A flying start?
Maternity leave and long-term outcomes for mother and child.*

by

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1. Introduction

How important for children's welfare and their *long term* adult outcomes is time spent with the mother the first months after birth? And are the potential positive effects large enough to trade-off a possible negative effect of the parents' career and earning prospect by taking time off work with their children? There is a large literature suggesting that more time spent with children in their first year and especially in the first months has a

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positive impact on *early* child development.[12] However, there is also evidence that there is a wage loss for women related to childbirths.[3] The twin questions we ask in this paper are whether the support found for short term positive effects in the childhood, gives the child an advantage also later in adult school and labor market performance, and whether these effects are large compared to the mothers' long term labor market outcomes?

Mandatory parental leave policies have become an important part of the agenda in industrialized countries due to the rapid increase in labor market participation of women. From a theoretical perspective there may be good reasons for governmental interventions to secure maternity leave regulations if there are market failures like credit constrains or information problems. It might be that mothers or fathers would like to take leave from work after child birth, however they may be credit constrained. It could also be that mothers do not perceive or value all the future benefits for their children by staying at home.

Focusing on theoretical reasons for why parental time spent with children may impact children's short and long term outcomes by reducing market work or increasing maternity leave periods, the predictions are ambiguous (Becker and Tomes, 1986; Blau and Hagy, 1998). On the positive side it is expected that less work outside of home implies more time – and more quality time - spent with children and thus more investment into children's development. Larger periods away from the child may also imply that both parents are less attached to the child which may have long term negative

[1] See for instance Brooks-Gunn, Han, Waldfogel (2002), Berger (2003) Berger, Hill and Waldfogel (2000) and Ruhm (2004).
[2] We also know that early investment in children is generally important for human capital accumulation and that skills acquired early on facilitate later earnings (Carneiro and Heckman, 2003; Heckman and Masterov, 2007).
[3] See Schønberg and Ludsteck (2007), Ejrnæs and Kunze (2006), Datta Gupta and Smith (2002) and Waldfogel (1997).

effects on the child. However, market work also means increased income leading to larger investment possibilities in the short and long run. There are also potential gains or costs for the mother. Mandatory job-protected maternity leave, leading to a continuity of employment, may increase women's earnings and increase gender equality. However, staying out of work may also harm mothers' present and future job and earnings prospects due to loss of human capital while taking care of children.[4]

Given the ambiguous predictions from theory, the literature on the effect on children's short term outcomes of parental work and of maternity leave is not conclusive. However, on a balance, positive effects are found of spending more time with children's on breast feeding, child health, reducing behavioral problems and child mortality, and cognitive test scores (Berger, 2005, Ruhm, 2000, 2003). There are several issues in this literature concerning identifying causal effects of time spent with children, such as selection of parents working, controlling for the negative income effect of not working etc. Only a couple of papers have started to look at the long term effects of mothers work and maternity leave (Dustmann and Scönberg, 2008; Wurtz, 2007). The literature on the effect of the female wage gap from having children is also ambigious. Several papers find support for a negative wage gap of having children (Ejrnæs and Kunze, 2006; Datta Gupta and Smith, 2002; Waldfogel, 1997), while for instance Waldfogel (1998) and Schønberg and Ludsteck (2007) do not find any long term negative effect on mother's earnings using US and German data.

[4] There is also a question of what the optimal length of maternity leave is since there may well be non-linearities in the effect of maternity leave both on children and on mothers. This is a very interesting question which requires several extensions of maternity leave in order to identify the effect of maternity leave.

In important ways, by using a rich population based register data, this paper extends our understanding of the impact of extended maternity leave on mothers income and labor market attachment, and children's intermediate and adult outcomes such as drop out rates from high school, college attendance, teenage pregnancy, IQ scores for young men aged 18, completed years of education at age 30, and earnings in the late 20s when almost everybody have completed education. We exploit a maternity leave reform that took place in 1977 in Norway extending job-protected paid leave from 12 to 18 weeks and up to one year of unpaid leave for mothers.[5] As in Dustmann and Schönberg (2008) and Würtz (2007), we use a regression discontinuity framework comparing the outcomes of children born in the months before and the months after the reform. However, unlike their studies, we can link mothers directly to the children. Furthermore, we have the complete income and work history of mothers pre and post reform and unlike the two previous studies we can analyze the effect of the reform for those who where eligible for the maternity leave period (based on earnings one year prior to the reform) as compared to all mothers given birth in this period. In addition, we can identify whether mothers actually complied with the reform by condition on whether mothers did not work in the maternity period provided. Being able to identify more strictly the treatment group using rules for eligibility and looking at compliers, should give us higher precision in measuring the effects. Also in terms of adult outcomes our study is an improvement since we are using completed education and earnings at the age of 30, in addition to

[5] There are good reasons for why the experiment of maternity leave we are exploiting for Norway is informative for instance for the current debate on maternity leave in the US today. The federal Family and Medical Leave Act of 1993 protects women's job security by offering up to 12 weeks unpaid leave with continuing health insurance and a guarantee of returning to the same job afterwards. Also the private sector offers little paid parental leave, only 8 % of private firms offer more than 12 weeks of paid leave.[5] The situation in the US today is therefore remarkably similar to the situation in Norway before the July 1st 1977 reform.

intermediate outcomes such as drop-out rates from high-school and IQ at 18 compared to previous studies using only drop-out rates at 21 and test scores at 15 (Würtz, 2007), or as in Dustmann and Schönberg (2008) wages and unemployment at the age of 23. One would expect that large proportions of the cohorts still are in school at that age and those working may be a highly selected group.

Furthermore, we also expand the analysis to the heterogeneous impacts of treatment for different education and income groups. In addition, we are able to go some way in testing for potential mechanisms of maternity leave on children's long term outcomes. First, the possible income effect of the reform we test by controlling for income around the time of birth to see whether the potential effect on children disappears. We also control for all post-reform characteristics of mothers to see if any of these variables can explain the positive effects on children. Second, mothers may act as role models for the children. She stays at home with children in the beginning and then goes back to work instead of staying out of the labor force for a long time. This mechanism can only be possible if there is an effect of the increased maternity leave period also for older children born before the child she has the maternity leave for. We test this by assessing whether there is a positive spillover of the maternity leave on under school age children. Thirdly, and in addition, breast feeding has been pointed to as potential mechanism through which extended maternity leave may work on children's outcomes. We try to test this indirectly, by testing whether there is any effect if grandparents of the child live close (in the same municipality). If breast feeding was of no importance, we would expect that grandparents living close could act as a substitute for mother staying at home since they could look after the child instead of the mother. If there is an additional

positive effect on children's outcomes, it implies that having grandparents close by are more a complement to the mother staying at home. We also test whether grandparents close to the mother have an effect on the probability to return to work after the paid leave period. If there is a higher probability of mothers returning to work with grandparents living close, it implies that they act as a substitute later in the child's life. We also test this conjecture by testing the effect on children's outcomes of the availability of child care around the age of one.

The results show a clear first stage effect on mother's predicted months of leave. However, it is essential that we focus on the group of mothers who are eligible for the reform; when not narrowing the group down to the mothers to the group of working mothers we only find very weak impact on mothers' response to the reform. The reform increases the average months of leave by around two months. We also see that income is affected by the reform; mothers are paid more after the reform than before. The last channel that the reform may affect is the long term return to work and income. The law was supposed to increase job protection for women taking leave. We do see that the reform increased the probability that mothers return to work within two and five years after giving birth, while the effect on income five years after birth is positive however not significantly different from zero. When focusing on the group of mothers the reform was supposed to impact, i.e., the eligible mothers, we find a positive, significant effect on all the educational variables of the childrem and also a drop in teenage pregnancy and an increase in IQ scores for young men. We also find a positive, however mostly insignificant, effect on wages. Testing for heterogeneity of the effects by family background, show that the reform has a greater impact on children from families with

lower educated mothers. Interestingly, we find a positive spillover effect on older siblings on college attendance and teenage motherhood. This implies that it is more than breast feeding which is important. We also find that the closer you are to your grandparents the greater positive effect the reform has on children's adult outcomes. This implies that there does not seem to be a trade-off between mothers staying home with the child and possibly breast feeding, and grandparents' time with the child. In addition, we do find that mothers living close to grandparents tend to have a higher probability to return to work after the paid leave, so grandparents may be an important substitute later in the child's life. This is also supported by the availability of child care from the child is close to one year old. The reform has more positive effects on children when the availability of child care is low. When testing for the income effect of the reform, we find that the positive effects on children are still there after controlling for income around the time of birth suggesting that the extra income is not the most important mechanisms behind our results.

The paper is organized as follows. Section 2 discusses relevant literature and mechanisms. Section 3 presents institutional settings linked to maternity leave legislations. Section 4 presents our identification strategy while Section 5 describes the data. Section 6 presents the results and Section 7 discusses the channels through which the reform affects mother and child. Finally, Section 8 concludes.

2. Literature Review

There is an extensive literature finding that early investment in children is important for human capital accumulation and that skills acquired early on facilitate later earnings (Ramey and Ramey, 1998; Carneiro and Heckman, 2003; Heckman, 2006; Heckman and Masterov, 2007; Cunha and Heckman, 2006; Knudsen, Heckman, Cameron, and Shonkoff, 2006). More specifically, the literature on changes in maternity leave policies and the effects of parent's time with very young children focuses on short term effects on mothers and children. In addition there is a medical literature of breastfeeding on children's cognitive and non-cognitive outcomes, which we think are one of the main mechanisms of maternity leave on children's outcome.

The medical literature reports several advantages of breastfeeding on the health conditions of children. In a recent review article from the *American Academy of Pediatrics*, many studies including studies from middle class families in western countries, are reportedly finding strong evidence that breast feeding decreases the incidence of many child diseases (American Academy pf Pediatrics, 2005). Also, more long-term health outcomes such as obesity, asthma etc., are found to be reduced by breastfeeding. Support for the connection between breast feeding and health– and in particularly through six months – is also supported by other medical studies; for reviews see Ip, Chung, Raman, Chew, Magula, Devine, Trikalinos and Lau (2007) and Kramer and Kakuma (2004). In addition there are studies showing a link between cognitive development and breastfeeding (Mortensen, Michaelsen, Sanders and Reinich, 2002). Using data from Denmark and using IQ scores from the Wechsler Adult Intelligent Test,

they find support for a positive effect of breastfeeding and IQ score. The effect increases up to 6-9 months of breast feeding and then leveling out.[6]

Most studies look at the implications of returning to work shortly after the baby is born, while more recently some studies have looked at effects of increasing parental leave directly. In general the literature does not provide strong identification because the decision to return to work is highly endogenous. Bernal and Keane (2006) summarize recent published papers using data from NLSY to look at the effect of maternal employment on children's outcomes. The results are inconclusive and they propose that more research and better methods of identification is needed to establish the causal effects of maternal employment and child care use on children's outcomes.

Papers focusing on the effect of increasing parental leave on children's outcomes are rare. Some earlier studies (Tanaka, 2005; Baker and Milligan, 2008) focus on short term outcomes for children while two new papers look at long term outcomes (Dustmann and Scönberg, 2008; Würtz, 2007). Tanaka (2005) looks at variations in maternity leave across OECD-countries. He finds that longer maternity leave has a small positive impact on birth weight and mortality rates of infants. Baker and Milligan (2008) uses variations in maternity leave legislations in Canada across providences to establish a causal effect of maternity leave on children's outcomes. They find a weak impact on different measures of child development. Again these studies focus on short term outcomes of children.[7]

The papers closest to our study are Dustmann and Scönberg (2008) and Würtz (2007). They use the same identification strategy as us, using data on children from

[6] However, the evidence on the effect of breastfeeding and cognitive development does not appear to be settled in the literature, see Concato and Leventhal (2002).
[7] Other important papers include Baum (2003), Ruhm (2004), Baker and Milligan (2005) and Han et al. (2007).

Germany and Denmark, respectively. They do not find any significant effect of reforms in maternity leave on children's long-term outcomes. Although providing an innovative and careful study of different maternity reforms in Germany, Dustmann and Schönberg (2008) assesses outcomes such as wages and unemployment rates at the age of 23, and attendance at high track schools when children are teenagers. However, no effect of maternity leave is found. Würtz (2007) use a maternity leave reform in Denmark and finds no effect on children's drop-out rates at 21 and test scores at 15.

Our second question is to measure the effect of the reform on mother's labor supply outcomes to evaluate possible trade-offs between positive effects of the maternity leave reform on children and effects on mothers. The literature looking at wages and labor supply from having children is not clear-cut; several papers find support for a negative wage gap of having children (Ejrnæs and Kunze, 2006; Datta Gupta and Smith, 2002; Waldfogel, 1997), while for instance Waldfogel (1998) and Schönberg and Ludsteck (2007) do not find any long term negative effect on mother's earnings using US and German data. Waldfogel (1998) also show that reforms in parental leave legislations are in general closing the negative wage gap between women with and without children depending on the degree of job protection and coverage, while Schönberg and Ludsteck (2007) finds no significant effects on mother's long term labor market outcomes by increasing paid leave from 2 to 6 months and unpaid leave from 18 to 36 month, in Germany.

3. Institutional Settings

In 1956 the maternity leave benefits became common to women in Norway through the introduction of compulsory sickness insurance for all employees.[8] The length of the maternity leave was 12 weeks, but the compensation varied substantially (Rønsen, 2002).[9] From July 1st 1977 paid maternity leave was extended to 18 weeks and unpaid maternity leave up to one year.[10] From 1987 and onwards the paid maternity leave was extended almost yearly until 1993. From 1993 and up till now Norway has had the same paid maternity leave of 42 weeks with 100 % cover or 52 weeks with 80 % cover. Table 1 provides an overview of the changes in the maternity leave legislation between 1977 and 1993.

