as the dependent variable is not new to this literature (see Cohen et al. 2013).

[31] The definition of immigrant in this case comes from the Census definition, which represents all individuals not born as a Canadian citizen.

[32] Nitsche et al. (2018) find evidence that it is important to also account for the male partner's education level as it also significantly predicts fertility.

[33] We also estimated $n = 4$ or more children and find that the results are similar to those for $n = 3$ or more.

[34] We limit our sample to women aged 35 to 39 because they are near the end of childbearing, while still being young enough to have their children living at home. The census only accounts for the number of children present in the household; thus, if we include older women, we may be missing children that are no longer living at home.

Table 3 Census summary statistics for married women 35–39 years old

	Quebec		Ontario	
	1991	2001	1991	2001
Number of children	1.753	1.746	1.875	1.819
Had one child	0.196	0.199	0.167	0.170
Had two children	0.445	0.427	0.441	0.440
Had three or more children	0.205	0.211	0.251	0.231
Female: allophone	0.075	0.106	0.199	0.249
Female: francophone	0.851	0.826	0.058	0.047
Female: anglophone	0.074	0.068	0.743	0.704
Female: high school dropout	0.259	0.167	0.212	0.161
Female: high school diploma	0.260	0.195	0.219	0.163
Female: some post-secondary	0.367	0.452	0.401	0.465
Female: university degree	0.114	0.186	0.168	0.211
Female: immigrant	0.083	0.097	0.257	0.282
Male: immigrant	0.100	0.100	0.290	0.271
Male: allophone	0.085	0.122	0.214	0.269
Male: francophone	0.844	0.812	0.055	0.045
Male: anglophone	0.071	0.066	0.731	0.686
Male: high school dropout	0.268	0.221	0.230	0.200
Male: high school diploma	0.168	0.169	0.136	0.140
Male: some post-secondary	0.402	0.430	0.429	0.459
Male: university degree	0.162	0.180	0.205	0.201
Live in urban area	0.754	0.767	0.827	0.861
Income: under C$19,999	0.228	0.258	0.162	0.209
Income: C$20,000–39,999	0.361	0.365	0.312	0.312
Income: C$40,000–59,999	0.272	0.236	0.322	0.269
Income: C$60,000–79,999	0.089	0.081	0.126	0.113
Income: C$80,000 and higher	0.050	0.060	0.078	0.097
Sum of weights	211,320	210,920	295,400	342,490

Each entry is the proportion of the weighted sample for each variable of each census file. Observations are weighted and are rounded to the nearest multiple of 5

6 Results

6.1 Findings

Table 4 displays the average marginal effects for Eq. (1) with our entire sample as a replication exercise of Milligan (2005), but using the confidential data file. Our average marginal effects provide more accurate estimates and almost all are statistically significant at the 1% level. The first column displays controls with female characteristics, the second male characteristics, and the third family income and whether or not the family lives in an urban area. With all our variables included in the regression, the marginal

Table 4 Average marginal effects

	(a)	(b)	(c)
Census1996 × Quebec	0.0100	0.0201	0.0178
	(0.0017)	(0.0016)	(0.0015)
Census1996	− 0.0042	− 0.0133	0.0020
	(0.0011)	(0.0011)	(0.0010)
Quebec	0.0024	− 0.0117	0.0003
	(0.0012)	(0.0015)	(0.0014)
One older child	0.4509	0.2314	0.1560
	(0.0016)	(0.0017)	(0.0014)
Two or more older children	0.1214	− 0.0358	− 0.0736
	(0.0017)	(0.0013)	(0.0012)
Female: 25–34 years old		0.2864	0.1174
		(0.0009)	(0.0010)
Female: immigrant		0.0755	0.0597
		(0.0014)	(0.0014)
Female: francophone		0.1276	0.1201
		(0.0015)	(0.0017)
Female: anglophone		0.1136	0.1107
		(0.0012)	(0.0013)
Female: high school diploma		0.0018	− 0.0173
		(0.0012)	(0.0011)
Female: some post-secondary		− 0.0177	− 0.0353
		(0.0010)	(0.0010)
Female: university degree		− 0.0790	− 0.0888
		(0.0012)	(0.0012)
Male: 25–34 years old			0.0822
			(0.0021)
Male: 35–44 years old			0.0466
			(0.0022)
Male: 45 and older			− 0.1171
			(0.0038)
Male: immigrant			− 0.0511
			(0.0012)
Male: francophone			− 0.1397
			(0.0012)
Male: anglophone			− 0.1203
			(0.0011)
Male: high school diploma			− 0.0081
			(0.0013)
Male: some post-secondary			− 0.0050
			(0.0010)
Male: university degree			0.0006
			(0.0014)

Table 4 (continued)

	(a)	(b)	(c)
Married			0.1947
			(0.0034)
Live in urban area			−0.0277
			(0.0009)
Income			0.00018
			(0.00001)
Pseudo-*R*-squared	0.0778	0.1789	0.2986
Number of observations	953,630	953,630	953,630

Dependent variable is *Had a child.* Robust standard errors are in parenthesis. Observations are rounded to the nearest multiple of 5

effect of the interaction $\text{Quebec}_j \times \text{Census1996}_t$ displays a 1.8 percentage point increase in the probability of having a child. This translates to an 8.6% implied increase in the probability of having a child.[35] As a comparison Milligan (2005) estimates a 1.3 percentage point increase in the probability of having a child and the implied percentage increase is 8.7.

Table 5 shows the average marginal effect of the ANC policy on having a child from Eq. (1) with each panel displaying a different group of interest (birth parity, sibship sex composition, income group, education level, and immigrant status). Each column represents the subsample for which a separate probit regression is estimated. The rows in each panel display the average marginal effect for the interaction term $\text{Quebec}_j \times \text{Census1996}_t$, its standard error, the implied percentage increase in the probability of having a child, the probability of having a child based on a representative woman, the pseudo *R*-squared from the probit model, the pre-policy and during policy rate, and the number of observations used in the regression. The implied percentage increase in probability of having a child is calculated by dividing the average marginal effect of the ANC policy (the interaction term for $\text{Quebec}_j \times \text{Census1996}_t$) by the proportion of women in each subsample that had a child in Quebec in our pre-policy period (1987–1988). The probability of having a child based on a representative woman is calculated using the probit coefficients, and the representative woman is described in the table note section of Table 5. The pre-policy and during policy rate are the proportion of our subsample that had a child in Quebec in the respective time period.

In panel A of Table 5, we find a large and statistically significant effect on birth order, specifically for families that already have two children: the estimates imply a 23% increase in the probability of having their third or higher child. The baby bonus also increases the implied marginal probability for first and second children by ten and 3%, respectively; however, it is clear the baby bonus supported higher birth order children most by providing a very generous baby bonus ($8000 for third- or higher-order children). Women with a previous child have a very high probability of having a

[35] This calculation is based on the average marginal effect for the interaction term divided by the proportion of women that had a child in Quebec in our pre-policy period (1987–88), which was 0.207.

