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Abstract

In 1998 the Norwegian government introduced a program that increased parents' incentives to stay home with children under the age of three. Many eligible children had older siblings, and we investigate how this program affected long-run educational outcomes of the older siblings. Using comprehensive administrative data, we estimate a difference-in-differences model which exploits differences in older siblings' exposures to the program. We find a significant positive treatment effect on older siblings' 10th grade GPA, and this effect seems to be largely driven by mother's reduced labor force participation and not by changes in family income or father's labor force participation.

JEL-Code: D130, H310, J220.

Keywords: child development, household production, household specialization, maternal labor force participation.

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1. Introduction

Stay-at-home parents are becoming increasingly rare in developed economies. In the United States in 1940, only ten percent of married women with children were working (Fogli and Veldkamp 2013). By 2010, this number had increased to 70 percent.[1] In Norway, the focus of our study, more than 84 percent of married mothers with children were working in 2012.[2] These dramatic increases in female labor force participation have led to large changes in the way families raise young children. Yet the notion that parental care is not easily substituted remains central to discussions of policies which either encourage or discourage parents to stay home.

It is unclear whether an increase in mother's labor force participation should lead to positive or negative long-run effects on children. The direction of the effect likely depends on the substitutability of parental care (Becker 1981). For example, Brooks, Hair, and Zaslow (2001) show that in cases where the alternative to maternal care is unsupervised time at home, children of working mothers often have less discipline and less self-confidence. Yet, some children's outcomes may improve if working parents rely on high quality day care programs and after school care (e.g. Blau and Currie 2006). Moreover, to the extent that mother's employment increases family income, the increased financial resources could have a positive effect on child development (e.g. Becker and Tomes 1986, Blau 1999, Baum 2003, Dahl and Lochner 2012).

Advantages of maternal care during a child's first year of life have already been substantially documented (e.g. Carneiro, Løken and Salvanes 2011, Blau and Grossberg 1992, Waldfogel, Han and Brooks-Gunn 2002, Berger, Hill and Waldfogel 2005, Ruhm 2004).[3] For older children, however, the empirical evidence on maternal care is mixed (Ruhm 2008, Blau and Currie 2006, Datcher-Loury 1988, Muller 1995). Studies evaluating welfare-to-work

[1] U.S. Bureau of Labor Statistics:"Women in the Labor Force: A Databook", Report 1034, December 2011.
[2] Labor Force Survey, Statistics Norway, 2012.
[3] Evidence from two recent studies suggestive of smaller effects than found in prior studies (Dustmann and Schönberg 2012, Baker and Milligan 2010)

programs provide consistent evidence that maternal labor force participation is *positive* for child development (Grogger, Karoly, and Klerman 2002). However, even if these studies provide compelling evidence for the population of welfare recipients, it is hard to generalize these results to the population at large.

Our research focuses on identifying the long-run effects of maternal labor force participation on primary school aged children. We study a unique, natural experiment in Norway which increased parents' incentives to stay home with their children up to age three.[4] The program, Cash-for-Care, was universal and paid any parent a significant allowance if they did not utilize a publicly subsidized daycare for their one- or two-year-old child. Many of the children who were eligible for the Cash-for-Care allowance had older siblings who may also have been affected by a parent's presence. It is this population that we focus on. We investigate how the Cash-for-Care allowance affected the long-run outcomes of the *older siblings* of the eligible population.

Our analysis utilizes a comprehensive, longitudinal register database containing annual records for every person in Norway, in addition to register data on the school grades of all 10th graders (final year of lower secondary school) in Norway from 2002 to 2008. We identify over 68,000 students who had a younger sibling born prior to the year of their tenth birthday. Depending on when this younger sibling was born, these older students may have been indirectly eligible for the Cash-for-Care program at ages seven to eleven.