By the July 1st 1977 reform parents were given universal right to 18 weeks of leave before and after the birth of a child.[11] The 18 weeks were fully compensated. Women had to take six weeks of this leave while the rest could be shared between the parents. In practice it was only the mother that made advantage of this new reform (Rønsen, 2002). At the same time parents were also allowed to take up to one year leave in addition to the 18 paid weeks, but the extra leave was unpaid.[12] With both the 18

[8] The history of maternity leave in Norway dates back longer than 1956, to the introduction of compulsory sickness benefits in 1909. At this time it became compulsory to give working women maternity leave benefits up to 6 weeks after birth. Because mostly non-married women worked, this was extended in 1915 to include a one-time-benefit to married women of 40 NOK as long as the husband had sickness insurance.
[9] You had to work at least 8 of 10 months before you gave birth. The coverage was maximum 120 NOK per month plus 0.1% of your salary.
[10] These changes were introduced together with a new law for work relations in Norway introducing improved protection of workers rights ("Arbeidsmiljøloven") accepted June 3rd 1977, introduced July 1st 1977 (see Prepositions, Ot.prp. nr. 71 and Innst.o. nr. 90)
[11] You could take a maximum of 12 weeks before the birth of the child.
[12] There was one exception from the rule that the reform was for mothers giving birth after july 1st 1977. If you gave birth after April 7th 1977, you could take an additional six weeks of leave and if you had a child less than one year old you may have rights to unpaid leave depending on whether you have returned to work or not. In practice this had little effects because of the policy that you had to inform your employer between four weeks and three months ahead ("Arbeidmiljøloven"). Since the mothers could not foresee this reform they could not have planned and informed their employer about additional leave. In our analysis we will predict the amount of leave, income effects and return to work after leave for mothers before and after July 1st 1977 to show how the reform affected the mothers giving birth after July 1st 1977 relative to mothers giving birth before that date.

weeks of compensated leave as well as up to a year uncompensated leave, job protection was secured.

The eligibility status of mothers is based on their income history. Only women working six of the past 10 months prior to birth were eligible for leave and coverage. From our dataset we define eligible mothers as mothers having at least six months of salary in the year before giving birth. We use one year instead of 10 months because we only have yearly income data, however if this slightly overstate numbers of eligible mothers the definition is at least the same across months and years. The labor force participation rate around 1977 was about 50 percent of married women which is the most relevant group in our case, and around 70 percent for non-married.[13]

An important assumption for identification is that the eligibility status has to be independent of the maternity law. The maternity reform was introduced during a big offensive from the sitting (very radical) parliament at the end of its period. It is hard to believe it were expected since it came along with a lot of other changes (unrelated to the maternity leave reform) and at the end of the period. We also checked national newspapers around 1976 and 1977 to see whether they wrote about the reform. We do not find any evidence that newspapers wrote about the reform earlier than June 1977.[14] The Government report became official on April 15th 1977 and was approved on June 13th 1977[15]. This means that all women giving birth after the announcement of the law in 1977 was already pregnant when the law was introduced.[16] Based on the rule of working six of ten months prior to birth, women could not easily change their status in the short

[13] See Figure A1 in appendix A.
[14] Verdens Gang 30.06.1977, Bergens Tiende 27.06.1977, 30.06.1977, Aftenposten 30.06.1977
[15] Propositions and regulations from the Government: Ot.prp nr. 61 and Innst.o. nr 61
[16] Possible effects on fertility will therefore not show up in the data before earliest in the beginning of 1978.

run. The assumption of eligibility status being independent of the maternity leave for mothers giving birth in 1977 holds.

In order to use the maternity leave reform by a RD design, we also need the data set to be balanced in terms of mothers' characteristics before and after the reform. Figure 2 presents average outcomes for mothers as a function of months. We include mother's education, pre-reform income and age at birth. We see that the mothers are equal in observed characteristics. The more months we include on each side of the discontinuity the more different the mothers might be in form of characteristics, however, there are no significant difference in any of the characteristics including all 12 months of the year. This makes us sure that mothers giving birth in different months in 1977 are on average very similar in all aspects that may affect outcomes.

The 1970s in Norway was the decade of oil discovery, labor participation of women increased dramatically and several welfare reforms were implemented. We have studied all possible laws and reforms that may have had an impact on women around pregnancy and birth time. The only law around the change in maternity leave, is the abortion law implemented 1.1.1976. The 76-law made it easier for women to have abortion within 12 weeks of pregnancy. The first monthly birth cohort to possibly be affected by this reform is then July 1976. This possibly gives a discontinuity between June and July 1976 and hence we do not use 1976 as a comparison to 1977.

4. Identification Strategy

We adopt the sharp regression discontinuity (RD) approach to identify the causal effect of the change in maternity leave July 1st 1977. The model for the observed outcome is given by:

$$y_i = m(x_i) + \beta\left[x_i \geq July1.1977\right] + \varepsilon_i ,$$

where y_i is the individual outcome variable for children or mothers. For mothers we use months of leave following the reform, return to work within two and five years and earnings after five years. We use the months of leave to test whether they stay more at home from work after the reform which is a necessary condition for an effect on their children. Since we are interested in a possible trade-off between a negative effect on mothers staying at home and a potential positive effect on children, we estimate the potential negative effect of mothers staying away from work, by estimating the effect on returning to work within two and five years as a consequence of the reform, and their earnings after five years. For children we use the intermediate outcomes as drop-out from high school, college attendance, teenage motherhood for women, and IQ for men, and long term outcomes such as completed education at the age of 30 and average earnings at the age of 26-28.

The parameter β is the estimates of the effect of the maternity reform on outcomes. $m(x_i)$ is an unknown, smooth function of month of birth. We will assume a flexible form of $m(x_i)$ and estimate its effect on mothers' and children's outcomes using different non-parametric and parametric specifications, and in addition to the RD

approach we alternatively use a difference-in-difference specification. There are a few estimation issues worth mentioning.

For children's outcomes we want to smooth the month of birth because there may be an independent effect on outcomes, irrespective of the reform. There could be different mechanisms here. Children born early in the year are older when they start school both in absolute and relative terms compared to their class mates and some studies find that they perform better on school tests and also go on to take more education (Angrist and Krueger, 1992). However, this finding has been disputed in the literature since there is linear dependency between age at school start and age at test, and also the problem with school leaving age as opposed to mandatory years of education in the US.[17] We will estimate equation (1) using local linear regression (LLR) as in Fan (1992), Hahn, Todd and Van der Klauuw (2001) and Porter (2003). They show that LLR outperform general kernel regressions avoiding the boundary problem, and obtaining a higher order of convergence at boundary points. We use the triangle kernel which is shown to be boundary optimal (Cheng, Fan and Marron, 1997). We obtain standard errors using the consistent formulas in Porter (2003).[18] The choice of bandwidth is important, because it effects the smoothing of our data. There is a general variance/bias tradeoff when choosing the optimal bandwidth. In our case, a larger bandwidth decreases the variance because we include more observations and take into account the separate effect of months on outcomes. At the same time a larger bandwidth increases the bias because we move

[17] See Black, Devereux and Salvanes (2008) for a review of the literature, and results confirming no effect of school start age on long term outcomes for children on school start age.

[18] We verify the results by using the paired-bootstrap percentile-T procedure with 2000 replications Cameron and Trivedi (2005) shows that the bootstrap percentile-T procedure may outperform the analytical standard errors. One reason for this might be the difficulty in estimating parts of the formulas from Porter. From our results we do see any significant difference between the two methods (if any a slightly better performance when using Porter), hence we will use the analytical framework.

further away from the discontinuity. We therefore present results using three different bandwidths, 2, 3 and 4 months around the discontinuity, with a preferred bandwidth of 3.[19]

Card and Lee (2007) shows that using a discrete dependent variable might lead to non-parametric results being not identified. This is based on the fact that you want to compare outcomes as close to the boundary as possible, while using a discrete dependent variable means that you do not have enough data close enough to the boundary. Since we have access to the whole Norwegian population in our dataset, we have a large number of observations in each month cell so only including one extra month on each side of the discontinuity gives much more information about the true parameters. This allows us to identify the discontinuity point. However to verify our results we alternatively present results using a parametric polynomial function of birth month, one of quadratic and one of fourth order. We obtain standard errors by clustering by birth month as suggested in Card and Lee (2007).[20] We will also use this framework to control for different post characteristics of mothers to sort out which mechanisms that drives our results.

Our main way of dealing with the separate effect of months on outcomes for svhildren is the difference-in-difference method comparing outcomes of eligible mothers in the year of the reform with outcomes of non-eligible mothers in the year of the reform

[19] Using cross validation as in Imbens and Lemieux (2007), we get an optimal bandwidth of 3. However Ludwig and Miller (2007) points to different problems using CV and the literature seems to agree that visual inspection is still the best method to choose the bandwidth. Most papers in the literature report results including at least 3 different bandwidths.

[20] We might still worry that effects linked to the reform, July 1st 1977 may be correlated with differences in monthly performance. However we do bear in mind those monthly effects on children's outcomes tend to go the opposite way of our results. This means that if anything our results are a lower bound of the true effect of the reform.

and outcomes of eligible mothers in 1975. [21] We will first run LLR on both the treatment sample and the control groups and then difference out the month effect. Again we will use analytical standard errors as in Porter (2003). We assume that in the absence of the reform the independent month effect is the same across treatment and control groups (common trends assumption). From an economic perspective it is no reason why monthly trends in outcomes should change as a response to the reform.[22] This is especially the case when using non-eligible mothers in 1977 since the children are then of the same cohort and on average exposed to the same environment, hence after showing the main results using the RD design and parametric forms we will turn to the differences-in-differences using non-eligible mothers in 1977 for the remaining robustness results.

For both mothers' outcomes and children's outcomes we will present the non-parametric regression discontinuity (RD) results using a triangle kernel with bandwidths of 2, 3, and 4 months on each side of the discontinuity. Then we present estimates of parametrical quadratic polynomial using three months on each side of discontinuity, and a forth order polynomial using six months on each side. In addition, we will present figures of the results where we estimate the different outcomes by birth months as estimated means and estimated curves using a triangle band width of 3. We use eligible mothers based in our main analysis as defined in Section 3.

For differences-in-differences results we first present results differencing out the month effect by using non-eligible mothers in 1977 as a control group and then eligible

[21] As we argued earlier we cannot use 1976 because of a reform in the abortion system. Since there might be fertility effects of the reform we also leave out years after the reform, however there are no discontinuities in any outcome between June and July for 1978, 1979 and 1980.
[22] We also see this by visual inspection in our graphs comparing outcomes of eligible mothers in 1977 with those of non-eligible mothers in 1977 and eligible mothers in 1975.

mothers in 1975. We also present figures comparing the treatment group to the different control groups.

Mechanisms of the reform for mothers and children

There are several possible mechanisms for why an increased maternity leave from three to four and a half months with full coverage and one year of unpaid leave may lead to an effect on mothers' labor market behavior and on the later performance of children. Some of these mechanisms we can test directly or indirectly. We have three channels which this reform may affect mothers' outcome and children's long term outcomes. For mothers: Staying out of the labor market for a longer period may give a negative long-term earnings effect. On the other hand, longer stay out of the labor force and job protection for a longer period may also provide a possibility for a stronger attachment to the labor force for women. We are able to test both the effect on attachment to the labor force in the short and long run (after two and five years), and effect on earnings after five years. For children: The maternity leave compensation and a possible income effect of the reform, the extra time spent with infants giving more time to breast-feed and less stress, and the right to one year unpaid maternity leave also providing more time with the child. The underlying assumption for an effect on both mothers and children, mothers giving birth under the new regime of maternity leave must take a longer leave than pre-reform, and this is the first implication we test.

More precisely on the tests we undertake for channels of affect on children; first, the possible income effect of the reform we test by controlling for income around the time of birth to see whether the potential effect on children disappears. We also control

for all post-reform characteristics of mothers to see if any of these variables can explain the positive effects on children. Second, and as we have pointed out, the medical literature suggests a positive effect on cognitive development of breast feeding, and an indication that this indeed may be an important channel in Norway, breastfeeding has been shown to be very common in Norway from the mid to late 1970s. Based on data from several maternity hospitals in Norway over time, Liestøl, Rosenberg and Walløe (1988), show that breastfeeding in Norway started to decline around 1920 and reached its lowest point around 1967 when only 30 percent of women breastfed for three months and as few as five percent for 9 months. In the late 1970s, the level of breastfeeding in Norway was back to the level of around 1940. Around the period of the maternity leave reform we are using, about 75 percent breastfed for three months, 50 percent for six months and 25 percent of mothers where breastfeeding for nine months or more. We do not have any direct way of testing this since we do not have data on breast feeding for mothers. We do, however, try to test this effect indirectly by testing whether there is any effect of grandparents of the child live close (in the same municipality). If breast feeding was of no importance, we would expect that grandparents living close could act as a substitute for mother staying at home since they could look after the child instead of the mother. If there is an additional positive effect on children's outcomes, it implies that having grandparents close by are more a complement to the mother staying at home. We also test whether grandparents close to the mother have an effect on the probability to return to work after the paid leave period. If there is a higher probability of mothers returning to work with grandparents living close, it implies that they act as a substitute

later in the child's life. We also test this conjecture by testing the effect on children's outcomes of the availability of child care around the age of one.

Thirdly, and in addition, mothers may act as role models for the children. She stays at home with children in the beginning and then goes back to work instead of staying out of the labor force for a long time. This mechanism can only be possible if there is an effect of the increased maternity leave period also for older children born before the child she has the maternity leave for. We test this by assessing whether there is a positive spillover of the maternity leave on under school age children.

5. Data

Our data source is the Norwegian Registry data maintained by Statistics Norway. It is a linked administrative dataset that covers the population of Norwegians up to 2006 and is a collection of different administrative registers and provide information about educational attainment, labor market status, earnings, and a set of demographic variables (age, gender) as well as information on families.[23] To ensure that all individuals studied went through the Norwegian educational system, we include only individuals born in Norway. The dataset includes a rich set of family background variables including education, income, men's IQ score from military service, distance to grandparents and municipality childcare coverage. We will mainly focus on five outcome variables for mother's labor supply and maternity leave decision, and six long term outcome variables for children. The yearly income history for mothers in the 1970s provide us with a tool for predicting months of leave, short and long-term effects on income of taking leave and

[23] See Møen, Salvanes and Sørensen (2004) for a description of these data.

the probability to return to work within two to five years after giving birth. The outcome variables for children are dropout rates from high school, college attendance, years of education, teenage pregnancy, IQ scores for young men around the age of 18 and income at the time of entering the labor market.