Table 5 Average marginal effects of ANC on child birth for selected groups

Panel A: subsamples by birth order					
		No older children	One older child	Two or more older children	
Average marginal effect (Quebec × Census1996)		0.0179	0.0127	0.0288	
		(0.0045)	(0.0068)	(0.0050)	
Implied percentage increase in probability of having a child		10.4%	3.2%	23.3%	
Probability of having a child[a]		36.4%	42.2%	12.5%	
Pseudo-*R*-squared		0.0536	0.0215	0.0310	
Pre-policy rate		17.2%	39.1%	12.3%	
During policy rate		26.0%	41.2%	15.0%	
Number of observations		213,010	83,940	93,080	
Panel B: subsamples by gender of first child					
		Son	Daughter		
Average marginal effect (Quebec × Census1996)		0.0213	0.0023		
		(0.0094)	(0.0096)		
Implied percentage increase in probability of having a child		5.6%	0.6%		
Probability of having a child[a]		42.5%	41.8%		
Pseudo-*R*-squared		0.0218	0.0237		
Pre-policy rate		38.3%	38.6%		
During policy rate		41.1%	40.4%		
Number of observations		43,770	41,770		
Panel C: subsamples by gender of previous two children					
		Son and daughter	Two sons	Two daughters	
Average marginal effect (Quebec × Census1996)		0.0381	0.0485	0.0357	
		(0.0106)	(0.0165)	(0.0161)	
Implied percentage increase in probability of having a child		33.8%	33.0%	23.3%	
Probability of having a child[a]		11.8%	15.3%	13.2%	
Pseudo-*R*-squared		0.0328	0.0281	0.0306	
Pre-policy rate		11.3%	14.7%	15.3%	
During policy rate		14.3%	17.5%	17.4%	
Number of observations		35,770	17,975	16,255	
Panel D: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	0.0057	0.0193	0.0312	0.0233	− 0.0006
	(0.0052)	(0.0042)	(0.0060)	(0.0129)	(0.0190)
Implied percentage increase in probability of having a child	1.6%	9.5%	13.6%	9.1%	− 0.2%
Probability of having a child[a]	20.4%	30.2%	34.2%	34.1%	17.8%
Pseudo-*R*-squared	0.0722	0.0654	0.0710	0.0823	0.0878
Pre-policy rate	17.7%	20.3%	23.0%	25.5%	27.8%
During policy rate	24.7%	26.9%	29.0%	29.5%	30.7%
Number of observations	97,410	168,170	92,300	21,300	10,850

Table 5 (continued)

Panel E: subsamples by women's education				
	High school dropout	High school diploma	Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0117	0.0121	0.0231	0.0263
	(0.0065)	(0.0065)	(0.0039)	(0.0068)
Implied percentage increase in probability of having a child	5.3%	5.2%	11.7%	15.2%
Probability of having a child[a]	25.4%	28.6%	30.9%	33.8%
Pseudo-*R*-squared	0.0629	0.0693	0.0740	0.1211
Pre-policy rate	22.1%	23.4%	19.7%	17.3%
During policy rate	25.7%	25.0%	27.4%	27.5%
Number of observations	72,545	72,775	185,170	59,540
Panel F: subsamples by immigration status				
	Non-immigrant (both parents)		Immigrant (either or both parents)	
Average marginal effect (Quebec × Census1996)	0.0171		0.0233	
	(0.0030)		(0.0083)	
Implied percentage increase in probability of having a child	8.4%		9.7%	
Probability of having a child[a]	28.7%		31.2%	
Pseudo-*R*-squared	0.0686		0.0560	
Pre-policy rate	20.3%		24.1%	
During policy rate	26.4%		30.3%	
Number of observations	321,245		68,780	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5. The pre-policy and during policy rate are the proportion of our subsample that had a child in the respective time period

[a] The probability of having a child is calculated based on a representative woman who is married, francophone, lives in an urban area in Quebec, 30–34 years old, during the policy period; (in panel A) is a non-immigrant with some post-secondary education and has no previous children; (in panel B) is a non-immigrant with a family income between $20,000–$40,000 and has no previous children; (in panel C) is a non-immigrant with some post-secondary education, with a family income between $20,000–$40,000; (in panel D) is a non-immigrant with some post-secondary education, with a family income between $20,000–$40,000, and already has two previous children; and (in panel E) has some post-secondary education, with a family income between $20,000–$40,000, and has no previous children

second (42.2% based on our representative woman), so the baby bonus was more likely to encourage third or higher birth order children. Laroque and Salanie (2008) also find evidence that first and third births are responsive to financial incentives in their examination of France's Allocation Parental d'Education (APE). Most people that

already have their first child are also going to have a second, whereas cash incentives either encourage first-time parents or parents of two to try for a third.

Panel B indicates that a gender preference for sons is present. We find that there is a statistically significant effect of the ANC policy for families that already have a son, but not for those who already have a daughter. The implied percentage increase is much higher for those with a previous son, demonstrating that families with a strong preference for a son and a previous daughter were planning to have another child regardless of the baby bonus, whereas families with a son were more encouraged to have another child. These results are in line with studies that find a stronger preference for sons (see Almond et al. 2013; Dahl and Moretti 2008).

Panel C further delves into sex preference with the third child by controlling for the sex of the previous two children. We find that the baby bonus provided the same incentive to have a third child for parents with two previous sons or with a son and a daughter (by 33.0% and 33.8% respectively) but somewhat less for parents with two daughters (23.3%). That suggests that the baby bonus encouraged more births from parents who otherwise would have stopped at two: prior to the policy, parents with two daughters were more inclined to have a third child than parents with both a son and daughter. In Quebec during our pre-policy period (1987–1988), the percent of parents with two previous daughters that had a third child was 15.3%, whereas the percent of parents with a previous son and daughter was only 11.3%. This follows well-documented empirical evidence that parents are more likely to go for a third child when they have two previous daughters (Angrist et al. 2010).

In panel D, we observe a hump shape response to the ANC by income groups. Interestingly, the lowest (under C$20,000) and highest (over C$80,000) income groups' response is not statistically significant, and the coefficients are very small. The second lowest (C$20,000–C$40,000) and highest (C$60,000–C$80,000) income groups both have an implied 9.5% increase in the probability of having a child that is statistically significant. Finally, the mid-income group (C$40,000–C$60,000) has the largest response with an implied increase of almost 14% in the probability of having a child; this result is statistically significant at the 1% level. Once the policy is implemented, we see Quebecois women with a higher probability of having a child, and the rise is predominantly in the mid-income range.[36]

Panel E shows the response by level of education of the women. All the results are statistically significant; however, we observe that women with a high school diploma or less have a 5% increase in the implied probability of having a child due to the baby bonus and an even greater response among women with more education: the implied percentage increase is twice as great for women with some post-secondary education and three times as great for those with a bachelor's degree or higher. This is consistent with recent work that suggests highly educated women are opting for more children (see Shang and Weinberg 2013). Moreover, the probability of having a child follows the same positive gradient across female education levels.[37]

[36] The representative female used to calculate the probability of having a child is a married non-immigrant francophone woman who is 30–34 years old, with some post-secondary education, lives in an urban area, and has no previous children. These characteristics are chosen as they are the most common female we encounter in our sample and thus make the most general comparison.

[37] Since younger women are likely to return to school, as a robustness check, we estimate our specification considering only women over 25 years of age and results do not change significantly.