We estimate a difference-in-differences model which exploits differences in students' exposures to the program from ages seven to eleven. Our identification focuses on differences in exposure among families which have similar structures and within similar birth cohorts. The analysis demonstrates that the Cash-for-Care allowance had a significant positive treatment effect on older siblings' 10th grade GPA which is a strong predictor for future

[4] Norway's parental leave is sufficiently generous so that parents can already exit the labor force for one year following the birth of a child. Even if Cash-for-Care is not as generous as the parental leave, it extends significant benefits until a child's third birthday.

educational outcomes such as high school completion and college enrollment. We further investigate the mechanisms by which the Cash-for-Care affects the grade outcomes in an IV-approach. In the IV-analysis we utilize the treatment variable interacted with household characteristics as instruments for maternal employment and family income. The analysis suggests that our estimated effects of the Cash-for-Care on students 10th grade GPA are largely driven by mother's change in labor force participation.

2. Norway's Cash-for-Care Reform

In August 1998, the newly elected Christian Democratic government began awarding cash allowances to parents who did not utilize publicly subsidized day care programs. Any family with a one- or two-year old toddler could claim this allowance. The government stated that the main goals of the allowance were to give families financial freedom to stay at home with their young children, to allow families themselves to choose what kind of care they wished for their children, and to equalize public transfers to families – regardless of what kind of care the family wanted or had access to for their child. When the program was introduced, publicly subsidized day care programs were rationed, particularly for children under three years of age.

The Cash-for-Care program was introduced in a time with high female labor force participation and extensive use of publicly subsidized day care. At the onset of the program, labor force participation among Norwegian women between 25-54 years was 83 percent, and 40 percent of children age one and two utilized publicly subsidized day care.[5] At this time parents were entitled to 42 weeks of parental leave with full compensation, or alternatively 52 weeks with 80 percent wage compensation,[6] in addition to one year of unpaid job protection

[5] OECD Labor Market Statistics: http://stats.oecd.org/ and Statistics Norway, Official Statistics of Norway: Kindergartens 1998.
[6] In 2009 the parental leave was further extended to 46 weeks of full compensation or 56 weeks of 80 percent compensation.

for each parent, in connection with childbirth. The Cash-for-Care program made it less costly to extend the period at home with the child before returning to work. The uptake of the Cash-for-Care program was substantial. About 65 percent of families with a one- or two-year-old were Cash-for-Care recipients.[7]

If a family wanted to receive the Cash-for-Care allowance, they would either have to take care of their child themselves or utilize informal care (e.g. relative, neighbor, or home-based day care). In Norway formalized care consists almost exclusively of public and publicly subsidized private day care centers. The two types of centers are regulated by the same law; they basically offer the same type of program, have the same price schedule for parental pay and are equally subsidized. Since there were very few private day care centers that did not run publicly subsidized programs, Cash-for-Care recipients in practice did not have the option of utilizing private formalized care.

The Cash-for-Care allowance constituted a significant part of family earnings even for high income families. At the time when the Cash-for-Care program was introduced, the annual allowance was NOK 36,000. The average annual fee for publicly subsidized day care was NOK 34,600, and there were some price subsidies available for low income families. For a family in the bottom income quartile the effective after tax price of a full-time day care slot for one- and two-year olds was approximately NOK 47,568, which is the sum of the day care payment and the forgone Cash-for-Care allowance, minus the tax income deduction from child expenditure. This constituted about 40 percent of average family earnings in that quartile. Even for the top income quartiles, the Cash-for-Care allowance constituted a significant part of family earnings. For the third and fourth income quartiles, the effective after tax price was about NOK 63,792, which constituted 15 and 10 percent of family earnings for the third and fourth income quartiles, respectively.

[7] Om evaluering av kontantstøtten, St.meld. nr. 43 (2000-2001).

2.1 Family Income and Labor Supply

The Cash-for-Care program gave families strong incentives to reduce labor supply and substitute formal care with parental care, or to substitute formal care with informal care. The effects were likely different across different families. For example, consider families that, in the absence of the program, would have worked and utilized publicly subsidized day care. Cash-for-Care could affect these families in at least two different ways. They could substitute formalized care with informal care, or they could reduce labor supply and substitute formalized care with parental care. To the extent that informal care was cheaper than formal care, children in the former family would most likely experience a positive income shock and increased informal care. Children in the latter family would most likely experience a negative income shock due to the mother's reduced labor supply (although this is partially offset by the subsidy) and increased parental care. While we do not have data to test this directly, other research has suggested that the program increased both parental time at home and time in informal day care (Rønsen 2001).