In terms of educational attainment, we measure education at the oldest age possible for each individual i.e. in 2006.[24] Dropout rates are defined in this paper as all children not obtaining a three year high school diploma. The college attendance is all children having started college/university. The IQ data are taken from the Norwegian military records for the relevant cohorts when they were tested at around age 18. In Norway, military service is compulsory for every able young man. Before entering the service, their medical and psychological suitability is assessed; this occurs for the great majority between their eighteenth and twentieth birthday. IQ at these ages is particularly interesting as it is about the time of entry to the labor market or to higher education.

The IQ measure is a composite score from three speeded IQ tests -- arithmetic, word similarities, and figures (see Sundet et al. (2004, 2005) and Thrane (1977) for details). The arithmetic test is quite similar to the arithmetic test in the Wechsler Adult Intelligence Scale (WAIS) (Sundet et al. 2005; Cronbach 1964), the word test is similar to the vocabulary test in WAIS, and the figures test is similar to the Raven Progressive Matrix test (Cronbach 1964). The composite IQ test score is an un-weighted mean of the three subtests. The IQ score is reported in stanine (Standard Nine) units, a method of standardizing raw scores into a nine point standard scale that has a discrete approximation

[24] Our measure of child educational attainment is reported by the educational establishment directly to Statistics Norway, thereby minimizing any measurement error due to misreporting. This educational register started in 1970.

to a normal distribution, a mean of 5, and a standard deviation of 2.[25] We have IQ scores on about 84% of the relevant population of men in Norway.[26]

Finally, earnings are measured as total pension-qualifying earnings reported in the tax registry and are available from 1967 to 2005. These are not top-coded and include labor earnings, taxable sick benefits, unemployment benefits, parental leave payments, and pensions.

Ideally we would have wanted direct information on months of leave however this is only available in Norway from 1992 and onwards. We therefore use the yearly information on income to predict months of maternity leave. The prediction is based on two main assumptions; we assume that before the reform all leave was unpaid while after the reform all eligible mothers take at least the four months paid leave.[27] We also assume that the mother earns the same real monthly wage after she returns to work as before she got pregnant. Using these assumptions, we predict months of maternity leave for mothers giving birth in 1977 by using the income information in 1975-1978[28].

6. Results

6.1 Descriptive statistics

[25] The correlation between this IQ measure and the WAIS IQ has been found to be .73 (Sundet et al., 1988).
[26] Eide et al (2005) examine patterns of missing IQ data for the men in the 1967-1987 cohorts. Of those, 1.2 percent died before 1 year and 0.9 percent died between 1 year of age and registering with the military at about age 18. About 1 percent of the sample of eligible men had emigrated before age 18, and 1.4 percent of the men were exempted because they were permanently disabled. An additional 6.2 percent are missing for a variety of reasons including foreign citizenship and missing observations. There are also some missing IQ scores for individuals who showed up to the military.
[27] This might give us an underestimate of the true leave, but the coverage was in general low (see Rønsen et al. 2002)
[28] We use income in 1975 and 1976, before the mother has a child, to construct average monthly wage. Then, starting in the month of birth of the child we compute months of leave by comparing how many months in 197 and 1978, after the birth of the child, the mother does not work, earning the monthly salary from before she got pregnant.

We start by presenting the descriptive statistics both of the extension of maternity leave reform both for eligible mothers work and income outcomes as well as medium and long term outcomes for their children in Table 1. If we first concentrate on a couple of socio demographics – see Figure 2 for a complete presentation of how balanced the sample is before and after the reform – we observe that mother's years of education, age at birth and earnings do not vary significantly from the first to the second half of 1977. Income in 1975 is a little lower for the reform group, however, this is a small effect compared to the big increase in earnings of the reform group in 1977. Interestingly, there are basically no differences in income and probability to return to work five years after giving birth. Important to note is that the first stage effect of an expected effect on children's adult outcomes is that the reform group takes on average two more months of leave.

For children we see a clear fall in dropout rates from high school, however, the unconditional means of college attendance, years of education, IQ scores and average income are very similar in the first and second half of 1977.

We next turn to the analysis of the potential causal effects of the results tendencies we saw in the descriptive statistics. We present the results by using different techniques in particular since there might be separate effects of month of birth. We start with the results for mothers.

6.2 Mothers' outcomes

First we present the effect of months of leave for eligible mothers of the reform which is necessary condition for any effect on children. Then we present results on income at year

of birth, income five years after birth and the return to work within two to five years after birth. All these variables are expected to change due to the maternity leave reform. The months of leave and income at year of birth is expected to increase due to the introduction of more paid leave. The return to work within two to five years is expected to rise due to the increase in unpaid leave (job protection) however it is unclear if this effect will show up in the income five years after birth.

We present the different results from non-parametric and parametric RD-design results for mothers' adjustment in the labor market in Table 2. We see that the predicted months of leave are a little more than two months longer leave than before the reform, and that the compensation has increased by approximately two monthly wages. This is in line with the change in the maternity law. The average leave before the reform was four months unpaid leave, while the average leave after the reform was six months, four months paid leave and two unpaid. This means that before the reform mothers will loose on average four months of salary while after the reform mothers will only loose two month of her salary when giving birth.

Also we see an increase of about 2-3 percentage points in the return to work within two to five years after birth. This is in line with the introduction of up to one year unpaid maternity leave in addition to the paid leave. It introduced a better long term job protection. This is an important result since it means that this extension of the maternity leave reform does not reduce women's return to work after taking an extended leave, but increases it slightly. Moreover, we do not see any significant results on income five years after giving birth. There is no difference in results when increasing band with or months

used before and after the reform, and also the parametric results are in line with the non-parametric results.

We present the results graphically for the third column in Table 2a (i.e. bandwith 3) in Figure 3a. We clearly see effects across all outcomes, except for income 5 years after the reform (in 1982), for mothers and that the differences in results hold up across months before and after.

In most studies on this topic so far there has been no distinction between eligible and non-eligible mothers, and next we consider the effect on non-eligible vs eligble mothers for return to work. We use this control group together with eligible mothers in 1975 and present the difference-in-differences estimates for mothers' outcomes in Table 2b.[29]. The effects are significant and around two to four percentage points.

Again we present the results graphically for the third column in Table 2b (i.e. bandwidth 3) in Figure 3b. We see that the effect is persistent across months.

The first stage predictions are therefore clear; the maternity leave had both a positive short term impact on mother's leave and introduced a better job- protection for mothers.

6.3 Children's outcomes

For children we will focus on dropout rates from high school, teenage pregnancy, years of education, college attendance, IQ for young men around the age of 18 and income at the age of entering the labor market. We present RD results for both non-parametric estimation and parametric estimation in Table 3a. Our results with a bandwidth of three

[29] We only show results for return to work within two to five years after birth because the other outcomes for mothers are based on income and our control group of non-eligible mothers cannot be used since they do not have any income

shows a fall of 2.5 percentage points in children's dropout rates. We also observe that the choice of bandwidth does not change the results drastically. We also see that the reform has a positive effect on college attendance and years of education, however only slightly significant. Interestingly, we also see an effect on IQ for some specifications. We only have IQ scores for men, but due to the large sample sizes we can still estimate the effect on the reform on IQ for only the male part of the sample. For the non-parametric specification with band-width 2, and for the parametric specification with a second-order polynomial, we find that men born after the reform have a higher IQ score. We do not see any effect on teenage pregnancy and average income at the age of entering the labor market. The parametric results are mostly in line with the non-parametric results.

We present the results graphically for the third column in Table 3a (i.e. bandwith 3) in Figure 4a. We clearly see effects across outcomes for children and that the differences in results hold up across months before and after. However we also see that there are monthly trends across the different outcomes. As pointed out earlier there are different reasons why children born earlier in the year might outperform children born later in the year.

We next turn to the results from a differences-in-differences approach which is our main approach to deal with the separate month effects. We compare children of eligible mothers in 1977 to children of non-eligible mothers in 1977 and eligible mothers in 1975. The advantage of comparing to non-eligible mothers in 1977 is that the difference-in-difference method in this case also better control for any trends in the data. The differences-in-differences for children are presented in Table 3b. Children's outcomes are all affected positively from the reform. Almost all the results are significant

at 1 % except for the results on wages. Again we present the results graphically for the third column in Table 3a (i.e. bandwidth 3) in Figure 4b-d. We see that the effects are persistent across months.

6.4 Placebo results

Table 4 present placebo RD-results for non-eligible mothers in 1977 and eligible mothers in 1975 where the reform July 1. 1977 is used to test for any effect. We do not find any significant results for mother's outcomes in these years. Graphical results comparing eligible mothers in 1975 to non-eligible mothers in 1975 are presented in Figure 5. We do not observe any effect from a placebo reform in 1975 in any of the children's outcomes.

7. Heterogeneous results and mechanisms

We also want to consider how the results may vary across family background. We have a rich variety of family characteristics like parental education, income, place of residence and availability of child care at the municipality level. By varying the results by family background we will also discuss further possible channels through which the maternity leave may have affected children's outcomes. We will only present results using differences-in-differences with non-eligible mothers as the control group. The reason is that by differencing out the month effect we get closer to the causal effect of the reform since we get closer to satisfy the common trend assumption however we have already shown in the first set of results that the results are robust to using eligible mothers in 1975 as control group.

7.1 Parental education

We want to see whether maternity leave may have a different effect on mothers with different educational background and on the children from families with high and low educated mothers. We split the sample in two; mothers with less than 10 years of education versus mothers with 10 years or more of education. From Table 5 we see that children of low educated mothers benefit more from the reform than children with high educated mothers. This is especially the case when we look at the educational outcomes. The effect on IQ is approximately the same for both groups, however, the effect on teenage pregnancy only shows up for the children of more educated parents.[30] We see a stronger effect on mothers probability to return to work within two years after giving birth when mothers have low education however the effect on the return to work within five years are similar for the two groups.

7.2 Boys/Girls

We check whether the reform has different impact on boys and girls and also whether mothers of boys and girls behave differently. Results are presented in Table 6. [31] We see that the results are more positive and significant for girls than boys. This is supported by the fact that mothers of girls are also affected slightly more by the reform, especially in the probability to return to work within two year after giving birth.

[30] Using above and below median income for mothers instead of high and low education, provides similar results.

[31] Note that the effects we find don IQ earlier is only effects for boys since we have IQ scores only for military service. The effects on teenage pregnancy is only for girls.

7.3 Childcare coverage and proximity to grandparents

As discussed in the section on specification and mechanisms, there are substitutes and complements to maternal time with children. We have rich data to exploit some of these possible substitutes and complements. We vary the results by availability of child care in Table 7.[32] We find that the reform had a greater impact on municipalities with low child care coverage. Typically in Norway you do not send your child to a child care before the child is one years old. This means that these results may be correlated with the part of the reform that gives the mother a right to up to one years of unpaid leave in addition to the paid leave. This is supported by the fact that mothers have a higher probability of returning to work within two to five years after giving birth when the child care coverage is low.

Another aspect is the proximity to grandparents. The grandmothers to the children in our samples would normally not be in the labor force. It was only in the 1960s and 1970s that relatively young women to a large degree entered the labor market. This means that grandparents may be an available substitute to maternal time with children. This hinges on the assumption that grandparents live close to their grandchildren so that they can help out in daily life. We split the sample in two; close means in the same municipality as your grandparents, while far is further away. We see from the results in Table 8 that the effect are larger for children when the family live close to grandparents.[33] It implies that there does not seem to be a trade-off between mothers staying home with the child and possibly breast feeding, and grandparents' time with the child.

[32] We have also verified the results by using a polynomial function of birth month and controlled for mothers education, income and age in order to be sure that the results are not driven by differences in mother's characteristics across municipalities.

[33] Again we verified the results by controlling for mothers characteristics.

A reasonable explanation for this could be that grandparents are a weak substitute to maternal time with the child in the first months of a child life. Before the reform the mother left the child with her parents while working, but after the reform she stays home at least for the first four months of the child's life. This support the idea that mother's time is important in the first months due to breast-feeding and less stress for both mother and child. A related explanation can be that grandparents are good substitutes to maternal time later in the child's life. The results show that mothers living close to her parents have a greater impact of the reform on the probability to return to work within two to five years after giving birth. The grandparents can hence constitute a good substitute so that mother's can return to their job and increase the resources within a family. Both these explanations are present in our data and can lead to positive effects on the children's outcomes.

7.4 Spillover to other siblings.

Next we present the results of older siblings of the 1977 cohort. If the positive effects on the outcomes of children affected by the reform also show up in the outcomes of their older siblings, there are other channels than breastfeeding and intervention in very early ages that works trough this reform, e.g. mother as a role model.

We define older siblings as those who are 24-48 months[34] older than the 1977 cohort.[35] Table 9 shows the differences-in-differences results using children of non-eligible mothers as a control group. We see that the older sibling's dropout rates are

[34] The mean distance between siblings is 35 months.

[35] We do not want to include siblings where mother has not finished leave and returned to work before she has the 1977 kid therefore we exclude siblings that are closer than two years in age. The older siblings aged 2-4 is the largest group of siblings, we have also studied siblings older than four; however the sample size is too small to find interesting results.

falling however the effect is not statistically significant. The effect on college attendance is positive and we see a drop in the probability of teenage pregnancy.[36] We do not see any significant effects on years of schooling or IQ. The reform seems to have some effect on the older sibling's outcomes however the effects are much smaller than on the children directly affected by the reform. We conclude for this result that clearly there are other mechanisms than through increased breast feeding the extended maternity leave period worked through.

7.5 Effect of increased income

We next look at the possible effect that it is the increased income through the fact that there is compensation when taking the extended leave that is important. Table 10 present parametric polynomial results.[37] The first row is the causal effect of the maternity leave reform on children's outcomes discussed earlier in Table 3. Then we control for mother's income in 1977 to see whether the effect on children changes. We observe that the effects on children's outcomes are slightly lower after controlling for income however for most outcomes, the results are still important and significant. Controlling for all post-reform characteristics of the mother, income five years after birth, months of leave and return to work within two to five years after birth does not change the results.