Table 6 Average marginal effects of ANC on child spacing by subsample

Panel A: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Dependent variable: had 2 or more kids in 3 years					
Average marginal effect (Quebec × Census1996)	0.0073	0.0137	0.0076	0.0053	0.0155
	(0.0046)	(0.0046)	(0.0035)	(0.0051)	(0.0066)
Implied percentage increase in probability	20.5%	39.1%	59.2%	40.0%	108.6%
Dependent variable: had 2 or more kids in 5 years					
Average marginal effect (Quebec × Census1996)	0.0337	0.0473	0.0095	0.0214	0.0211
	(0.0084)	(0.0083)	(0.0074)	(0.0115)	(0.0120)
Implied percentage increase in probability	143.3%	182.6%	87.3%	162.9%	210.7%
Dependent variable: had 3 or more kids in 5 years					
Average marginal effect (Quebec × Census1996)	0.0091	0.0117	0.0006	− 0.0004	0.0110
	(0.0033)	(0.0036)	(0.0024)	(0.0034)	(0.0069)
Implied percentage increase in probability	38.7%	45.2%	5.5%	− 3.0%	109.8%
Number of observations	31,030	32,535	18,470	9470	8495
Panel B: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Dependent variable: had 2 or more kids in 3 years					
Average marginal effect (Quebec × Census1996)	0.0050	0.0081	0.0135	0.0152	0.0194
	(0.0021)	(0.0021)	(0.0033)	(0.0073)	(0.0104)
Implied percentage increase in probability	17.7%	29.0%	37.6%	37.2%	45.1%
Dependent variable: had 2 or more kids in 5 years					
Average marginal effect (Quebec × Census1996)	0.0161	0.0238	0.0338	0.0417	0.0385
	(0.0034)	(0.0034)	(0.0052)	(0.0114)	(0.0171)
Implied percentage increase in probability	19.1%	24.5%	28.2%	28.6%	24.7%
Dependent variable: had 3 or more kids in 5 years					
Average marginal effect (Quebec × Census1996)	0.0041	0.0044	0.0050	0.0127	0.0052
	(0.0013)	(0.0012)	(0.0019)	(0.0052)	(0.0056)
Implied percentage increase in probability	59.3%	73.9%	83.3%	141.1%	37.3%
Number of observations	137,785	168,170	92,300	21,295	10,845
Panel C: subsamples by women's education					
	High school dropout	High school diploma	Some post-secondary	Bachelor degree or higher	
Dependent variable: had 2 or more kids in 3 years					
Average marginal effect (Quebec × Census1996)	0.0089	0.0078	0.0089	0.0052	
	(0.0035)	(0.0033)	(0.0020)	(0.0035)	
Implied percentage increase in probability	27.1%	22.2%	30.7%	18.6%	
Dependent variable: had 2 or more kids in 5 years					
Average marginal effect (Quebec × Census1996)	0.0040	0.0266	0.0269	0.0229	
	(0.0055)	(0.0055)	(0.0033)	(0.0054)	
	3.4%	22.7%	28.7%	28.6%	

Table 6 (continued)

Implied percentage increase in probability				
Dependent variable: had 3 or more kids in 5 years				
Average marginal effect (Quebec × Census1996)	0.0034	0.0041	0.0053	0.0023
	(0.0021)	(0.0019)	(0.0012)	(0.0017)
Implied percentage increase in probability	41.9%	51.5%	88.5%	45.8%
Number of observations	72,540	72,780	185,165	59,540
Panel D: subsamples by immigrant status				
	Non-immigrant (both parents)	Immigrant (either or both parents)		
Dependent variable: had 2 or more kids in 3 years				
Average marginal effect (Quebec × Census1996)	0.0077	0.0106		
	(0.0015)	(0.0042)		
Implied percentage increase in probability	25.8%	28.6%		
Dependent variable: had 2 or more kids in 5 years				
Average marginal effect (Quebec × Census1996)	0.0220	0.0252		
	(0.0025)	(0.0068)		
Implied percentage increase in probability	21.8%	21.2%		
Dependent variable: had 3 or more kids in 5 years				
Average marginal effect (Quebec × Census1996)	0.0044	0.0040		
	(0.0009)	(0.0023)		
Implied percentage increase in probability	73.6%	44.9%		
Number of observations	321,245	68,780		

The implied percentage increase is calculated by dividing the average marginal effect from the Quebec pre-policy dependent variable by each respective subsample. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Finally, in panel F, we examine the response based on immigrant status. The results for both immigrant and non-immigrants are positive statistically significant at the 1% level and suggest that the immigrant response is only slightly greater. When both parents are non-immigrants there is an implied 8% increase in the probability of having a child; when either or both are immigrants, it is almost 10%. Both have around a 30% likelihood of having a child.

Table 6 examines the impact of sibship sex composition, family income, mother's education, and immigrant status on the spacing of children to assess whether the baby bonus encouraged families to have their children closer together. In the first panel, in general, the baby bonus encouraged a rise in tempo. Specifically, we see that families with a daughter are even more inclined to space children closer together, and this result is statistically significant across all three separate regressions. When examining the gender of two previous children, it is the family that already has two daughters that is spacing their children closer together. In panel B, we find as family income increases more children are spaced closer together; the results are statistically significant. In panel C, all the marginal effects by mother's education are positive and mostly statistically

Table 7 Average marginal effects of ANC on completed fertility

Panel A: linear model	
Dependent variable: total number of children	
Average marginal effect (Quebec × Census2001)	0.0417
	(0.0099)
Implied percentage increase	2.4%
Number of observations	208,560
Panel B: probit model	
Dependent variable: family had 1 child	
Average marginal effect (Quebec × Census2001)	0.0008
	(0.0034)
Implied percentage increase in probability	0.4%
Dependent variable: family had 2 children	
Average marginal effect (Quebec × Census2001)	−0.0176
	(0.0044)
Implied percentage increase in probability	−4.0%
Dependent variable: family had 3 or more children	
Average marginal effect (Quebec × Census2001)	0.0208
	(0.0038)
Implied percentage increase in probability	10.2%
Number of observations	208,560
Panel C: 3-child family formation (probit model)	
Dependent variable: had 3 sons	
Average marginal effect (Quebec × Census2001)	0.0023
	(0.0016)
Implied percentage increase in probability	9.1%
Dependent variable: had 3 daughters	
Average marginal effect (Quebec × Census2001)	0.0015
	(0.0014)
Implied percentage increase in probability	7.0%
Dependent variable: had 1 son and 2 daughters	
Average marginal effect (Quebec × Census2001)	0.0020
	(0.0023)
Implied percentage increase in probability	3.4%
Dependent variable: had 1 daughter and 2 sons	
Average marginal effect (Quebec × Census2001)	0.0093
	(0.0024)
Implied percentage increase in probability	15.7%
Number of observations	195,620

The implied percentage increase is calculated by dividing the average marginal effect from the Quebec pre-policy dependent variable. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

significant; that suggests that the baby bonus encouraged parents to space their children closer together. Panel D continues to show that the baby bonus affected non-immigrant and immigrant families similarly. The final row of panel D does show a much larger

implied percentage increase in the probability of non-immigrants having three or more children in 5 years, but it is based on relatively few observations.

Using the 1991 and 2001 censuses, Table 7 asks whether the ANC increased fertility and thus had a permanent effect. Panel A displays the results from a linear model where the dependent variable is the total number of children each family has. Here, we see that there was a positive statistically significant effect which implied a 2.4% increase in the total number of children. To further examine how the ANC affected the total number of children born per family, probit models are estimated. The results in panel B suggest that the baby bonus had a statistically insignificant and economically negligible effect on the probability of having one child and a negative effect on having two children.[38] However, the ANC policy had a positive, large, and statistically significant effect on families with three or more children. Specifically, there was a 10.2% increase in the probability of having a family with three or more kids due to the Quebec baby bonus. Since we observe that the ANC policy had a large impact on three-child families, we examine which of these family formations had the greatest increase due to the policy. Panel C shows that there was a statistically significant 16% increase in the number of three-child families that had one daughter and two sons due to the ANC policy.

Table 8 follows the same probit model as Panel B of Table 7 but subgroups by family income, mother's education, and immigrant status. Here again we see that the ANC was mostly statistically insignificant for one child families, has a negative coefficient on the two-child household, and had a major impact on increasing family size to three or more children.