The direction of the income shock is ambiguous for families where both parents had a strong attachment to the labor market. However, in families where one parent had no attachment to the labor force and already stayed at home with the children, Cash-for-Care created a positive income shock. For these families the Cash-for-Care allowance was simply a cash transfer that they received with no change in behavior.

These potential responses lead to specific predictions. First, the Cash-for-Care allowance will, on average, reduce parental labor force participation. This could be true for one or both parents. Previous studies document that the Cash-for-Care allowance decreased eligible mothers' labor force participation by about five percentage points across the whole population, but had no effect on fathers' labor force participation (Schøne 2004; Drange

2012). The findings in Rønsen (2009) suggest that the long-term effects on mothers' labor supply may be even stronger.

Next, the effects on family income are ambiguous. To the extent that parents leave the labor force, income should decline; however, this should be partly offset by the subsidy amount. In families where one spouse had a weak attachment to the labor force or low earnings relative to the subsidy, income effects should be unambiguously positive.

Finally, the effects on children are also ambiguous. If parental care generates a more positive effect on student learning than after school care and unsupervised time at home, then students' long-run educational outcomes should improve. If income shocks lead to positive educational outcomes (e.g. Dahl and Lochner 2012), then educational outcomes may also improve. However, if the net income shock is negative (i.e. forgone income is less than the subsidy), then educational outcomes may worsen.

As described below, the fact that the Cash-for-Care subsidy affects labor force participation and family earnings differently across different types of families, allows us to investigate different mechanisms by which the Cash-for-Care affects the grade outcomes in an IV-analysis.

2.2 Treated Older Siblings

Our focus in this paper is on how the Cash-for-Care program affected the long-run outcomes of the *older siblings* of the eligible population. In particular, we focus on older siblings aged six to nine when the eligible children were born. We treat it as random whether or not a child aged six to nine had a younger sibling who was eligible for the Cash-for-Care allowance. Given that the allowance was quite abruptly introduced in 1998,[8] the program likely did not affect fertility. The presence of a younger sibling is likely exogenous to the

[8] The Cash-for-Care scheme was, however, a debated issue in the campaign for the parliamentary election in September 1997.

program. In fact, over the period of our study, the birth rate was stable or even weakly declining.[9] One might still be concerned that the families we identify as treated by the program differ from other families in our study especially given the spacing that must exist between a child aged six to nine and an eligible sibling. As we show below, we include a variety of controls for family structure (including fixed effects for family size and spacing), age, and parental characteristics to isolate the effects of the program. We discuss the strengths and weaknesses of our identification strategy in greater detail below.

While the Cash-for-Care program was implemented simultaneously throughout Norway, there is variation in time and the ages of eligible children. Two almost identical families may have dramatically different experiences with the Cash-for-Care allowance depending on the ages of the younger siblings. Starting in August 1998, all one-year-old children were eligible for the Cash-for-Care allowance, and from January 1999 both one- and two-year-old children were eligible.[10] As a consequence, all children born from 1998 onwards are eligible for 24 months of the Cash-for-Care allowance. For these children the eligibility starts at the end of maternity leave (12 months). These children are fully treated and their older siblings constitute our treatment group. Children born prior to 1996 are not affected by the Cash-for-Care allowance and their older siblings constitute our control group. Children born in 1996 or 1997 could be eligible for as little as one month and as many as 24 months of the Cash-for-Care allowance and we will refer to their older siblings as partially treated.

Notably, the Cash-for-Care program likely had different effects on older siblings of different ages because of differences in out-of-home care arrangements. In Norway children start school at age six, but the school day is short. The typical solution for young children of working parents is then to participate in publicly subsidized after school care programs. In these programs children can participate in free play, craft activities, sports or work with their

[9] Statistics Norway's official birth rate statistics http://www.ssb.no/fodte/tab-2010-04-08-03.html.
[10] There was an exemption from this rule for all children who turned two years old after August1, 1998. This exemption ensured that no children had a break in the eligibility for the Cash-for-Care allowance.

homework while being supervised by adults. The programs have been criticized for their low level of quality due to a low staff-student ratio and lack of staff qualifications. In 1999, 60 percent of six and seven year olds, 40 percent of eight year olds, and 25 percent of nine year old children participated in publicly subsidized after school care programs.[11] Thus, for a six- or seven-year-old, more maternal time likely substituted for time in after school care, whereas for children nine years or older, more maternal time likely substituted for unsupervised time at home between school and parents' return from work.