8. Concluding remarks

[36] We also perform a placebo tests on older siblings of the 1975 cohort and find no significant effect on any outcomes fro this group.

[37] We can not present differences-in-differences here bacuse we want to control for income however our control group, non-eligible mother do not work, hence thay have no income.

Can families, by not working or working less in the first years of a child's life, influence the ability of children? And are the potential positive effects large enough to trade-off a possible negative effect of the parents' career and earning prospect by taking time off work with their children? Exploiting a maternity leave reform in Norway, opening up for up to four months of paid leave and an additional one year of unpaid leave, show us that this is the case. Children have a higher probability of completing high school, going to college and have more years of education and boys have a higher IQ score at age 18. By using yearly income of mothers we have been able to split the sample into eligible and non-eligible mothers. This has not been done in the literature before and gives us more precise estimate of the effect of maternity leave on children's long term outcomes. We use the rich dataset on family background variables to exploit the effect on mother's months of leave, income effects and probability to return to work within two to five years after giving birth. We find that the reform increases the time mother spend at home with infants- however they have a higher probability to return to work meaning a better job protection due to the maternity reform. This support our main source of mechanism of why an increase in maternity leave should effect children's outcomes, mother's spend more time – quality time – with the child in its first year of life. Then we use the data on family background to understand more about heterogeneous effects of the reform. We find that the reform is more effectual for children of low educated mothers.

To understand more the mechanisms driving the results we use measures of municipality child care coverage and distance to grandparents, and in addition we measured spillover effects to older under-school age children in the family. The two first measures may be seen as substitutes (or complements) to maternal time with children.

We find that the reform has more impact on children's outcomes when the municipality has low child care coverage and when parents live close to grandparents. The first support our hypothesis that official child care is a substitute to maternal time, in the long run, with children while grandparents seem to be complements, in the short run, to maternal time. When testing effects on older siblings aged 2-4 in 1977, we find some evidence that the reform also has a positive, although smaller, effect on them indicating that mother's behavior as a role model is important. This also suggests a positive spillover effect of the reform that has to be taken into account when evaluating costs and benefits of introducing these policies.

For policy implications we conclude that constructing policies to increase parents' time with children after birth may have an impact on children's abilities later in life. This effect has been an important part of the goals behind expansions in maternity leave across countries; however this study is the first to show that this may also be achieved. There are not only short terms effects of increasing maternity leave (Tanaka, 2005; Bernal and Keane, 2006), but also substantial benefits in the long run. As mentioned in the introduction the situation on maternity leave is remarkably similar in the US today as it was in Norway before the reform. Parental leave is currently under debate in the US[38] and an introduction of four months of paid leave and better job protection are typically within feasible policies.[39] Using the rich set on family background variables to address heterogeneity of effects also give us the advantage of making the study less dependent on institutional settings in Norway. For example by showing that the effects are bigger for children from lower educated households this may be important for policy discussions

[38] USAtoday 26.07.2005, The New York Times 16.04.2008
[39] http://www.govtrack.us/congress/bill.xpd?bill=h110-3799

related to lowering inequalities in general. Many countries, like the US, Britain, South America have a substantial inequality in education and income. While increasing maternity leave for women and men in these countries will not solve these problems we have shown that it might reduce the existing gap.

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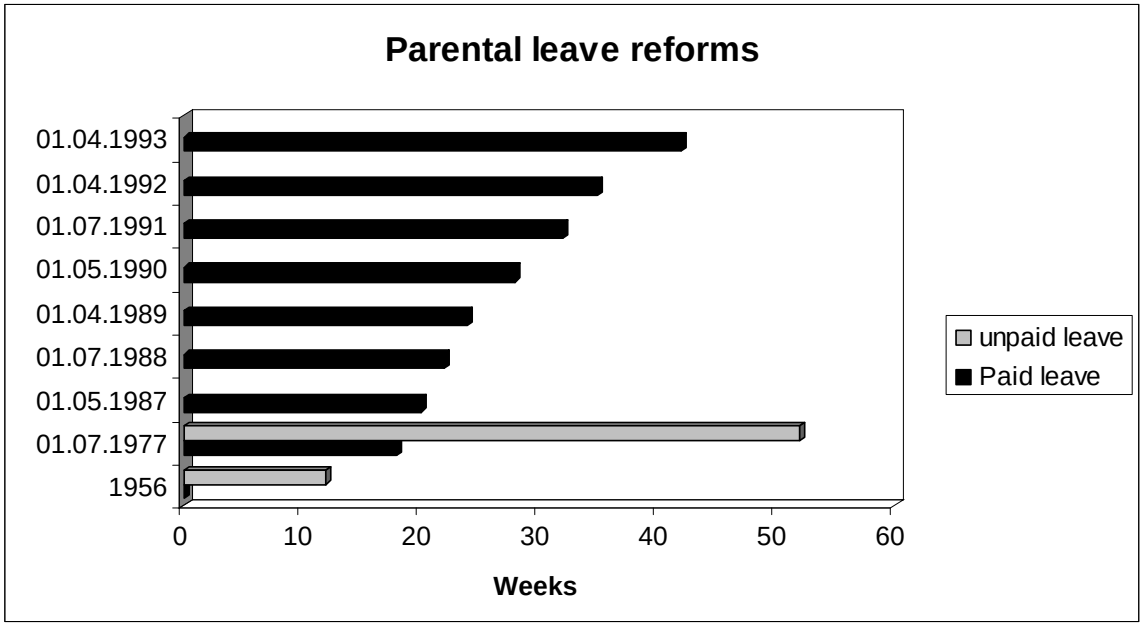
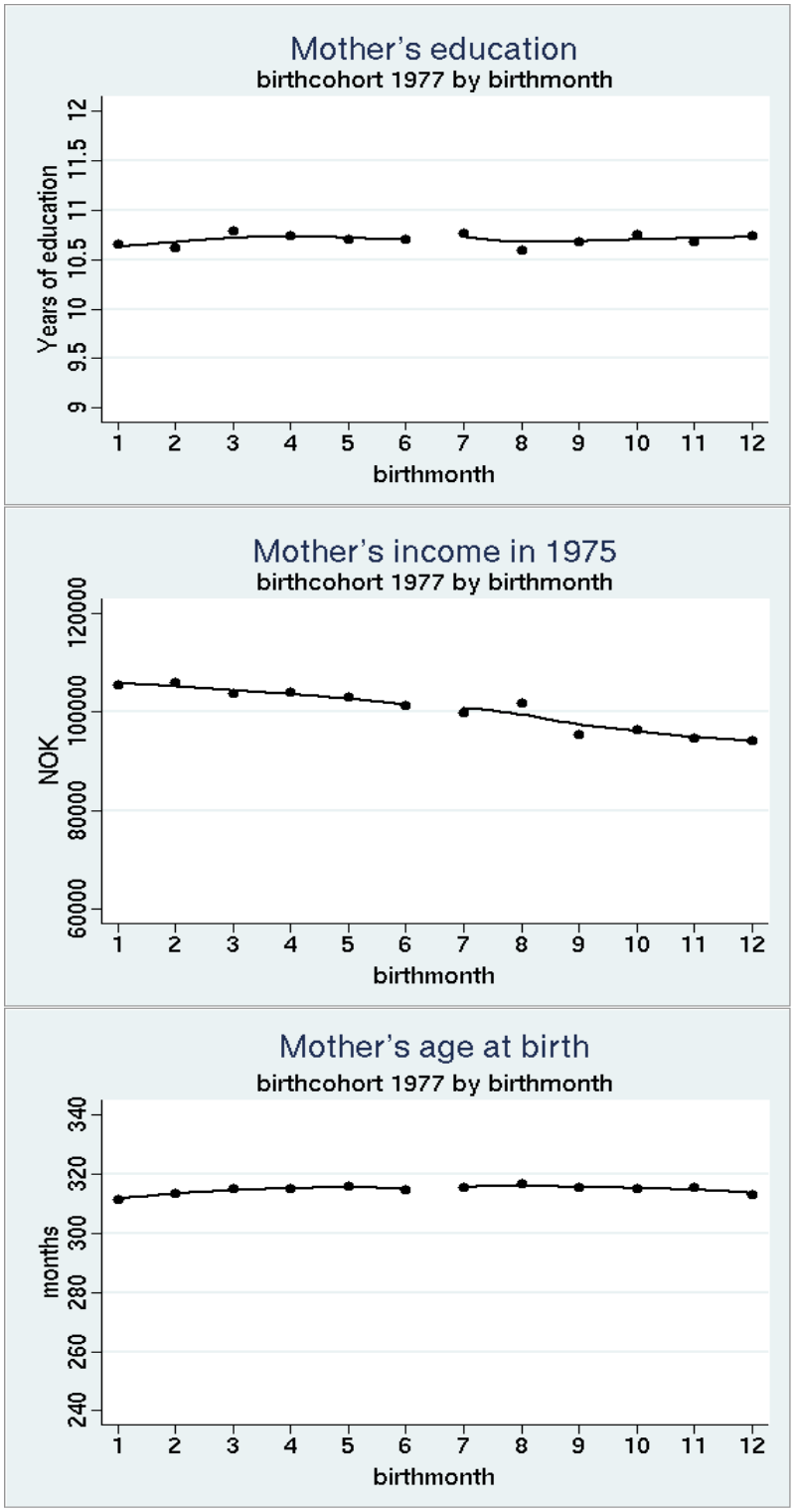
Figure 1

Parental leave reforms in Norway



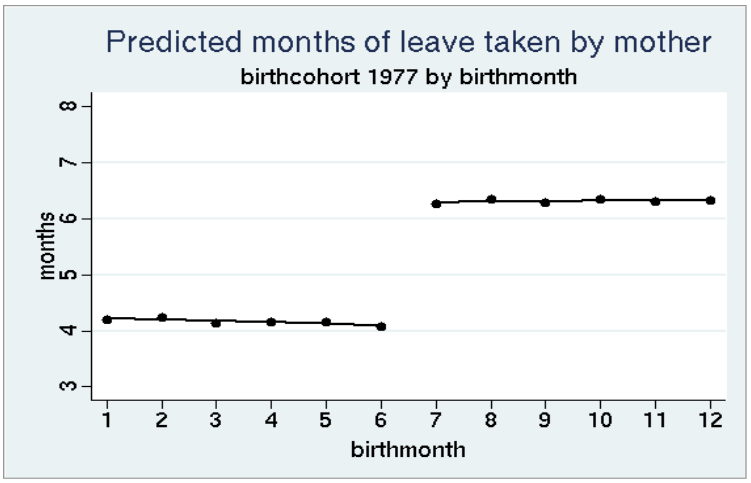
Source: regjeringen.no, lovdata.no

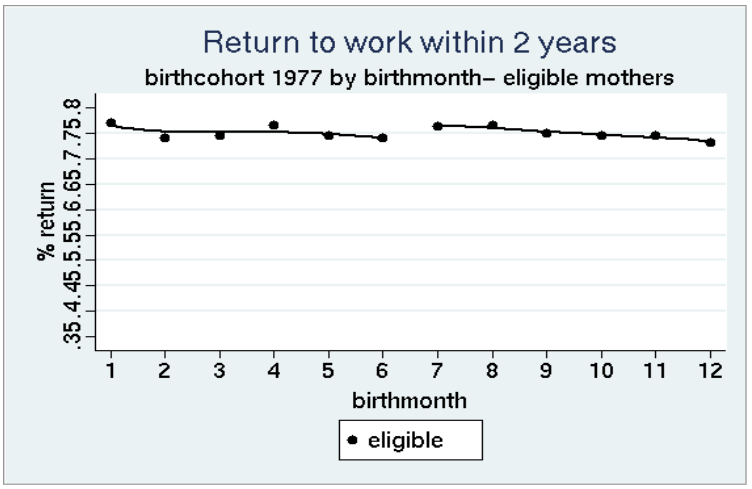
Figure 2
Mother's characteristics by birth month, eligible mothers 1977

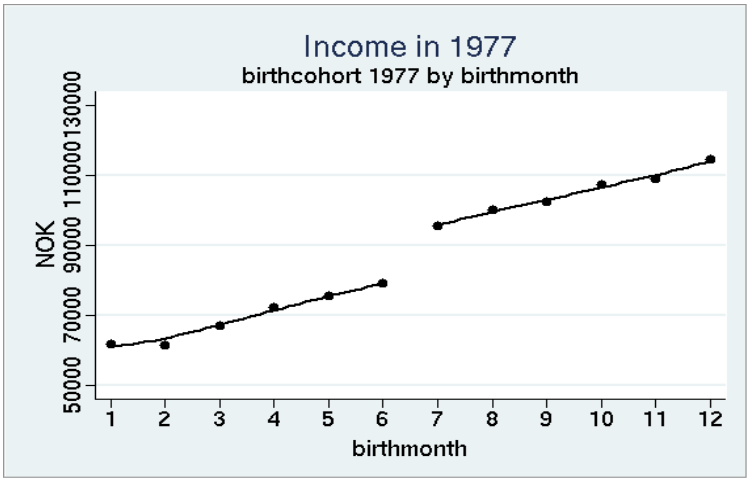


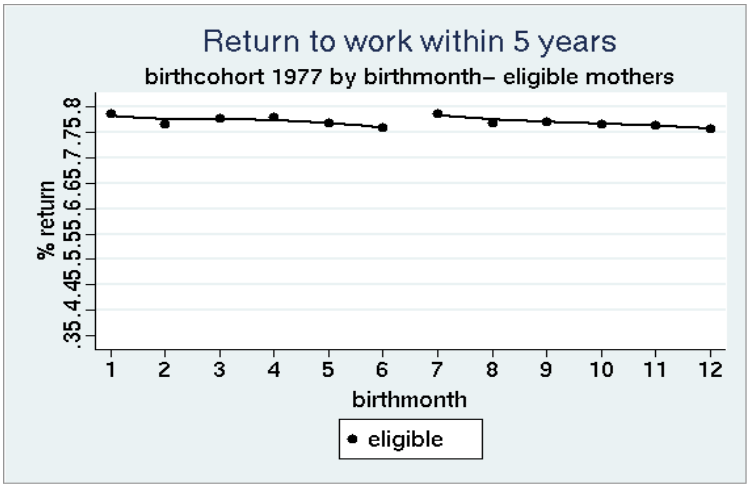
Note: Each graph shows the estimated mean characteristic for mothers birth month. The solid line is nonparametrically fitted using triangle kernel with a bandwidth of three.