6.2 Sensitivity analysis

As a robustness check, we re-estimate the same specification for Tables 5, 6, and 7 using a linear probability model instead of a probit model; we find similar results. As a second robustness check, we re-estimate Table 5 without controlling for male characteristics since, as a consequence of assortative mating, they may be highly correlated with income and the female's characteristics. The exclusion of spousal characteristics does not alter our findings. These estimates can be found in the Appendix section under Table 9. Since we previously excluded families that had an income of zero from our sample, we now include these families back in. In Table 10, we see that our hump shape result for family income still holds. Low-income families respond far less to the policy than mid-income families. Specifically, the coefficient estimate for family income between $0 and $20,000 decreases from 0.0057 to 0.0028 illustrating that the poorest of the poor are responding even less.

We also examine single females, previously excluded from our sample, in Table 11. We are able to divide the population of single females by marital status, which are those that have never been married versus those that are separated from a previous marriage. The baby bonus has a statistically insignificant positive effect on separated women and a statistically significant negative effect on females that have never been married. Table 11 also shows the pre-policy rate of having a child in Quebec and these values are very small; the baby bonus was utilized by married women and not encouraging new single mothers.

[38] Households' response to having two children is negative since they are likely moving to a family with three children given the large cash incentive.

Table 8 Average marginal effects of ANC on number of children by subsample

Panel A: subsamples by income group					
	Under C$19,999	C$20,000 –C$39,999	C$40,000 –C$59,999	C$60,000 –C$79,999	C$80,000 higher
Dependent variable: family had 1 child					
Average marginal effect (Quebec × Census2001)	0.0082	0.0006	−0.0062	0.0100	−0.0197
	(0.0074)	(0.0061)	(0.0066)	(0.0107)	(0.0129)
Implied percentage increase in probability	3.9%	0.3%	−3.3%	5.7%	−12.2%
Dependent variable: family had 2 children					
Average marginal effect (Quebec × Census2001)	−0.0137	−0.0189	−0.0128	−0.0370	−0.0148
	(0.0091)	(0.0076)	(0.0086)	(0.0144)	(0.0177)
Implied percentage increase in probability	−3.4%	−4.2%	−2.7%	−7.8%	−3.3%
Dependent variable: family had 3 or more children					
Average marginal effect (Quebec × Census2001)	0.0037	0.0216	0.0161	0.0375	0.0411
	(0.0081)	(0.0064)	(0.0072)	(0.0123)	(0.0158)
Implied percentage increase in probability	1.7%	11.0%	8.2%	17.7%	16.3%
Number of observations	43,920	69,020	57,830	21,900	15,350
Panel B: subsamples by women's education					
	High school dropout	High school diploma	Some post-secondary	Bachelor degree or higher	
Dependent variable: family had 1 child					
Average marginal effect (Quebec × Census2001)	0.0152	−0.0010	−0.0061	−0.0193	
	(0.0084)	(0.0078)	(0.0055)	(0.0090)	
Implied percentage increase in probability	7.8%	−0.5%	−3.1%	−9.6%	
Dependent variable: family had 2 children					
Average marginal effect (Quebec × Census2001)	−0.0502	−0.0239	−0.0111	0.0143	
	(0.0108)	(0.0101)	(0.0070)	(0.0113)	
Implied percentage increase in probability	−11.2%	−5.0%	−2.4%	3.6%	
Dependent variable: family had 3 or more children					
Average marginal effect (Quebec × Census2001)	0.0387	0.0362	0.0163	0.0373	
	(0.0098)	(0.0086)	(0.0060)	(0.0091)	
Implied percentage increase in probability	16.4%	19.2%	8.2%	20.1%	
Number of observations	35,505	40,130	84,860	35,130	
Panel C: subsamples by immigrant status					
	Non-immigrant (both parents)	Immigrant (either or both parents)			
Dependent variable: family had 1 child					
Average marginal effect (Quebec × Census2001)	0.0033	−0.0090			
	(0.0041)	(0.0088)			
Implied percentage increase in probability	1.6%	−5.1%			
Dependent variable: family had 2 children					
Average marginal effect (Quebec × Census2001)	−0.0202	−0.0201			
	(0.0052)	(0.0115)			
Implied percentage increase in probability	−4.4%	−4.6%			
Dependent variable: family had 3 or more children					
Average marginal effect (Quebec × Census2001)	0.0211	0.0334			
	(0.0043)	(0.0103)			
Implied percentage increase in probability	10.8%	12.3%			
Number of observations	146,450	49,170			

The implied percentage increase is calculated by dividing the average marginal effect from the Quebec pre-policy dependent variable by each respective subsample. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Next, we use 1984 and 1985 from the 1986 census file as our control group, instead of 1987 and 1988 from the 1991 census file. The results, found in Table 12, are substantially unchanged qualitatively, but exact estimates do vary because of the substantial decline in fertility in the mid-1980s. For example, we find the same hump shape by income but it is shifted up because the new control group (1984–1985) had fewer children, thereby creating a larger difference from the treatment group (1994–1995).

Furthermore, to minimize the cultural dissimilarity between our treated and control group, we conduct the following exercise: we estimate our model using only households living near the border of the two provinces. We find Table 13 results are qualitatively similar.[39]

We re-estimate Table 5 with a 3-year and 5-year window inside and outside the policy to ensure our 2-year window from all previous regressions is reliable. In the 3-year window (Table 14), we use 1986 to 1988 as the pre-policy window and 1993 to 1995 as the within-policy window. For the 5-year window (Table 15), we examine 1984 to 1988 versus 1991 to 1995. Qualitatively, the results are the same and statistically significant with the same hump shape response in income, as well as the same heterogeneous responses in parity, sibship sex composition, and education.

Since immigrants may respond differently to the baby bonus, we exclude them from the sample and re-estimate the model. The results are shown in Table 16. In Table 17, we limit the sample to only females aged 25–34 since females younger than 25 are likely still in school. We find the response is weaker at the margin, but is consistent with our birth CDF findings; more females gave birth at younger ages under the ANC policy. These robustness checks confirm that the baby bonus did create heterogeneous responses among women.

As a final check, we also use the exact match method that stratifies females with the same characteristics and then perform a difference-in-differences calculation across time (pre-policy and within-policy) and across groups (Quebec and Ontario). This method relaxes the assumptions on global common trends and model dependence. We match females by birth parity, income group, education level, and age group. Each unique grouping forms a stratum. In this case, we create 180 strata (3 parity groups × 5 income groups × 4 education levels × 3 age groups).[40] For each stratum, we calculate the difference in having a child between Quebec and Ontario females as well as pre-policy and within-policy periods. This difference-in-differences calculation results in a hump shape response across income groups, confirming our earlier findings.[41]

7 Conclusion

When we examine the impact of the ANC on fertility by birth order, we find a strong increase in the probability of having a third child or higher order. We are aware that

[39] The sample size drops to 90,000 households. Also, Quebec has almost four times the number of observations than Ontario. Thus, this is not our preferred specification. The CMAs we selected are Temiskming Shores, North Bay, Petawawa, Pembroke, Hawkesbury, Cornwall, Rouyn-Noranda, Lachute, Salaberry-de-Valleyfield, Val-d'Or, and Amos.

[40] We drop 12 strata because they contain less than 5 observations for each province and each period.

[41] Results available upon request.

these results are due to the specific payment structure of the ANC. From May 1992 until the cancelation of the policy in September 1997, the transfer payments were C$500 for the first child, C$1000 for the second, and C$8000 for the third child or higher. Had the payment structure provided a constant amount regardless of parity, the estimates for third or higher parity children would not be as large. The Quebec government continuously increased the transfer payment for third or higher children, from C$3000 to C$8000, demonstrating that they were also aware that families with two children already present in the household require a larger income transfer to induce them to have a third child.