2.3 Other Family Reforms

During the years prior to the introduction of the Cash-for-Care allowance in 1998, Norway implemented several work-family related policies. In particular, there was a large extension in paid parental leave between 1986 and 1993. In 1986, Norwegian parents were granted 18 weeks of paid parental leave, but during subsequent years leave rights were gradually extended to 35 weeks in 1992 and to 42 weeks in 1993. Moreover, in 1993 Norway introduced a paternity quota of the paid parental leave. Of the 42 weeks of paid parental leave, four weeks were reserved exclusively for the father.

Convincing evidence documents that the family policies introduced prior to the Cash-for-Care allowance affected mothers' and fathers' labor force participation (Carneiro, Løken and Salvanes 2011, Rege and Solli 2012). The uptake of the expansions in parental leave was immediate, whereas the paternity leave was not extensively utilized until two years after implementation. Notably, however, these policies were initiated at least three years prior to the introduction of the Cash-for-Care allowance, and at least five years before the birth of the first cohort that was fully treated by the allowance. Thus, even if the paternity quota had slow uptake the two first years after implementation, our partially treated younger siblings were

[11] Statistics Norway. Aktuell utdanningsstatistikk nr. 7/2001.

fully affected by these reforms. Consequently, since our control group was only partially affected by the reforms, the coefficient of the partially treated estimate will be an indicator for whether we should be concerned that our main estimate is biased by these other reforms. As we show below, we find small and non-significant effects of the Cash-for-Care subsidy on the partially treated group, making it unlikely that the paternity quota is confounding our estimates of the impact on the fully treated group.

In 1997 the Norwegian government implemented a large school reform that potentially could affect our estimates. The reform changed school starting age from age seven to age six and increased mandatory schooling from nine to ten years. All children born in 1991 or later were affected by this reform. As we will see, the 1991 cohort is in our treatment group. This may raise the concern that a treatment effect of the Cash-for-Care program is biased by the school reform. Notably, however, *all* students in the 1991 cohort were affected by the school reform, regardless of the age or presence of younger siblings. Thus, we should expect our difference-in-differences approach, which includes cohort fixed effects, to address this concern. In fact, our estimates are biased by the school reform only if it affected students differently depending on the age and the presence of the students' younger siblings.

3. Data and Methodology

3.1. Data

Our empirical analysis utilizes register data provided by Statistics Norway. Our key educational outcome comes from a registry of school grades for all 10^{th} graders (final year of lower secondary school) in Norway from 2002 to 2008 (students born 1986-1992). In addition, we use data from a variety of government administrative records, resulting in a rich longitudinal dataset. The data allow us to track both the students' and their parents' demographic information (sex, age, marital status, number, age of children), socio-economic

data (years of education, income), employment histories (full-time, part-time, minor part-time, self-employed), indicators of receipt of social assistance, and geographic identifiers for municipality of residence. We also use information on the receipt of the Cash-for-Care allowance. The use of common identifiers enables the matching of different data sources, and allows us to match 10th graders to their parents and their siblings.[12] All three pieces of data – students' records, parents' records, and siblings' birthdates – are essential to the analyses.

Our analytic sample consists of all 10th graders graduating between 2002 and 2008. We applied the following exclusion criteria to create our final sample of 10th graders. First, we exclude all children who did not reside in the same municipality as their mother until age 16. Second, we limit our sample to individuals born in Norway by Norwegian-born parents, since immigrants in general have substantially weaker labor force attachment (Olsen 2008). Third and important for our identification strategy, we exclude all children with younger siblings that are born after the year of their ninth birthday. This restriction ensures that we have one year of data, the 2002 10th grade cohort, for which no student was eligible for the Cash-for-Care allowance. The 2002 cohort was born in 1986, and the first children who were eligible for the allowance were born in 1996. Thus, the 10th grade students in 2002 would have been older than nine at the birth of their younger sibling who might have been eligible.