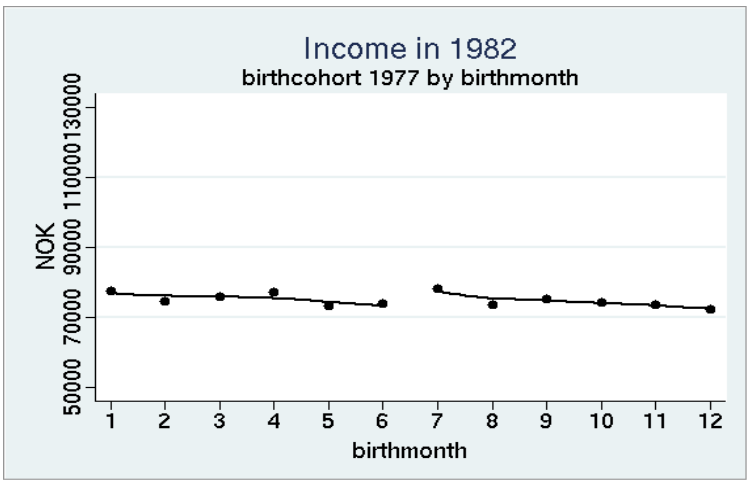
Figure 3a
Mother's outcomes by birth month, eligible mothers 1977





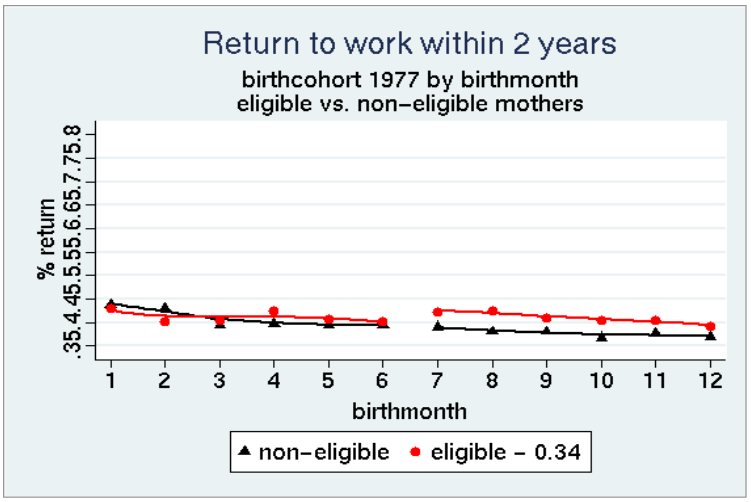


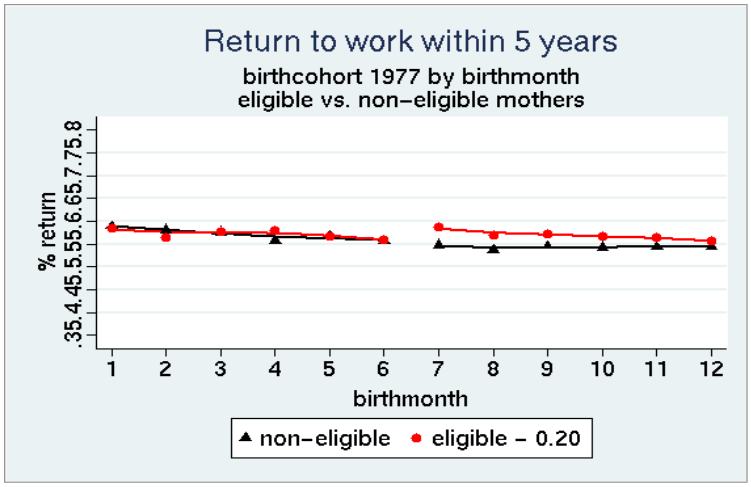


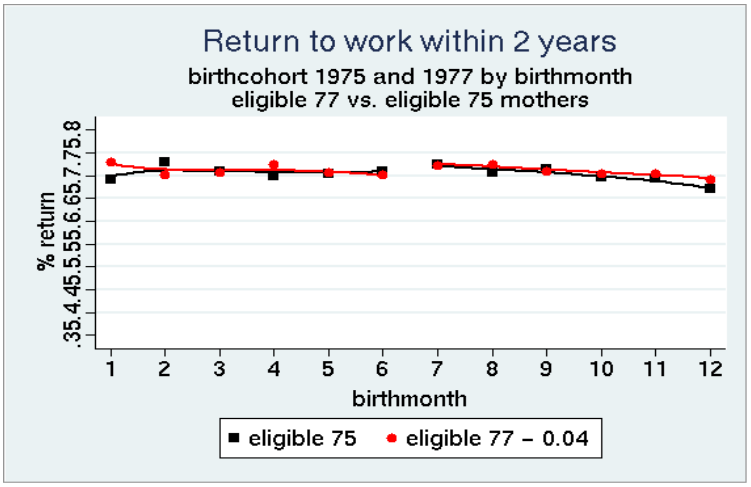


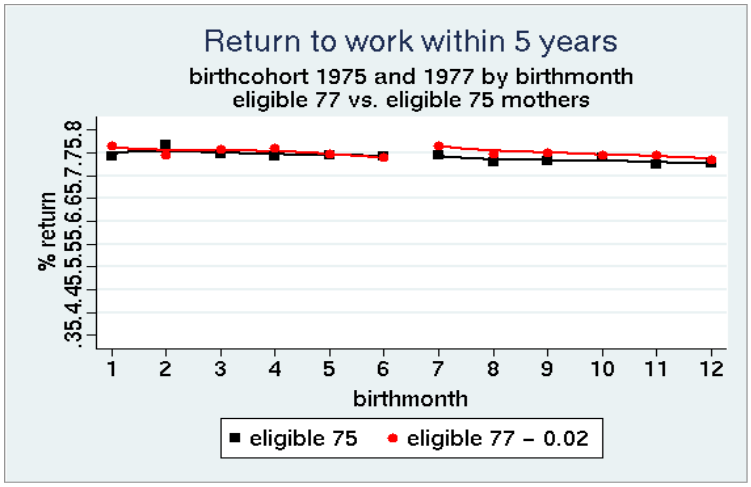
Note: Each graph shows the estimated mean for mother's outcomes by birth month. The solid line is non-parametrically fitted using triangle kernel with a bandwidth of three.

Figure 3b
Mother's outcomes by birth month, eligible mothers 1977 versus non-eligible mothers 1977 and eligible mothers 1975



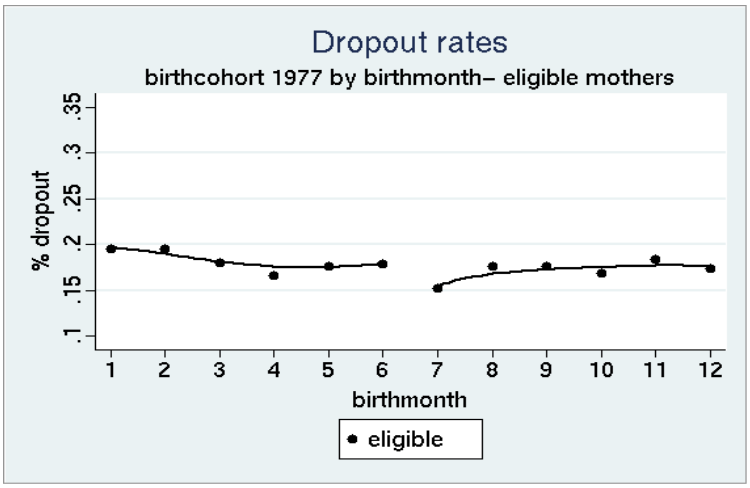


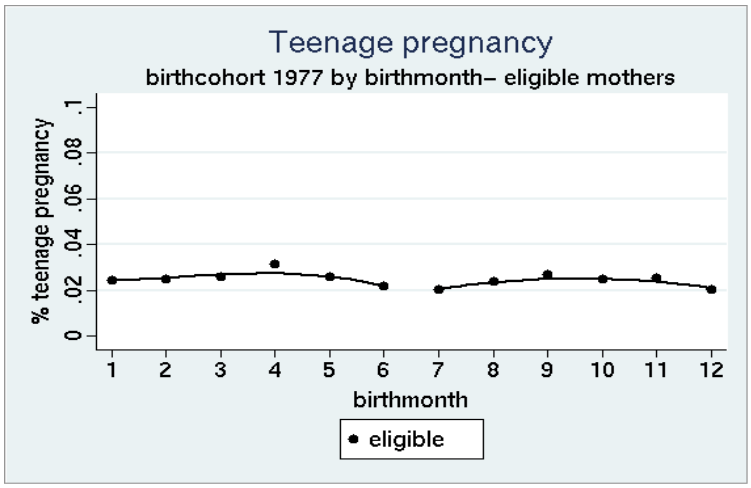


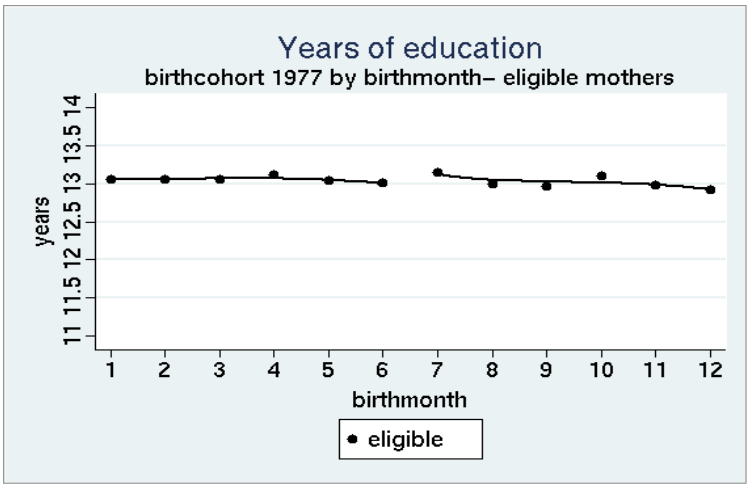


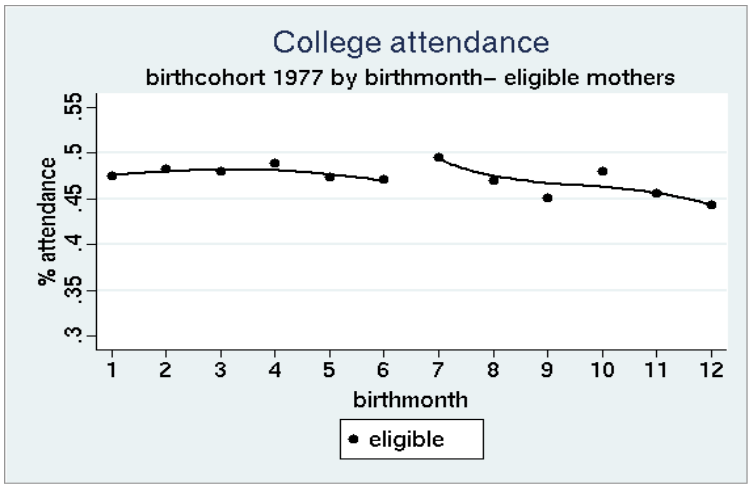
Note: Each graph shows the estimated mean for mother's outcomes by birth month. The solid line is non-parametrically fitted using triangle kernel with a bandwidth of three.

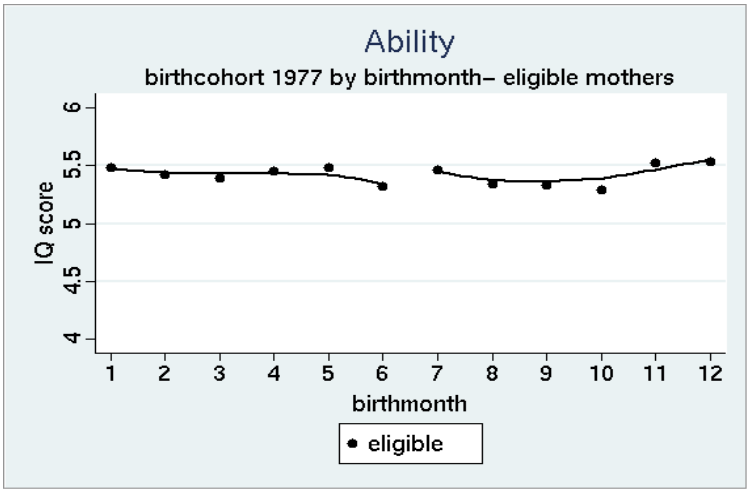
Figure 4a
Children's outcomes by birth month, eligible mothers 1977