North American parents prefer to have one-of-each gender, with a secondary preference for sons (Williamson 1983). Interestingly, parents with two previous sons, or a previous son and daughter, were more inclined to have a third child after the ANC was implemented. This illustrates that parents who were more likely to stop at two children were successfully encouraged by the ANC to have another child. These results provide strong evidence to suggest that Quebec's baby bonus did in fact accomplish its goal of increasing fertility, while simultaneously alleviating the gender preferences of parents.

The heterogeneous responses we find suggest that baby bonuses do work. Pro-natalist policies can encourage household births by targeting the subgroups whose fertility decisions are highly responsive to cash incentives. For example, when examining the heterogeneous response of the ANC by income group, we find a hump shape result that is robust to many different specifications. Interestingly, Becker and Tomes (1976) model a U-shaped path for the desired number of children as income rises. This model predicts that a negative exogenous shock in the price of children would have low-income mothers spend extra income on children they already have rather than having more children. Moreover, the amount of the transfer may not be enough for high-income individuals to be induced to have another child. Mid-income families seem poised to take advantage of a baby bonus, and if structured strategically pro-natalist policies can increase higher parity births. Furthermore, we find that highly educated women are more likely to participate in a baby bonus than less educated women. This encourages the reduction of the fertility rate disparity that is related to maternal education.

Moreover, we are able to observe the completed fertility rates of many cohorts that were exposed to the ANC. We see that, in addition to a transitory effect where women were having their children closer together, there was also an increase in completed fertility of women aged 15 to 39, illustrating that the pro-natalist policy does have a permanent effect on fertility in Quebec. We find that among three-child households, the baby bonus was able to create more one daughter-two son families then other sibship sex compositions. Pro-natalist policies, if structured correctly, could cost-effectively increase fertility and alleviate the immense concern of below-replacement rates for developed nations. Furthermore, pro-natalist policies can also diminish gender preferences by incentivizing parents to have more children.

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Conflict of interest Beyond these, the authors declare that they have no conflict of interest.

Appendix

Fig. 4

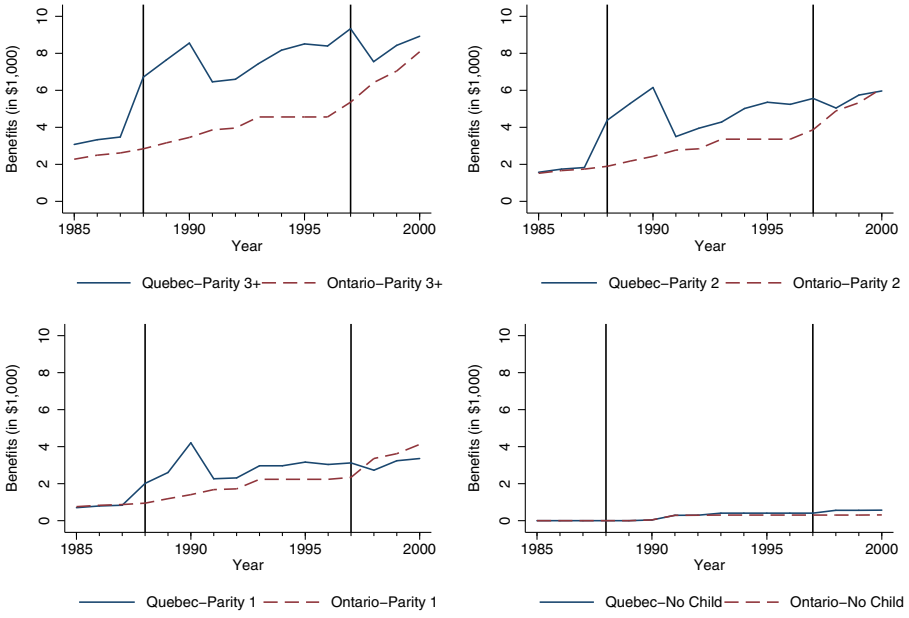

Fig. 4 Total family benefit for household income of $20,000. The first vertical bar signifies the start of the ANC policy in May 1988, and the second vertical bar signifies the end of the policy in September 1997. Source: Milligan (2016a), Canadian Tax and Credit Simulator. Database, software, and documentation, version 2016-2

Fig. 5

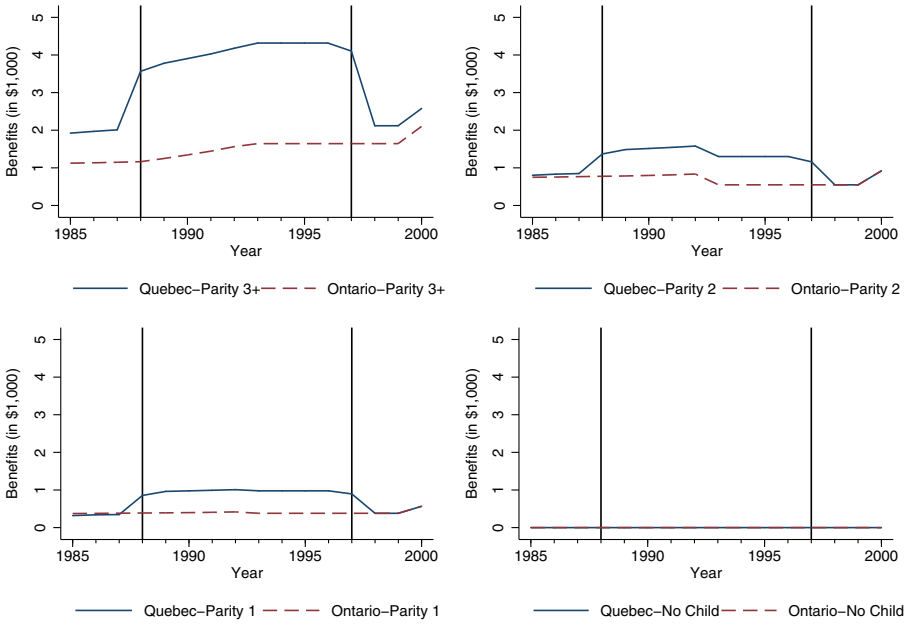

Fig. 5 Total family benefit for household income of $60,000. The first vertical bar signifies the start of the ANC policy in May 1988, and the second vertical bar signifies the end of the policy in September 1997. Source: Milligan (2016a), Canadian Tax and Credit Simulator. Database, software, and documentation, version 2016-2

Fig. 6

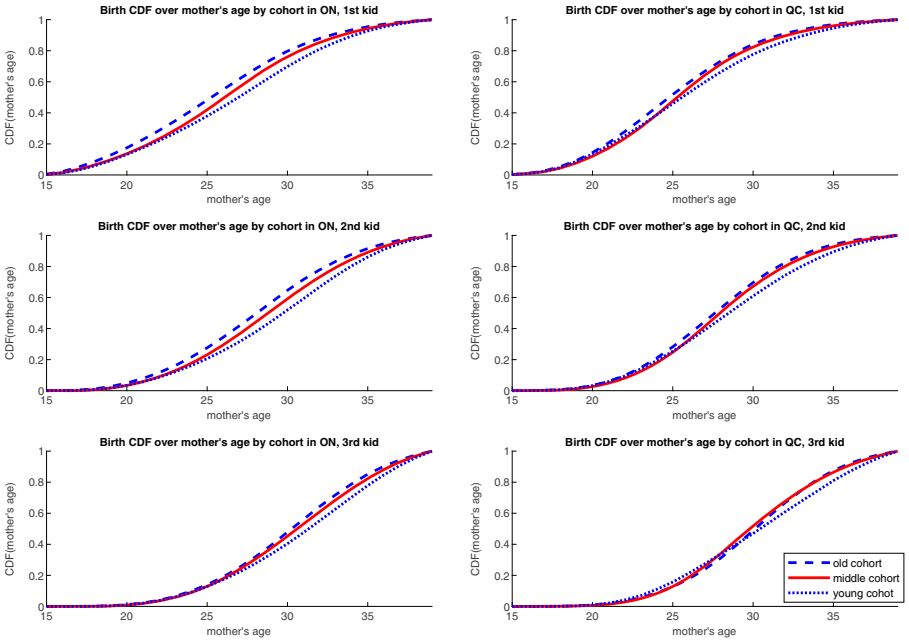

Fig. 6 Birth cumulative distribution function by mother's age, cohorts aged 15–39. Birth Vital Statistics source. The "old cohort" was born between 1959 and 1962 and aged 26–38 during the policy; the "middle cohort" was born between 1963 and 1968 and aged 20–34 during the policy; and the "young cohort" was born between 1969 and 1972 and aged 16–28 during the policy