Finally, in Norway most children start school the calendar year they turn six and therefore graduate from 10th grade in the calendar year when they turn sixteen. In order to ensure that our estimate is based on children of standard school age, we exclude students who did not graduate at normal graduation age. These are students who likely started school earlier or later than normal because of their maturity at school start. Notably, our students are treated either when they are six, seven, eight or nine year old.[13] Thus, late or early school entry

[12]Up until recently Norway has not been gathering data on educational outcomes of children before 10th grade.
[13] In the Norwegian school system children are not kept behind in grades despite poor performance. Instead, students who are not doing well in their classes are supposed to be closely followed up and given special

cannot be outcomes affected by the reform. Applying these restrictions provides us with a sample of 284,455 tenth graders. In our main analysis we further restrict the sample to students with a 5-9 years younger sibling, as it is among these students there is variation across treatment. Our main sample consists of 68,695 students.

Outcome variables

Our key outcome is students' grade records in 10^{th} grade. In Norway students receive grades in 11 different subjects. Grades range from one to six, where six indicates excellence and one indicates very little competence. As a summary measure of a child's performance we use the students' grade point average (*GPA*). Except for one final written and oral exam, grades are awarded by teachers and may have some subjectivity to them. Despite the subjectivity, the GPA is the key academic indicator used by high school admissions offices in offering admission to students for upper secondary school. Individual data on lower secondary school GPA have only been available for about a decade, limiting the possibilities to study the relation with future labor market outcomes. However, research shows that it is strongly related to future educational outcomes. Hægeland et al. (2011) and Falch and Strøm (2011) show that GPA is a strong predictor for achievement in upper secondary school, both in terms of grade points and completion. Moreover, Falch, Nyhus and Strøm (2013) show that grades from lower secondary school strongly predicts later college enrollment and is negatively correlated with being inactive or on welfare benefits at age 22.

The employment record in the registry database includes variables for parents' employment status and earnings. As a measure of a parent's labor force participation we construct an indicator variable capturing whether the parent was working more than 20 hours

tutoring. Moreover, it is not possible to fail a class and students are allowed to graduate even with the worst possible grades.

when the student was ten years old.[14] We focus on the year when the older sibling turns ten, because this is the first year *all* families in our treatment group are fully treated.[15] Notably, at age ten some of our treated families are no longer eligible for the Cash-for-Care subsidy because the younger sibling has turned three years old. We nevertheless focus on labor force participation at age ten, because it has been documented that the Cash-for-Care also had prolonged effects on mothers' labor force participation (Drange and Rege 2012). As a measure of family earnings we use the sum of mother's and father's earnings, the Cash-for-Care subsidy, and welfare transfers. We adjust earnings using the GDP deflator to be in real terms. Additionally, we use the combination of welfare transfers and Cash-for-Care subsidies to generate a variable measuring the overall percentage of a family's income that comes from government transfers. We use this measure as an additional outcome in our analysis.

Control variables

Our data allow us to construct several variables capturing important child, father and mother characteristics that we include in our regression analyses. Some variables are possibly endogenous to the Cash-for-Care allowance. In these cases, we define the variable prior to the intervention. To control for potential nonlinearities in the effects of the control variables, we use indicator variables wherever possible for each of the controls. Our control variables include the following:

[14] This measure does not capture self-employment.
[15] We get similar results when we estimate the effects on labor force participation at ages 9 or 11. We have also conducted the analysis focusing on parental outcomes when the eligible sibling reaches the age of two. The results are similar and available upon request.

- *Child characteristics:* gender, number of full siblings (0,1,2,3,4, ≥5)[16], spacing (indicator for age of older sibling when younger sibling is born (1,2,3,…,9)) [17] and birth order (1,2,3,4, ≥5), municipality of birth fixed effects, number of half-siblings;[18]
- *Father and Mother characteristics*: age at birth of student (<20,20-25,25-30,30-35,35-40, 40-45,≥45), age at birth of his oldest child (<20,20-25,25-30,30-35,35-40, 40-45,≥45), years of education when student is five years old (<10, 10-12, 13-15, ≥16), linear and quadratic controls for average earnings during first five years of the student's life, and an indicator for whether the mother was working part-time of full-time when the student was four years old.