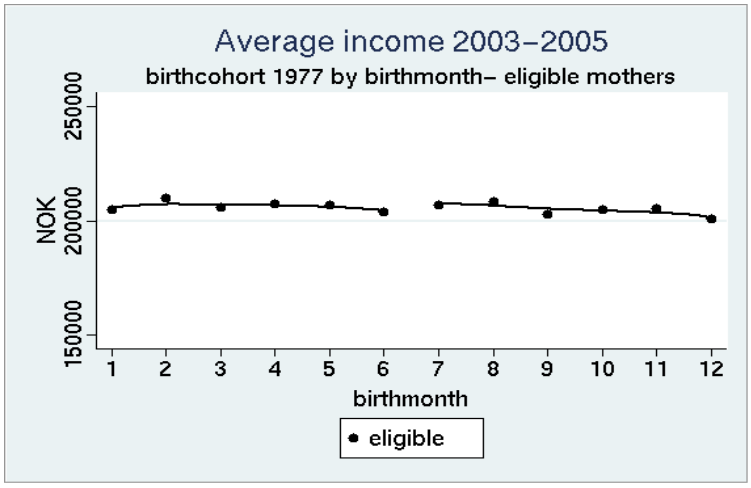






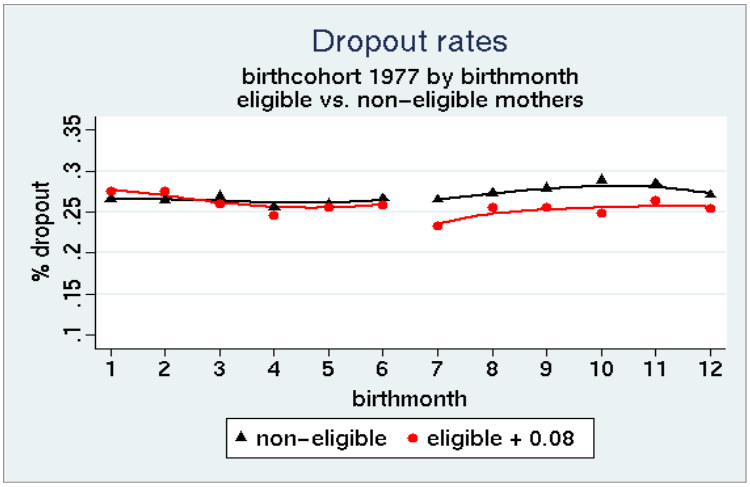


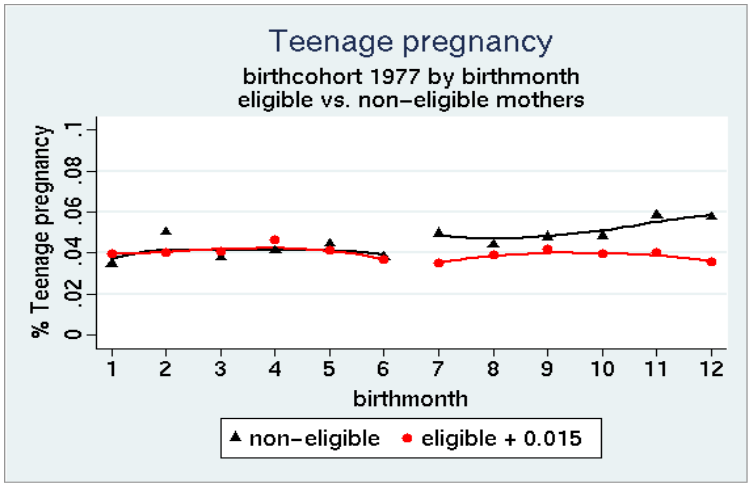


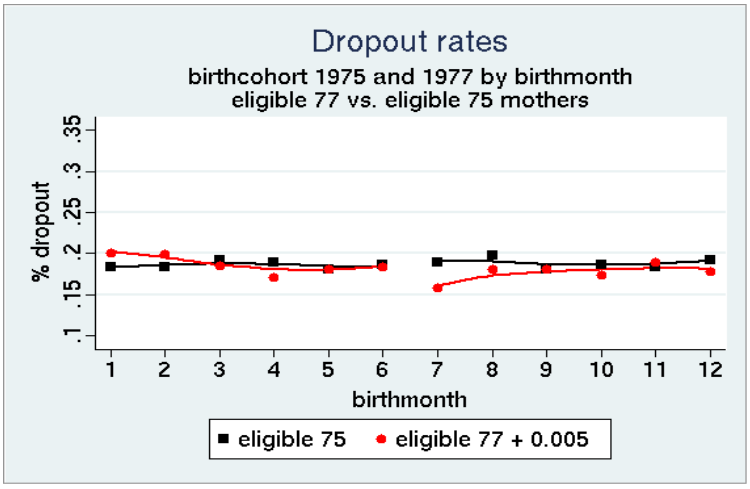


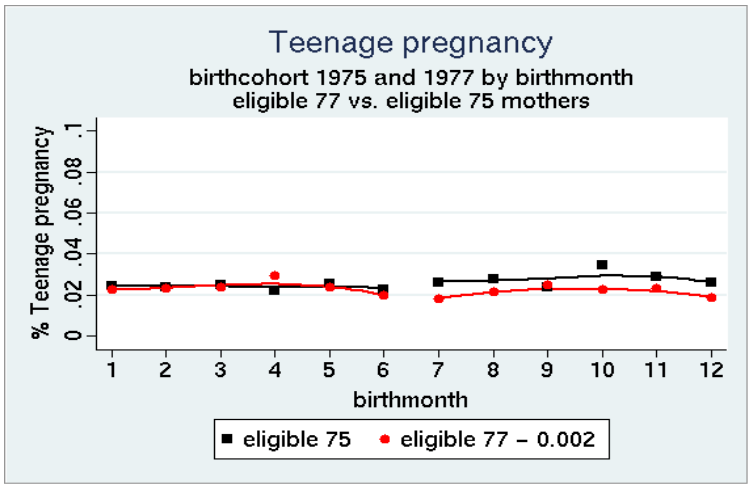
Note: Each graph shows the estimated mean characteristic for children's outcomes, by birth month. The solid line is nonparametrically fitted using triangle kernel with a bandwidth of three.

Figure 4b
Children's outcomes by birth month, eligible mothers 1977 versus non-eligible mothers 1977 and eligible mothers 1975



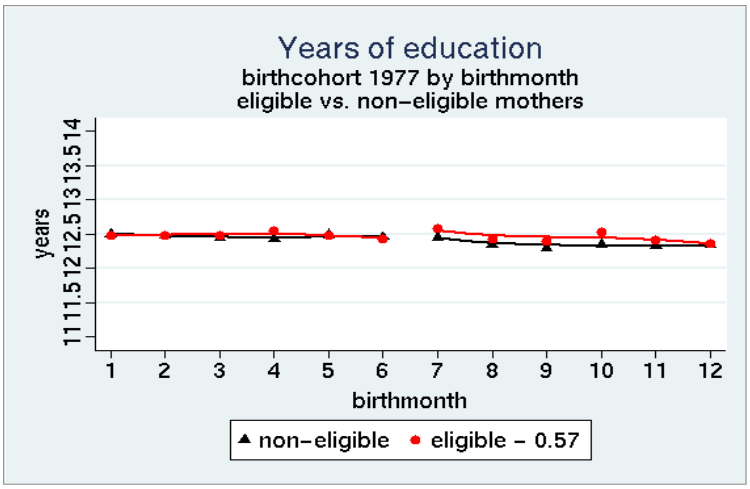


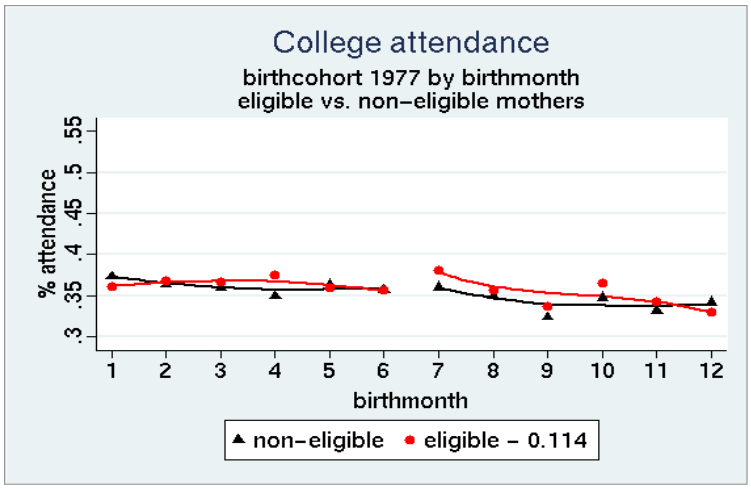


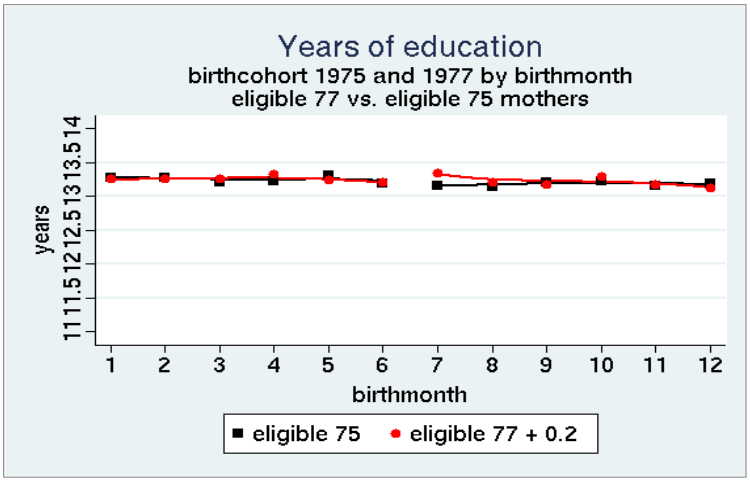


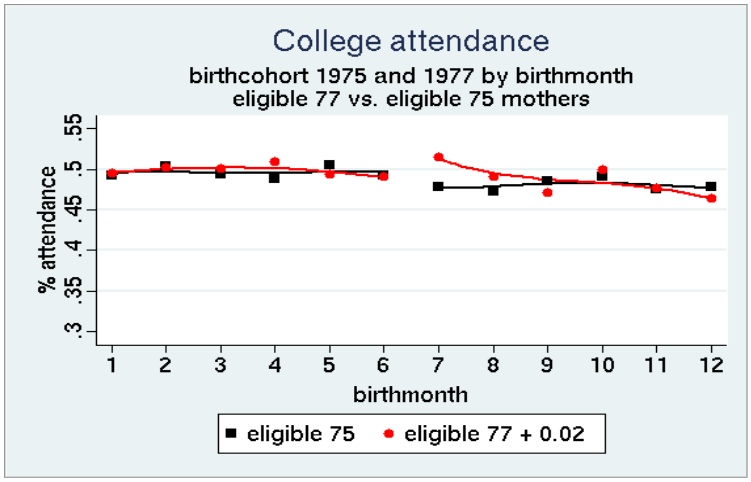
Note: Each graph shows the estimated mean dropout rates, by birth month. The solid line is nonparametrically fitted using triangle kernel with a bandwidth of three.

Figure 4c
Children's outcomes by birth month, eligible mothers 1977 versus non-eligible mothers 1977 and eligible mothers 1975



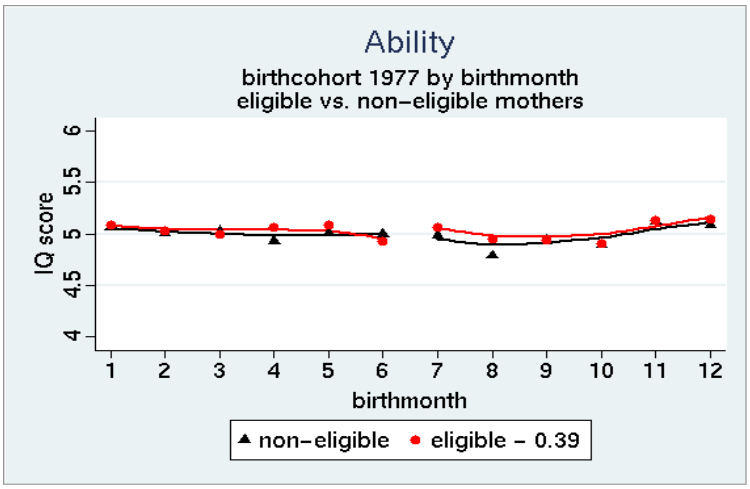


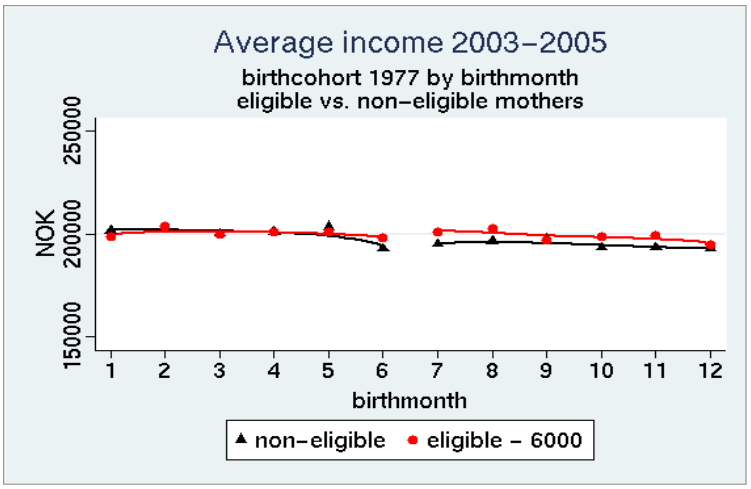


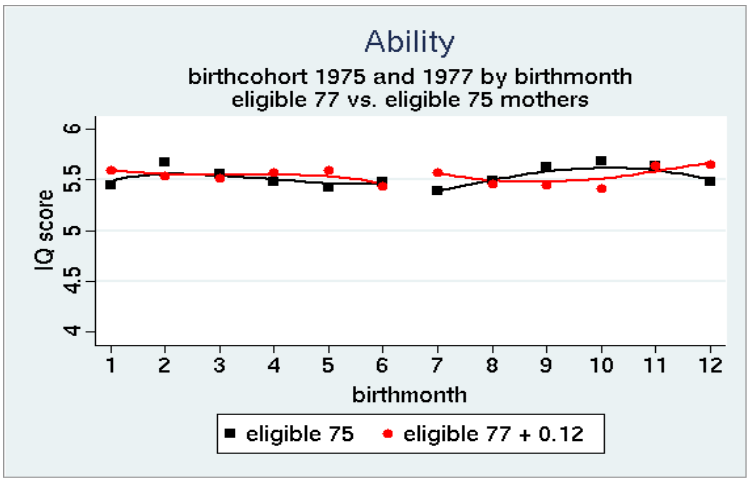


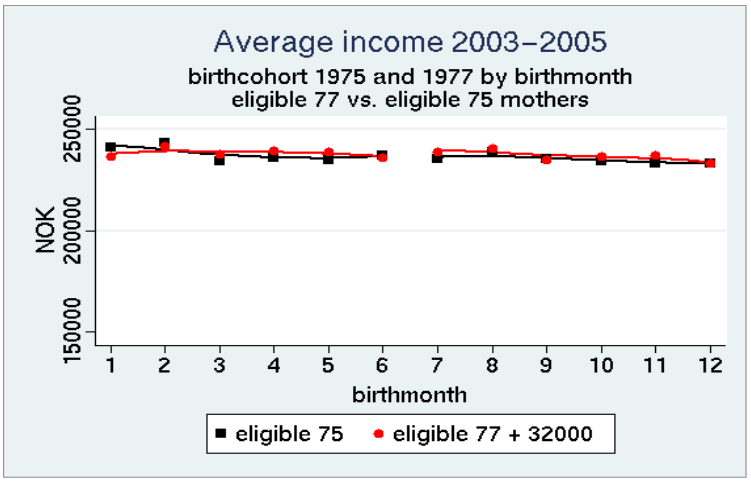
Note: Each graph shows the estimated mean dropout rates, by birth month. The solid line is nonparametrically fitted using triangle kernel with a bandwidth of three