Table 9 Average marginal effects of ANC on child birth—excluding male characteristics

Panel A: subsamples by birth order					
	No older children	One older child		Two or more older children	
Average marginal effect (Quebec × Census1996)	0.0165	0.0112		0.0305	
	(0.0038)	(0.0068)		(0.0049)	
Number of observations	213,010	83,940		93,080	
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0211	0.0018	0.0353	0.0400	0.0355
	(0.0096)	(0.0098)	(0.0088)	(0.0130)	(0.0143)
Number of observations	42,990	40,950	35,770	17,975	16,255
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000higher
Average marginal effect (Quebec × Census1996)	0.0050	0.0168	0.0294	0.0222	− 0.0055
	(0.0052)	(0.0042)	(0.0060)	(0.0130)	(0.0190)
Number of observations	97,410	168,170	92,300	21,300	10,850
Panel D: subsamples by women's education					
	High school dropout	High school diploma		Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0103	0.0106		0.0218	0.0256
	(0.0066)	(0.0065)		(0.0039)	(0.0067)
Number of observations	72,545	72,775		185,170	59,540
Panel E: subsamples by immigration status					
	Non-immigrant (both parents)			Immigrant (either or both parents)	
Average marginal effect (Quebec × Census1996)	0.0161			0.0220	
	(0.0030)			(0.0083)	
Number of observations	321,250			68,780	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 10 Average marginal effects of ANC on child birth—including zero income households

Panel A: subsamples by birth order					
	No older children		One older child	Two or more older children	
Average marginal effect (Quebec × Census1996)	0.0225		0.0131	0.0294	
	(0.0035)		(0.0066)	(0.0048)	
Number of observations	240,140		89,385	100,875	
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0218	0.0041	0.0268	0.0359	0.0345
	(0.0092)	(0.0094)	(0.0074)	(0.0116)	(0.0122)
Number of observations	45,755	43,630	38,360	19,240	17,425
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	0.0028	0.0193	0.0312	0.0233	− 0.0006
	(0.0042)	(0.0042)	(0.0060)	(0.0129)	(0.0190)
Number of observations	137,785	168,170	92,300	21,295	10,845
Panel D: subsamples by women's education					
	High school dropout	High school diploma		Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0112	0.0139		0.0252	0.0295
	(0.0058)	(0.0061)		(0.0037)	(0.0066)
Number of observations	87,905	80,015		199,850	62,620
Panel E: subsamples by immigration status					
	Non-immigrant (both parents)			Immigrant (either or both parents)	
Average marginal effect (Quebec × Census1996)	0.0189			0.0304	
	(0.0028)			(0.0077)	
Number of observations	351,750			78,645	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 11 Average marginal effects of ANC on child birth—single females (84 to 88 vs. 91 to 95)

Panel A: subsamples by marital status				
	Never married	Separated		
Average marginal effect (Quebec × Census1996)	−0.0019	0.0019		
	(0.0008)	(0.0071)		
Quebec pre-policy rate	1.8%	13.3%		
Number of observations	482,330	38,495		
Panel B: subsamples by birth order				
	No older children	One older child	Two or more older children	
Average marginal effect (Quebec × Census1996)	−0.0011	0.0221	0.0392	
	(0.0007)	(0.0102)	(0.0107)	
Quebec pre-policy rate	1.8%	15.7%	7.8%	
Number of observations	478,820	24,405	17,600	
Panel C: subsamples by women's education				
	High school dropout	High school diploma	Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0037	−0.0002	0.0007	−0.0012
	(0.0017)	(0.0023)	(0.0014)	(0.0017)
Quebec pre-policy rate	3.6%	2.5%	2.1%	1.0%
Number of observations	181,070	80,440	201,825	57,490
Panel D: subsamples by immigration status				
	Non-immigrant (both parents)	Immigrant (either or both parents)		
Average marginal effect (Quebec × Census1996)	0.0018	0.0010		
	(0.0010)	(0.0034)		
Quebec pre-policy rate	2.7%	1.6%		
Number of observations	398,090	122,735		

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 12 Average marginal effects of ANC on child birth—84 to 85 vs. 94 to 95

Panel A: subsamples by birth order					
	No older children	One older child		Two or more older children	
Average marginal effect (Quebec × Census1996)	0.0286	0.0284		0.0195	
	(0.0041)	(0.0065)		(0.0043)	
Number of observations	187,900	93,420		118,480	
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0428	0.0127	0.0310	0.0252	0.0163
	(0.0091)	(0.0093)	(0.0091)	(0.0146)	(0.0143)
Number of observations	47,830	45,345	44,845	22,525	20,485
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	0.0128	0.0225	0.0386	0.0518	0.0020
	(0.0053)	(0.0042)	(0.0058)	(0.0129)	(0.0194)
Number of observations	100,650	168,310	98,630	21,080	10,080
Panel D: subsamples by women's education					
	High school dropout	High school diploma		Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0079	0.0345		0.01894	0.0420
	(0.0062)	(0.0064)		(0.0041)	(0.0077)
Number of observations	89,370	78,480		176,670	55,290
Panel E: subsamples by immigration status					
	Non-immigrant (both parents)			Immigrant (either or both parents)	
Average marginal effect (Quebec × Census1996)	0.0259			0.0179	
	(0.0030)			(0.0081)	
Number of observations	324,220			74,530	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 13 Average marginal effects of ANC on child birth—border cities

Panel A: subsamples by birth order					
	No older children	One older child		Two or more older children	
Average marginal effect (Quebec × Census1996)	0.0257	0.0084		0.0189	
	(0.0084)	(0.0166)		(0.0113)	
Number of observations	60,230	21,290		19,780	
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0245	− 0.0070	0.0010	0.0595	0.0047
	(0.0232)	(0.0237)	(0.0205)	(0.0338)	(0.0227)
Number of observations	10,870	10,420	7965	4055	3610
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	− 0.0019	0.02891	0.0305	− 0.0021	0.0066
	(0.0123)	(0.0099)	(0.0133)	(0.0268)	(0.0392)
Number of observations	25,610	43,730	23,390	5780	2780
Panel D: subsamples by women's education					
	High school dropout	High school diploma		Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0031	0.0016		0.0260	0.0334
	(0.0189)	(0.0160)		(0.0091)	(0.0131)
Number of observations	15,570	17,710		48,890	19,130
Panel E: subsamples by immigration status					
	Non-immigrant (both parents)			Immigrant (either or both parents)	
Average marginal effect (Quebec × Census1996)	0.0236			0.0054	
	(0.0069)			(0.0164)	
Number of observations	85,770			15,520	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 14 Average marginal effects of ANC on child birth—1986 to 1988 vs1993 to 1995