In Table 1, we present summary statistics for our outcome variables and our key explanatory variables focusing on program eligibility. Summary statistics for other control variables appear in Appendix Table 1. The first column shows the means while the second column shows the sample sizes of our main analytic sample. The average GPA, our key educational outcome, is about 4.1 on a six-point scale. The standard deviation is 0.79 points.

The next set of variables shows the average numbers of 10th grade students who had a sibling 6-9 years younger. These are the students who could have potentially been fully eligible for the allowance. Approximately 25 percent of the students were age six at the birth of their younger sibling. Similarly, about 20, 15 and 10 percent were seven, eight and nine year olds, respectively, at the birth of their younger sibling. Among these students, the timing of the births of the younger siblings was such that about 30 percent of the overall sample was "fully treated." About 21 percent of the overall sample was "partially treated."

[16] Parenthetical documentation on any control variable indicates the ranges of the series of categorical variables which characterize the specific trait.

[17] For a student with multiple younger siblings, these categories are not mutually exclusive. This implies that we assume that the effect of spacing on 10th grade GPA is independent of family size. In a robustness analysis we focus on families with only two children. Our point estimates remain similar but we have less precision in our estimation.

[18] We could also include school fixed effects, but we elected not to do so given that the students' school choice could be affected by the program. However, given that this endogeneity may be debatable, we have run our key results in this paper with school fixed effects, and the results do not change.

3.2. Methodology

To estimate the effects of the Cash-for-Care program on older siblings, we exploit variation across similar families over time. The shading in Table 2 illustrates the nature of the treatment. Each row represents a birth cohort of older siblings. Each column represents the older sibling's age at the birth of their younger sibling. In the cells we report birth year of younger sibling. As described in Section 2, younger siblings born in 1996 or 1997 are partially treated. These are indicated by lightly shaded cells. Younger siblings born after 1997 are fully treated. These are indicated by darkly shaded cells.

To better understand how we arrive at the variation in Table 2, it is useful to consider an example of how the treatment might affect an older sibling. Let us start by considering the first column that represents older siblings who are age five when the younger sibling is born. If the older sibling was born in 1991 or 1992, then he/she was affected by the Cash-for-Care through the five-year-younger sibling's (born in 1996 or 1997) partial eligibility. If the older sibling was born in 1986-1990, then he/she was not affected by the Cash-for-Care because the five-year-younger sibling (born in 1991-1995) was not eligible.

Similarly, the fifth column represents older siblings who are age nine when the younger sibling is born. If the older sibling was born in 1989-1992, then he/she was affected by the nine-year-younger sibling's (born 1998-2001) full eligibility. If the older sibling was born in 1987 or 1988, then he/she was affected through the nine-year-younger sibling's (born in 1996 or 1997) partial eligibility. However, if the older sibling was born in 1986, then he/she was not affected because the nine-year-younger sibling (born 1995) was not eligible.

The variation upon which we focus comes from comparing families with similar spacing between children but with differing eligibility. From Table 2, our empirical model compares students in the non-shaded cells to the lightly shaded cells and the dark shaded

cells, while carefully controlling for cohort and the spacing between the student and his or her younger siblings. If a student has more than one younger sibling, his family's treatment eligibility will be based on the youngest sibling being either partially or fully eligible. Note that our model implies that the identification comes from families with rather large spacing between their children. However, such spacing is common in Norway comprising almost 25 percent of the sample of non-immigrant 10th graders. We keep "partially treated" as a separate category, since its meaning is somewhat ambiguous. It could be as little as one month or as many as 24 months. While we control for "partially treated", our key results and primary identification come from comparing the fully treated (dark shading) to the untreated (no shading) cells in Table 2.

To make the comparisons across students in potentially eligible families, we estimate the following difference-in-differences model:

$$(1) \qquad y_{ijc} = \gamma_j + \gamma_c + \beta(\text{PartiallyTreated})_{jc} + \lambda(\text{FullyTreated})_{jc} + \mu X_i + \varepsilon_i$$

where y_{ijc} is the outcome of student i in birth cohort j and whose age at the birth of the youngest sibling is c. Like standard difference-in-differences models, we include fixed effects for the birth cohort (γ_j) and indicators for birth spacing between the student and the younger siblings (γ_c), which varies from 0 to 9. The vector $X_i$captures child, father and mother characteristics (described in Section 3.1). We report heteroskedasticity-consistent standard errors throughout the paper.