Figure 4d
Children's outcomes by birth month, eligible mothers 1977 versus non-eligible mothers 1977 and eligible mothers 1975



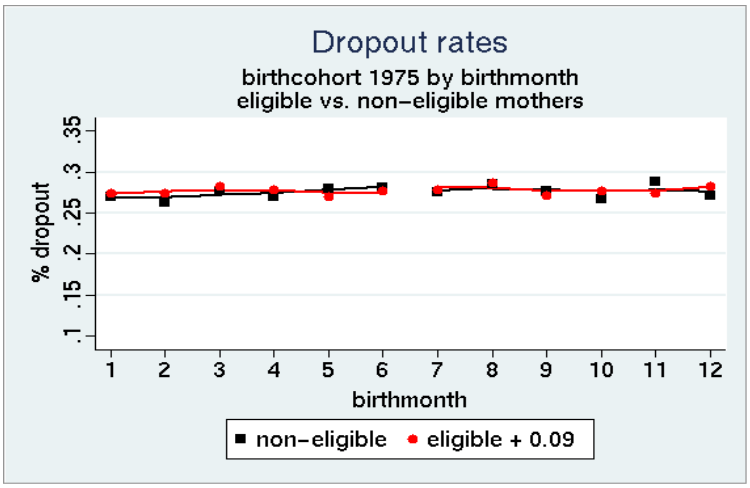


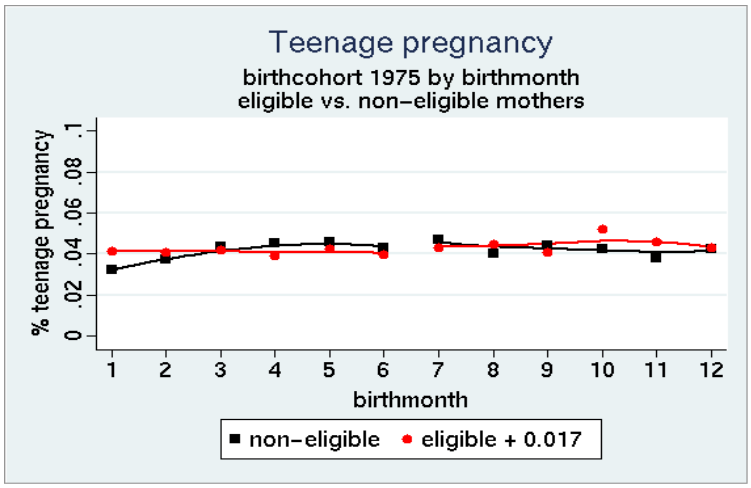


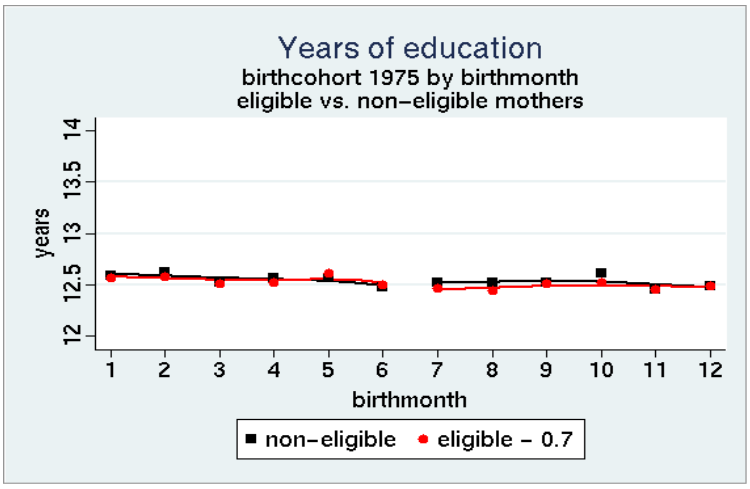


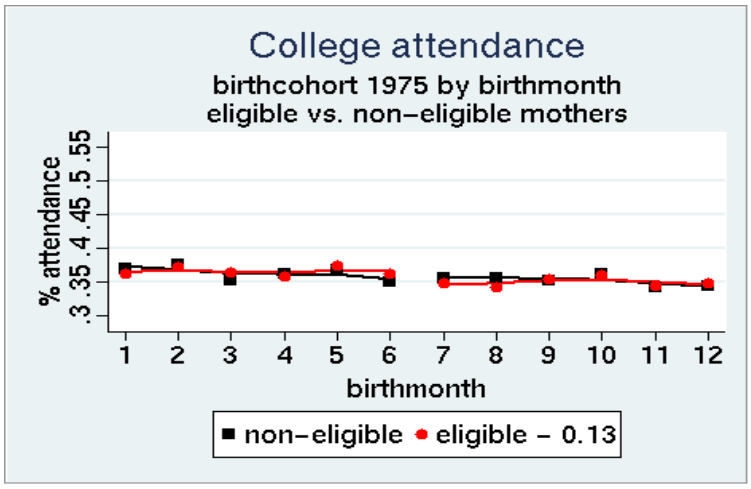
Note: Each graph shows the estimated mean dropout rates, by birth month. The solid line is nonparametrically fitted using triangle kernel with a bandwidth of three.

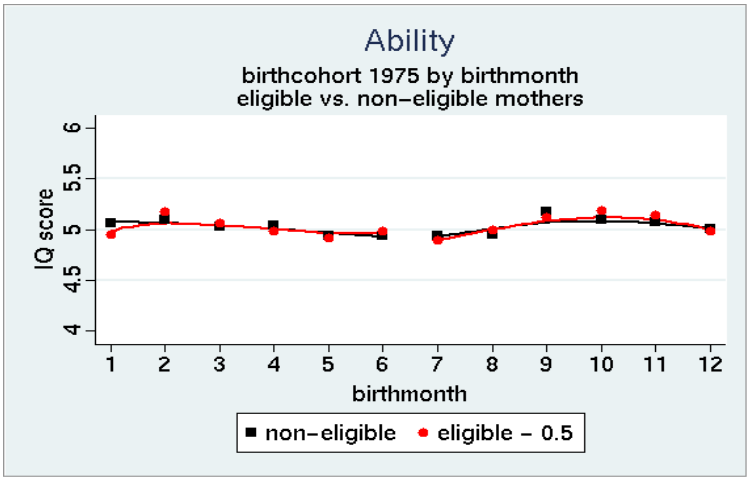
Figure 5:
Placebo results, eligible mothers versus non-eligible mothers in 1975

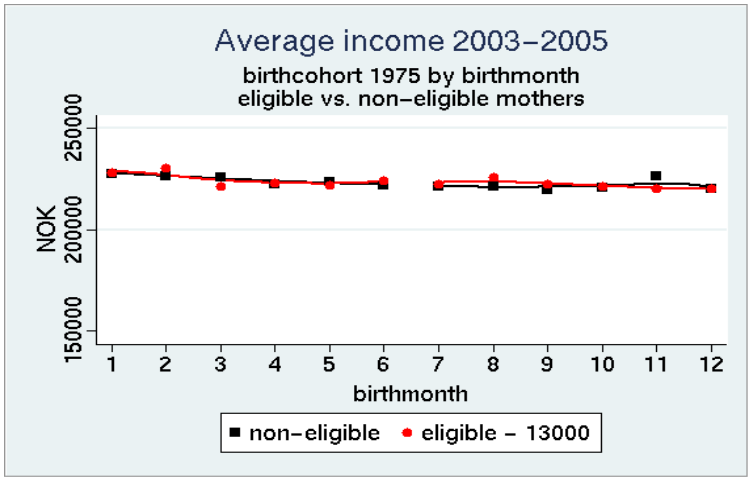












Note: Each graph shows the estimated mean dropout rates, by birth month. The solid line is nonparametrically fitted using triangle kernel with a bandwidth of three.

Table 1
Descriptive statistics, eligible mothers and children of eligible mothers in 1977

Birth month	January - June	July - December	Difference
Mothers			
Years of education	10.71 (.019)	10.70 (.020)	-.006 (.028)
Age at birth (in months)	314.44 (.481)	315.15 (.515)	.707 (.704)
Income in 1975 in NOK	103,868 (573)	97,105 (628)	-6,764*** (849)
Income in 1977 in NOK	69,922 (573)	10,4810 (611)	34,888*** (837)
Income in 1982 in NOK	75,496 (642)	74,586 (679)	-910 (934)
Predicted months of leave	4.157 (.040)	6.309 (.018)	2.15*** (.045)
Probability to return to work within 2 years	.751 (.004)	.750 (.004)	-.001 (.005)
Probability to return to work within 5 years	.772 (.004)	.769 (.004)	-.004 (.005)
Children			
Dropout rates	.181 (.003)	.172 (.003)	-.009** (.005)
College attendance	.479 (.004)	.476 (.005)	-.003 (.006)
Years of education	13.06 (.021)	13.02 (.022)	-.035 (.030)
Teenage pregnancy	.021 (.001)	.019 (.001)	-.002* (.001)
IQ young men	5.425 (.022)	5.413 (.024)	-.012 (.032)
Average income 2003-2005 in NOK	206,446 (977)	204,879 (1027)	-1567 (1417)

Note: 1USD=5.23NOK (16.06.2008)

Table 2a
The effects of maternity leave reform on mother's labor supply
Regression Discontinuity

Variables	Mean	Nonparametric			Parametric Quadratic	Parametric 4th order poly.
Bandwidth		**2**	**3**	**4**	**3**	**6**
Predicted months of leave	5.2	2.204*** (.078)	2.207*** (.071)	2.198*** (.065)	2.230*** (.054)	2.317*** (.056)
Ln(Income) (1977)	10.98	.242*** (0.036)	.244*** (0.029)	.241*** (.028)	.181*** (0.006)	.168*** (.017)
Return 2 years after birth	.75	.022* (.014)	.026** (.012)	.024** (.011)	.038*** (.006)	.023*** (.008)
Return 5 years after birth	.77	.028** (.014)	.026** (.010)	.024** (.011)	.033*** (0.005)	.026*** (.007)
Ln(Income) 5 years after birth	11.02	.028 (0.050)	.025 (.041)	.009 (.037)	.041 (.049)	-.008 (.045)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 2nd order and a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%, N=25645

Table 2b
The effects of maternity leave reform on mother's labor supply
Differences-in-differences using non-eligible mothers 1977 and eligible mothers 1975

Variables	Nonparametric difference-in-differences estimates					
Bandwidth	**2**		**3**		**4**	
Control group	Noneligible 1977	Eligible 1975	Noneligible 1977	Eligible 1975	Noneligible 1977	Eligible 1975
Return 2 years after birth	.028** (.012)	.008 (.010)	.031*** (.010)	.014* (.009)	.029*** (.009)	.010 (.008)
Return 5 years after birth	.036*** (.011)	.025** (.010)	.038*** (.010)	.026*** (.008)	.036*** (.009)	.026*** (.008)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 2nd order and a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007) under the assumption that that the trend in outcomes would be the same before and after the reform. ***significant at 1 %, **significant at 5%, *significant at 10%, N=48515 (eligible 1977 and non-eligible 1977), N=50716 (eligible 1977 and eligible 1975)

Table 3a
The effects of maternity leave reform on children's outcomes
Regression Discontinuity

Variables	Mean	Nonparametric			Parametric Quadratic	Parametric 4th order poly.
Bandwidth		**2**	**3**	**4**	**3**	**6**
Dropout rate	.18	-.026** (.012)	-.025** (.011)	-.020** (.010)	-.033*** (.008)	-.025*** (.009)
College attendance	.47	.024 (.016)	.025* (.014)	.018 (.013)	.041*** (.006)	.024* (.012)
Years of schooling	13.04	.140* (.080)	.133* (.068)	.095 (.06)	.198*** (.037)	.106 (.069)
Teenage pregnancy	.025	-.003 (.005)	-.003 (.004)	-.003 (.004)	-.002 (.001)	-.004 (.004)
IQ (boys)	5.42	.142* (.082)	.110 (.072)	.078 (.064)	.155** (0.057)	.099 (0.084)
Ln(Income) 2003-2005	12.09	.017 (.030)	.024 (.021)	.022 (.021)	.043*** (0.012)	.030*** (0.009)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present standard errors and p-values derived from bootstrapping using 1000 replications. We also present parametric results using a 2nd order and a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%, N=25645

Table 3b
The effects of maternity leave reform on children's outcomes
Differences-in-differences using non-eligible mothers 1977 and eligible mothers 1975