Panel A: subsamples by birth order					
	No older children		One older child		Two or more older children
Average marginal effect (Quebec × Census1996)	0.0226		0.0135		0.0417
	(0.0038)		(0.0070)		(0.0063)
Number of observations	236,050		78,240		75,740
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0156	0.0019	0.0647	0.0609	0.0352
	(0.0111)	(0.0113)	(0.0125)	(0.0178)	(0.0180)
Number of observations	31,385	29,800	29,635	14,875	13,380
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	0.0128	0.0263	0.0336	0.0330	0.0122
	(0.0056)	(0.0045)	(0.0064)	(0.0136)	(0.0197)
Number of observations	97,410	168,170	92,300	21,300	10,850
Panel D: subsamples by women's education					
	High school dropout	High school diploma		Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0077	0.0189		0.0285	0.0347
	(0.0070)	(0.0070)		(0.0042)	(0.0071)
Number of observations	72,545	72,775		185,170	59,540
Panel E: subsamples by immigration status					
	Non-immigrant (both parents)		Immigrant (either or both parents)		
Average marginal effect (Quebec × Census1996)	0.0218		0.0248		
	(0.0032)		(0.0088)		
Number of observations	321,250		68,780		

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 15 Average marginal effects of ANC on child birth—1984 to 1988 vs1991 to 1995

Panel A: subsamples by birth order					
	No older children		One older child		Two or more older children
Average marginal effect (Quebec × Census1996)	0.0280		0.0018		0.0111
	(0.0037)		(0.0065)		(0.0081)
Number of observations	258,920		71,225		59,880
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0009	0.0007	0.0537	0.0589	0.0683
	(0.0126)	(0.0129)	(0.0140)	(0.0203)	(0.0216)
Number of observations	26,070	24,910	18,470	9470	8495
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	0.0179	0.0333	0.0386	0.0291	0.0003
	(0.0058)	(0.0046)	(0.0066)	(0.0138)	(0.0196)
Number of observations	97,415	168,165	92,300	21,295	10,845
Panel D: subsamples by women's education					
	High school dropout	High school diploma		Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	0.0148	0.0194		0.0340	0.0427
	(0.0073)	(0.0072)		(0.0043)	(0.0073)
Number of observations	72,545	72,775		185,170	59,540
Panel E: subsamples by immigration status					
	Non-immigrant (both parents)			Immigrant (either or both parents)	
Average marginal effect (Quebec × Census1996)	0.0265			0.0407	
	(0.0033)			(0.0089)	
Number of observations	321,245			68,780	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 16 Average marginal effects of ANC on child birth—excluding immigrants

Panel A: subsamples by birth order					
	No older children	One older child		Two or more older children	
Average marginal effect (Quebec × Census1996)	0.0161	0.0149		0.0239	
	(0.0041)	(0.0075)		(0.0053)	
Number of observations	179,000	67,400		74,840	
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0233	0.0063	0.0383	0.0432	0.0234
	(0.0105)	(0.0107)	(0.0121)	(0.0186)	(0.0171)
Number of observations	34,515	32,885	28,885	14,470	13,180
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	0.0033	0.0136	0.0319	0.0265	− 0.0227
	(0.0058)	(0.0045)	(0.0065)	(0.0140)	(0.0210)
Number of observations	79,710	140,000	76,130	17,010	8390
Panel D: subsamples by women's education					
	High school dropout	High school diploma	Some post-secondary	Bachelor degree or higher	
Average marginal effect (Quebec × Census1996)	0.0070	0.0111	0.0192	0.0236	
	(0.0071)	(0.0070)	(0.0043)	(0.0075)	
Number of observations	59,550	60,680	154,090	46,930	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 17 Average marginal effects of ANC on child birth—female aged 25 to 34

Panel A: subsamples by birth order					
	No older children		One older child		Two or more older children
Average marginal effect (Quebec × Census1996)	0.0125		0.0106		0.0285
	(0.0045)		(0.0070)		(0.0050)
Number of observations	162,670		78,860		91,590
Panel B: subsamples by previous children					
	Son	Daughter	Son and daughter	Two sons	Two daughters
Average marginal effect (Quebec × Census1996)	0.0187	0.0024	0.0367	0.0452	0.0358
	(0.0098)	(0.0100)	(0.0106)	(0.0166)	(0.0161)
Number of observations	40,350	38,505	35,140	17,635	15,955
Panel C: subsamples by income group					
	Under C$19,999	C$20,000–C$39,999	C$40,000–C$59,999	C$60,000–C$79,999	C$80,000 higher
Average marginal effect (Quebec × Census1996)	0.0078	0.0116	0.0284	0.0204	− 0.0069
	(0.0062)	(0.0046)	(0.0062)	(0.0132)	(0.0194)
Number of observations	72,400	143,310	86,420	20,480	10,510
Panel D: subsamples by women's education					
	High school dropout	High school diploma		Some post-secondary	Bachelor degree or higher
Average marginal effect (Quebec × Census1996)	− 0.0003	0.0193		0.0166	0.0260
	(0.0071)	(0.0070)		(0.0044)	(0.0072)
Number of observations	68,680	68,240		167,450	58,140
Panel E: subsamples by immigration status					
	Non-immigrant (both parents)			Immigrant (either or both parents)	
Average marginal effect (Quebec × Census1996)	0.0135			0.0201	
	(0.0033)			(0.0088)	
Number of observations	270,810			62,310	

Dependent variable is *Had a child*. Robust standard errors are in parenthesis. The number of observations is rounded to the nearest multiple of 5

Table 18 Data sources

Source	Title	Reference table or year
Statistics Canada	Induced abortions in hospitals and clinics, annual	CANSIM Table 106-9013
Statistics Canada	Consumer Price Index, annual	CANSIM Table 326-0021
Statistics Canada	Estimates of population, annual	CANSIM Table 051-0001
Statistics Canada	Vital Statistics - Birth Database	Years: 1946 to 2013
Statistics Canada	Census of Population	Years: 1986, 1991, 1996, 2001

References

Ai C, Norton EC (2003) Interaction term in logit and probit models. Econ Lett 80:123–129
Almond D, Edlund L, Milligan K (2013) Son preference and the persistence of culture: evidence from south and east Asian immigrants to Canada. Popul Dev Rev 39(1):75–95
Andersson G, Hank K, Ronsen M, Vikat A (2006) Gendering family composition: sex preferences for children and childbearing behavior in the Nordic countries. Demography 43(2):255–267
Ang XL (2015) The effects of cash transfer fertility incentives and parental leave benefits on fertility and labor supply: evidence from two natural experiments. J Fam Econ Iss 36(2):263–288
Angrist JD, Evans WN (1998) Children and their parents' labor supply: evidence from exogenous variation in family size. Am Econ Rev 88(3):450–477
Angrist JD, Lavy V, Schlosser A (2010) Multiple experiments for the causal link between the quantity and quality of children. J Labor Econ 28(4):773–824
Baker M, Gruber J, Milligan K (2008) Universal child care, maternal labor supply, and family well-being. J Polit Econ 116(4):709–745
Battle K, Mendelson M (1997) Child benefit reform in Canada: an evaluative framework and future directions. Caledon Institute of Social Policy
Baudin T, de la Croix D, Gobbi PE (2015) Fertility and childlessness in the United States. Am Econ Rev 105(6):1852–1882
Baughman R, Dickert-Conlin S (2009) The earned income tax credit and fertility. J Popul Econ 22(3):537–563
Becker GS (1960) An economic analysis of fertility. In: Bureau U-N (ed) Demographic and economic change in developed countries: a conference of the Universities-National Bureau Committee for Economic Research, vol 11. Princeton University Press, Princeton, pp 209–231
Becker GS (1981) A treatise on the family. Harvard University Press, Cambridge, Massachusetts
Becker GS, Lewis G (1973) On the interaction between the quantity and quality of children. J Polit Econ 81(2):S279–S288
Becker GS, Tomes N (1976) Child endowments and the quantity and quality of children. J Polit Econ 84(4): S143–S162
Bernard A (1989) Government Policies. L'Année Politique au Québec 1987–1988. Denis Monière, ed. Montréal, Le Devoir, Québec-Amérique
Berrington A (2004) Perpetual postponers? Women's, men's and couple's fertility intentions and subsequent fertility behavior. Popul Trends 117:9–19
Bjorklund A (2006) Does family policy affect fertility? J Popul Econ 19:3–24
Bongaarts J (2001) Fertility and reproductive preferences in post-transitional societies. Popul Dev Rev 27: 260–281
Brewer M, Ratcliffe A, Smith S (2012) Does welfare reform affect fertility? Evidence from the UK. J Popul Econ 25:245–266
Cigno A (1986) Fertility and the tax-benefit system: a reconsideration of the theory of family taxation. Econ J 96:1035–1051
Cigno A, Ermish J (1989) A microeconomic analysis of the timing of births. Eur Econ Rev 33:737–760
Cohen A, Dehejia R, Romanov D (2013) Do financial incentives affect fertility? Rev Econ Stat 95(1):1–20