The coefficient of interest in Equation 1 is λ, which measures the difference between the fully treated students and those not treated. We interpret this to be the treatment effect of having a younger sibling who was eligible for all 24 months of the Cash-for-Care allowance. We also alter Equation 1 by allowing the coefficient λ to vary by sibling age group c. This

allows us to estimate whether Cash-for-Care has different effects on students of different ages.

Our identifying assumption is that the differences in GPA across students of different age at the birth of the younger sibling would have been the same across cohorts in absence of the Cash-for-Care reform. This assumption could be problematic if the compositional differences between the different types of families changes over time. This could for example occur if fertility increases among high educated women but not low educated women, and thereby decreases the spacing between children of high educated mothers. The detailed registry data allows us to do several robustness tests addressing these types of concerns. In particular, we investigate if our estimates are robust to the inclusion of controls for observable mother and father characteristics, and to municipality fixed effects indicating where students were born.

As discussed in Section 2, there are many mechanisms through which the Cash-for-Care may affect the student outcome. We explore the mechanisms by which the Cash-for-Care may have affected the students in an IV analysis. In the first stage equations, we estimate a modified version of Equation 1 using maternal labor supply and family earnings when students are 10 years old as the dependent variables (denoted by *w* in Equation 2 below). We modify Equation 1 by including interactions between being "fully treated" and family income. In particular, we interact "fully treated" with an indicator for whether the family's income was in the lowest quartile prior to the birth of the younger sibling, and we interact "fully treated" with the family's average income during the same period. The main effects of the respective income terms are included in the covariates X_i. These income measures are measured prior to the birth of the younger sibling and hence are likely exogenous to the treatment.

$$(2) \qquad w_{ijc} = \gamma_j + \gamma_c + \beta(\text{PartiallyTreated})_{jc} + \lambda_1(\text{FullyTreated})_{jc}$$

$$+\lambda_2(\text{FullyTreated})_{jc} * (\text{Income in 1st quartile Age 0-4})$$

$$+\lambda_3(\text{FullyTreated})_{jc} * (\text{Average income Ages 0-4}) + \mu X_i + \varepsilon_i$$

Families in the lowest quartile of income had the smallest attachment to the labor force, and the effects of the program among these individuals was likely small on labor force participation but larger on family income. By contrast, families with higher incomes, particularly when one spouse had high earnings, were more likely to respond to the program by having one spouse reduce labor force participation, and the income effect could be ambiguous depending on the displaced earnings.

In the second stage equation, we investigate how the student 10th grade GPA is affected by the changes in maternal labor supply and family earnings induced by the Cash-for-Care. This is denoted in Equation 3 where *w* denotes the predicted values from Equation 2 for family income and maternal labor supply measured when students are age 10. The vector θ denotes the impact of income and maternal labor supply on students' outcomes.

(3) $$y_{ijc} = \gamma_j + \gamma_c + \theta w_{ijc} + \varepsilon_i$$

4. Empirical Results

4.1. Long-Term Educational Outcome

We start by examining the effect of the Cash-for-Care program on 10th graders' GPA. We do this by estimating Equation 1. We report the results in Table 3. In our simplest model we find a small effect of the Cash-for-Care reform for students who were fully treated, but the effect is not statistically significant (Model 1). Once we include parental characteristics, the estimated effect increases to about 0.03 grade points (Model 2). This estimate is significant and robust to the inclusion of municipality fixed effects (Model 3). In Model 4 of Table 3, we allow the estimated treatment effects for fully treated students to differ by students' ages at the birth of their younger sibling. None of the estimated effects are significantly different from

each other, yet the qualitative evidence seems to suggest that the Cash-for-Care has a somewhat larger effect on the students who are six or seven at the birth of their younger sibling compared to those who are eight or nine. So far we have restricted the sample to students with sibling who is 5-9 years younger. In Model 5 we drop this restriction. As we can see, the estimated effect is still significant but has dropped from .03 to .02.