Variables	Nonparametric difference-in-differences estimates					
Bandwidth	**2**		**3**		**4**	
Control group	Non-elig. 1977	Eligible 1975	Non-elig. 1977	Eligible 1975	Non-elig. 1977	Eligible 1975
Dropout rate	-.025** (.010)	-.029*** (.009)	-.024*** (.009)	-.031*** (.008)	-.021*** (.008)	-.028*** (.007)
College attendance	.022** (.012)	.039*** (.011)	.023** (.010)	.044*** (.010)	.019** (.009)	.039*** (.009)
Years of schooling	.143** (.059)	.174*** (.057)	.153*** (.050)	.196*** (.049)	.130*** (.046)	.175*** (.044)
Teenage pregnancy	-.012*** (.004)	-.005* (.003)	-.010*** (.004)	-.005* (.003)	-.010*** (.003)	-.005* (.003)
IQ (boys)	.149** (.063)	.232*** (.059)	.158*** (.054)	.189*** (.051)	132*** (.049)	.140*** (.046)
Ln(Income) 2003-2005	.014 (.021)	.027 (.020)	.021 (.016)	.030** (.014)	.022 (.016)	.024* (.014)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 2nd order and a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007) under the assumption that that the trend in outcomes would be the same before and after the reform. ***significant at 1 %, **significant at 5%, *significant at 10%, N=48515 (eligible 1977 and non-eligible 1977), N=50716 (eligible 1977 and eligible 1975)

Table 4
Placebo results: The effects of maternity leave reform on mother's labor supply and children's outcomes
Non-eligible mothers 1977 and eligible mothers 1975

Variables	Nonparametric					
Bandwidth	**2**		**3**		**4**	
Control group	**Non-elig. 1977**	**Eligible 1975**	**Non-elig. 1977**	**Eligible 1975**	**Non-elig. 1977**	**Eligible 1975**
Dropout rate	.008 (.013)	-.001 (.015)	.007 (.011)	-.001 (.013)	.008 (.010)	.002 (.012)
College attendance	-.015 (.016)	.002 (.017)	-.020 (.014)	.002 (.014)	-.018 (.013)	-.001 (.013)
Years of schooling	-.034 (.082)	-.003 (.083)	-.064 (.070)	-.020 (.071)	-.080 (.064)	-.035 (.064)
Teenage pregnancy	.004 (.005)	.004 (.008)	.004 (.005)	.004 (.007)	.003 (.004)	.005 (.006)
IQ (boys)	-.089 (.083)	-.006 (.090)	-.078 (.072)	-.048 (.078)	-.061 (.065)	-.054 (.070)
Ln(Income) 2003-2005	-.010 (.027)	.003 (.031)	-.006 (.019)	.003 (.023)	-.002 (.020)	.000 (.022)
Ln(Income) (1977)	-	-	-	-	-	-
Return 2 years after birth	.015 (.015)	-.005 (.017)	.012 (.013)	-.006 (.015)	.014 (.012)	-.006 (.013)
Return 5 years after birth	.002 (.014)	-.008 (.017)	-.000 (.012)	-.012 (.015)	-.003 (.011)	-.013 (.013)
Ln(Income) 5 years after birth	-.002 (0.050)	-	.016 (.042)	-	.022 (.039)	-

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007).
***significant at 1 %, **significant at 5%, *significant at 10%, N=22869 (eligible 1977 and non-eligible 1977), N=25071 (eligible 1977 and eligible 1975)

Table 5
The effects of maternity leave reform on mother's labor supply and children's outcomes.
Differences-in-differences using non-eligible as comparison group
Results by mother's education: less than 10 years of education/ 10 years or more of education

Variables	Nonparametric					
Bandwidth	**2**		**3**		**4**	
Mothers education	**More than 10 years**	**Less than 10 years**	**More than 10 years**	**Less than 10 years**	**More than 10 years**	**Less than 10 years**
Dropout rate	-.057***	-.005	-.050***	-.005	-.043***	-.006
	(.017)	(.011)	(.015)	(.010)	(.013)	(.009)
College attendance	.029*	.019	.027*	.018	.024*	.015
	(.017)	(.015)	(.015)	(.014)	(.013)	(.012)
Years of schooling	.182**	.126*	.167**	.132**	.155**	.108*
	(.086)	(.077)	(.073)	(.066)	(.066)	(.059)
Teenage pregnancy	-.009	-.009**	-.008	-.009**	-.008	-.011***
	(.008)	(.005)	(.007)	(.004)	(.006)	(.004)
IQ (boys)	.141	.178**	.171**	.165**	.170**	.130**
	(.095)	(.078)	(.082)	(.068)	(.174)	(.061)
Ln(Income) 2003-2005	.005	.006	.009	.021	.015	.019
	(.032)	(.029)	(.024)	(.021)	(.023)	(.021)
Return 2 years after birth	.036**	.019	.038**	.023*	.035**	.021*
	(.019)	(.015)	(.016)	(.013)	(.015)	(.011)
Return 5 years after birth	.036**	.038***	.038**	.041***	.037**	.037***
	(.018)	(.014)	(.016)	(.012)	(.014)	(.011)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%, N=18933 (mother less than 10 years of education), N=27312 (mother 10 years or more of education)

Table 6
The effects of maternity leave reform on mother's labor supply and children's outcomes.
Differences-in-differences using non-eligible as comparison group by gender

Variables	Nonparametric					
Bandwidth	**2**		**3**		**4**	
Gender	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**
Dropout rate	-.019	-.033**	-.014	-.036***	-.007	-.038***
	(.014)	(.013)	(.012)	(.012)	(.011)	(.011)
College attendance	-.010	.056***	-.008	.058***	-.011	.054***
	(.016)	(.017)	(.014)	(.015)	(.012)	(.013)
Years of schooling	.057	.239***	.060	.261***	.023	.258***
	(.080)	(.085)	(.068)	(.073)	(.061)	(.066)
Ln(Income) 2003-2005	-.015	.045	-.004	.045**	.005	.037*
	(.030)	(.030)	(.021)	(.022)	(.021)	(.022)
Return 2 years after birth	.020	.035**	.021	.042***	.019	.039***
	(.016)	(.017)	(.014)	(.015)	(.013)	(.013)
Return 5 years after birth	.051***	.020	.048***	.028**	.045***	.027**
	(.016)	(.016)	(.014)	(.014)	(.012)	(.013)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%, N=23812 (boys), N=22433 (girls)

Table 7
The effects of maternity leave reform on mother's labor supply and children's outcomes.
Differences-in-differences using non-eligible as comparison group
Results by child care coverage.

Variables	Nonparametric					
Bandwidth	**2**		**3**		**4**	
Child care coverage	**low**	**high**	**low**	**high**	**low**	**high**
Dropout rate	-.054***	.003	-.059***	.008	-.064***	.018
	(.014)	(.014)	(.012)	(.012)	(.011)	(.011)
College attendance	.040**	.004	.042***	.006	.042***	-.002
	(.017)	(.016)	(.015)	(.014)	(.013)	(.013)
Years of schooling	.224***	.057	.268***	.043	.286***	-.014
	(.082)	(.083)	(.071)	(.071)	(.064)	(.064)
Teenage pregnancy	-.012*	-.010*	-.011**	-.008	-.011**	-.007*
	(.006)	(.006)	(.006)	(.005)	(.005)	(.005)
IQ (boys)	.116	.207**	.123*	.216***	.126*	.163**
	(.089)	(.087)	(.077)	(.075)	(.070)	(.068)
Ln(Income) 2003-2005	.004	.025	.011	.034	.017	.030
	(.030)	(.030)	(.022)	(.022)	(.022)	(.022)
Return 2 years after birth	.036**	.021	.039***	.025*	.034***	.026**
	(.017)	(.016)	(.015)	(.014)	(.013)	(.013)
Return 5 years after birth	.043***	.028*	.050***	.027**	.049***	.024**
	(.016)	(.015)	(.014)	(.013)	(.013)	(.012)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%, N=22305 (low child care coverage), N=23940 (high child care coverage)

Table 8
The effects of maternity leave reform on mother's labor supply and children's outcomes.
Differences-in-differences using non-eligible as comparison group
Results by distance to grandparents

Variables	Nonparametric					
Bandwidth	**2**		**3**		**4**	
Distance to grandparents	**Close**	**Not-close**	**Close**	**Not-close**	**Close**	**Not-clsoe**
Dropout rate	-.067***	-.012	-.069***	-.010	-.078***	-.006
	(.019)	(.013)	(.017)	(.012)	(.015)	(.010)
College attendance	.110***	-.026*	.099***	-.022	.089***	-.021*
	(.023)	(.016)	(.020)	(.014)	(.018)	(.012)
Years of schooling	.476***	-.037	.488***	-.041	.482***	-.053
	(.113)	(.079)	(.097)	(.067)	(.088)	(.061)
Teenage pregnancy	-.007	-.008	-.006	-.006	-.008	-.006
	(.009)	(.006)	(.008)	(.005)	(.007)	(.005)
IQ (boys)	.588***	-.018	.569***	.013	.441***	.031
	(.123)	(.084)	(.108)	(.072)	(.096)	(.065)
Ln(Income) 2003-2005	.109**	-.037	.109***	-.032	.095***	-.024
	(.043)	(.028)	(.031)	(.021)	(.030)	(.021)
Return 2 years after birth	.072***	.025	.066***	.032**	.063***	.031***
	(.024)	(.016)	(.021)	(.014)	(.019)	(.012)
Return 5 years after birth	.068***	.024	.071***	.027**	.065***	.025**
	(.023)	(.015)	(.020)	(.013)	(.018)	(.012)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%, N=11405 (close to grandparents), N=25857 (far from grandparents)

Table 9
The effects of maternity leave reform on siblings aged 2-4
Differences-in-differences using non-eligible as comparison years

Variables	Nonparametric difference-in-differences estimates		
Bandwidth	**2**	**3**	**4**
Dropout rate	-.012 (.020)	-.016 (.018)	-.011 (.016)
College attendance	.041 (.026)	.052** (.023)	.056*** (.019)
Years of schooling	.031 (.146)	.086 (.122)	.082 (.105)
Teenage pregnancy	-.020* (.010)	-.020** (.009)	-.018** (.008)
IQ (boys)	.236 (.148)	.210 (.129)	.164 (.116)

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regressions using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present parametric results using a 2nd order and a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007) under the assumption that that the trend in outcomes would be the same before and after the reform. ***significant at 1 %, **significant at 5%, *significant at 10%, N=9693

Table 10
The effects of maternity leave reform on children's outcomes
Using 2nd and 4th order polynomial
Control for mothers post-reform characteristics

Variables	Parametric Quadratic			Parametric 4th order poly.		
Bandwidth	**3**			6		
Dropout rate	-.033***	-.026***	-.028***	-.025***	-.020***	-.022***
	(.008)	(.005)	(.005)	(.009)	(.007)	(.007)
College attendance	.041***	.024***	.030***	.024*	.011	.016*
	(.006)	(.003)	(.001)	(.012)	(.008)	(.009)
Years of schooling	.198***	.136***	.151***	.106	.059	.077
	(.037)	(.020)	(.030)	(.069)	(.053)	(.058)
Teenage pregnancy	-.002	.000	.004	-.004	-.003	.002
	(.001)	(.001)	(.002)	(.004)	(.003)	(.004)
IQ (boys)	.155**	.101**	.102**	.099	.045	.047
	(.057)	(.033)	(.040)	(.084)	(.063)	(.066)
Ln(Income) 2003-2005	.043***	.043***	.045***	.030***	.028**	.027**
	(.012)	(.012)	(.014)	(.009)	(.010)	(.009)
Controls	No	Only mothers income in 1977	All mothers post-reform outcomes	No	Only mothers income in 1977	All mothers post-reform outcomes

We present parametric results using a 2nd order and a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%

Appendix A

Table A1: Labor force participation for women in Norway.

Kilde: Beregnede tall konsistente med Nasjonalregnskapet, Statistisk sentralbyrå

Table A2
The effects of maternity leave reform on mother's labor supply and children's outcomes using the total sample of all mothers and children in 1977 and 1975
RD results all mothers in 1977/Diff-in-diff using all mothers in 1975 and 1977

Variables	Nonparametric **RD** and difference-in-differences estimates					
Bandwidth	**2**		**3**		**4**	
Dropout rate	**-.015**	-.014**	**-.013**	-.012**	**-.009**	-.010*
	(.010)	(.007)	**(.009)**	(.006)	**(.008)**	(.005)
College attendance	**.009**	.013	**.009**	.016**	**.004**	.014**
	(.012)	(.008)	**(.010)**	(.007)	**(.009)**	(.006)
Years of schooling	**.054**	.050	**.035**	.047	**.003**	.033
	(.059)	(.041)	**(.050)**	(.035)	**(.046)**	(.032)
Teenage pregnancy	**.002**	.002	**.002**	.002	**.002**	.002
	(.004)	(.003)	**(.004)**	(.003)	**(.003)**	(.003)
IQ (boys)	**.060**	.128***	**027**	.086**	**.006**	.046
	(.062)	(.043)	**(.054)**	(.037)	**(.049)**	(.034)
Ln(Income) 2003-2005	**.012**	.019	**.015**	.019*	**.012**	.012
	(.021)	(.014)	**(.016)**	(.010)	**(.015)**	(.010)
Return 2 years after birth	**-.007**	-.011	**-.006**	-.010	**-.008**	-.010
	(.012)	(.008)	**(.010)**	(.007)	**(.009)**	(.006)
Return 5 years after birth	**-.002**	-.008	**-.005**	-.009	**-.007**	-.007
	(.011)	(.008)	**(.010)**	(.007)	**(.009)**	(.006)
Ln(Income) 5 years after birth	**-.001**	-	**-.006**	-	**-.015**	-
	(.042)		**(.035)**		**(.032)**	

Each cell presents the estimated discontinuity in the outcomes as a result of the maternity leave reform July 1st 1977. We estimate regression x using local linear regression as in Hahn et al. (2003) and derive analytic standard errors based on formulas in Porter (2003) using a triangle kernel. We also present standard errors and p-values derived from bootstrapping using 1000 replications. We also present parametric results using a 2nd order and a 4th order polynomial function of birth month. We cluster standard errors as in Lee and Card (2007). ***significant at 1 %, **significant at 5%, *significant at 10%, N=46245 (RD), N=97312 (diff-in-diff using 1975 as control group)