Cygan-Rehm K (2016) Parental leave benefit and differential fertility responses: evidence from a German reform. J Popul Econ 29:73–103
Dahl GB, Moretti E (2008) The demand for sons. Rev Econ Stud 75(4):1085–1120
Duclos E, Lefebvre P, Merrigan P (2001) A natural experiment on the economics of storks: evidence on the impact of differential family policy on fertility rates in Canada. Working Paper No. 136, CREFE
Esping-Andersen G (2009) The incomplete revolution. Adapting to women's new roles. Polity Press, Cambridge
Freedman D, Freedman R, Whelpton PK (1960) Size of family and preference for children of each sex. Am J Sociol 66(2):141–146
Gonzalez L (2013) The effect of a universal child benefit on conceptions, abortions, and early maternal labor supply. Am Econ J Econ Pol 5(3):160–188
Haeck C, Lefebvre P, Merrigan P (2015) Canadian evidence on ten years of universal preschool policies: the good and the bad. Labour Econ 36:137–157
Havnes T, Mogstad M (2011) Money for nothing? Universal child care and maternal employment. J Public Econ 95:1455–1465
Heckman JJ, Walker JR (1990) The relationship between wages and income and the timing and spacing of births: evidence from Swedish longitudinal data. Econometrica 58(6):1411–1441
Heiland F, Prskawetz A, Sanderson WC (2008) Are individuals' desired family size stable? Evidence from West German panel data. Eur J Popul 24(2):129–156
Hotz VJ, Miller R (1988) An empirical analysis of life cycle fertility and female labor supply. Econometrica 56(1):91–118
Hotz VJ, Klerman JA, Willis RJ (1997) The econometrics of fertility in developed countries. In: Rosenzweig MR, Stark O (eds) Handbook of population economics. Elsevier Science, Amsterdam
Hoynes H (1995) Does welfare play any role in female headship decisions? National Bureau of Economic Research Working Paper No. 5149
Jones L, Tertilt M (2008) An economic history of fertility in the U.S.: 1826–1960. In: Rupert P (ed) Frontiers of family economics. Emerald Press, London, pp 165–230
Kim YA (2012) Impact of direct cash transfer on fertility by income and education subgroup: study of allowance for newborn children of Canada. Korean J Popul Stud 35:29–55
Kim YA (2014) Lifetime impact of cash transfer on fertility. Can Stud Popul 41:97–110
Kravdal O, Rindfuss RR (2008) Changing relationships between education and fertility: a study of women and men born 1940 to 1964. Am Sociol Rev 73:854–873
La Presse (1988) Baisse d'impots pour tous. May 13, p. A-1
Lalive R, Zweimuller J (2009) How does parental leave affect fertility and return to work? Evidence from two natural experiments. Q J Econ 124(3):1363–1402
LaLumia S, Sallee JM, Turner S (2015) New evidence on taxes and the timing of birth. Am Econ J Econ Pol 7(2):258–293
Laroque G, Salanie B (2008) Does fertility respond to financial incentives? CESifo working paper 2339
Manski CF, Pepper JV (2018) How do right-to-carry laws affect crime rates? Coping with ambiguity using bounded-variation assumptions. Rev Econ Stat 100(2):232–244
Milligan K (2002) Quebec's baby bonus: can public policy raise fertility? Backgrounder, C.D. Howe Institute, 1–9
Milligan K (2005) Subsidizing the stork: new evidence on tax incentives and fertility. Rev Econ Stat 87(3): 539–555
Milligan K (2016a) Canadian tax and credit simulator. Database, software and documentation, Version 2016-2
Milligan K (2016b) Finances of the nation. Can Tax J 64(3):601–618
Milligan K, Stabile M (2011) Do child tax benefits affect the well-being of children? Evidence from Canadian child benefit expansions. Am Econ J Econ Pol 3(3):175–205
Moffitt R (1994) Welfare effects on female headship with area effects. J Hum Resour 29(2):621–636
Mogstad M, Wiswall M (2016) Testing the quantity-quality model of fertility. Quant Econ 7:157–192
Montreal Gazette (1988a) Have more babies, liberals say. February 28, p. A-1
Montreal Gazette (1988b) Parizeau's family plan: triple baby bonus. March 15, p. A-1
Neyer G, Andersson G (2008) Consequences of family policies on childbearing behavior: effects or artifacts? Popul Dev Rev 34(4):699–724
Nitsche N, Matysiak A, Van Bravel J, Vignoli D (2018) Partners' educational pairings and fertility across Europe. Demography 55:1195–1232
Ost B, Dziadula E (2016) Gender preference and age at arrival among Asian immigrant mothers in the US. Econ Lett 145:286–290

Palermo T, Handa S, Peterman A, Prencipe L, Seidenfeld D (2016) Unconditional government social cash transfer in Africa does not increase fertility. J Popul Econ 29:1083–1111
Parent D, Wang L (2007) Tax incentives and fertility in Canada: quantum vs tempo effects. Can J Econ 40(2): 371–400
Pop-Eleches C (2006) The impact of an abortion ban on socioeconomic outcomes of children: evidence from Romania. J Polit Econ 114(4):744–773
Quesnel-Vallee A, Morgan SP (2003) Missing the target? Correspondence of fertility intentions and behavior in the US. Popul Res Policy Rev 22(5–6):497–525
Raute A (2017) Can financial incentives reduce the baby gap? Evidence from a reform in maternity leave benefits. National Bureau of Economic Research Working Paper No. 23793. Forthcoming: Journal of Public Economics
Riphahn RT, Wiynck FJ (2017) Fertility effects of child benefits. J Popul Econ 30:1135–1184
R v Morgentaler (1988) 1 SCR 30, 37 CCC (3d)
Shang Q, Weinberg BA (2013) Opting for families: recent trends in the fertility of highly educated women. J Popul Econ 26:5–32
Testa MR (2014) On the positive correlation between education and fertility intentions in Europe: individual- and country-level evidence. Adv Life Course Res 21:28–42
Williamson N (1983) Parental sex preferences and sex selection. In: Bennett N (ed) Sex selection of children. Academic Press, New York, NY
Yakita A (2018) Fertility and education decisions and child-care policy effects in a Nash-bargaining family model. J Popul Econ 31:1177–1201
Young M (1998) Immigration: The Canada-Quebec Accord. Publication BP-252E, Parliamentary Research Branch, Library of Parliament, Ottawa
Zhang J, Quan J, Van Meerbergen P (1994) The effect of tax-transfer policies on fertility in Canada, 1921-1988. J Hum Resour 29:181–201

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