4.2. Parent's Labor Supply and Family Earnings

We estimate the impact of Cash-for-Care on mothers' and fathers' labor force participation and family earnings by estimating Equation 1. Our dependent variables are now parental labor force participation or family earnings when the older sibling is 10 years old. We use all of the same control variables as in our preferred specification (Model 3) from Table 3. We start by examining the effects of the program on mother's labor force participation. In Model 1 of Table 4, we can see that the program reduced mother's labor force participation at age 10 by 2.7 percentage points. This estimate is somewhat lower than the estimates from previous studies (Schøne 2004, Drange and Rege 2012). This difference is likely due to our focus on families with older siblings. Mothers in these larger families are less likely to be working independently of the Cash-for-Care program. Moreover, as described in the data section, at age ten some of our treated families are no longer eligible for the Cash-for-Care subsidy because the younger sibling has turned three years old.

In Model 2 of Table 4, we examine the effects of the program on fathers' labor force participation at age 10. The overall treatment effect on fathers is about a 1.3 percentage point decrease, which is less than half of the effect for mothers. The estimate is not significant.

In Model 3 we show the effects of the Cash-for-Care program on family earnings, inclusive of welfare and Cash-for-Care payments, at age 10. We can see that the Cash-for-Care program had a very small effect on average family earnings. The estimate is 0.64 percent

and not significant. In Model 4 we investigate how the Cash-for-Care program affected the share of income from government transfers at age 10. We can see that the share of transfers increased by about 5.5 percent. Given that the dependent variable mean is 15 percent, this represents a substantial increase in the share of income that families are receiving in terms of transfers. The program on average is not increasing incomes, but it is changing the composition of families' incomes.

4.3. Mechanism Investigation

As discussed in Section 2, there are a variety of mechanisms which could lead to the small, but positive effect estimate of the Cash-for-Care program. In Table 4 we demonstrated that the program decreased the mothers' labor force participation. This may have affected the child through increased parental time and/or through reduced family earnings. Moreover, in some families the program may have affected the child directly through increased family income from the Cash-for-Care allowance. In Table 5, we attempt to distinguish between these mechanisms in an IV analysis. Model 1 uses the basic sample (same as in Model 3 Table 3), whereas Model 2 uses the extended sample (same as in Model 5 Table 3).

Panel A presents the first stage estimates. In Model 1 we can see that the Cash-for-Care program has a large and significant effect on mother's labor force participation and log family income at students' age 10 and that the effects are heterogeneous across families with different family income when the child was 0-4 years. In the case of maternal labor force participation, the Cash-for-Care program has little effect on participation among families who had the lowest incomes early in children's lives. Most of the labor market effect seems to come from families with higher incomes. In terms of family income at students' age 10, the main impact is negative, but this is completely offset for families who had low income early

in their child's life. For a low-income family, the first stage implies only a small bump in earnings.

While individual variables and interactions predict labor force participation and family income, the F-statistics on the excluded instruments are 4.22 and 5.97, which is below conventional thresholds for identifying weak-instrument problems. However, when we use the extended sample including students without siblings 5-9 years younger, then the predictive power of the excluded instruments increase substantially. In the extended sample the F-statistics reads 12.91 in the estimation of maternal labor force participation and 13.54 in the estimation of family income, clearly passing the test of weak instruments.

Panel B in Table 5 presents the second stage estimates. In Model 1 we can see that mothers' work force participation at age 10 decreased the student's grade point average by 1.9 grade points. Using the extended sample in Model 2 the magnitude decreases to 1.2 grade points. There is no significant effect of family income on the student's grade point average in Models 1 and 2. As Model 1 did not pass the weak instrument test, Model 2 is our preferred Model. This model suggests that children, whose mother did not work at age ten because of the Cash-for-Care, on average obtained a 1.2 point increase in the GPA.

In the coefficients on the income variables, it is useful to examine the standard error bands. Our key estimates in Table 5 suggested that there was no significant increase in log family earnings across the entire sample. In Table 5, we showed that families in the lowest quartile could have had an increase in earnings as much as 5 percent (an upper bound given the other treatment variables and interactions). If we examine the upper bound of the confidence interval implied in Model 2 of Panel B of Table 5, an increase of .05 log points would imply an increase in GPA of only 0.03 GPA points [(-.0174+1.96*.3407)*.05]. This represents about 0.042 of a standard deviation improvement at the upper end of the confidence interval and for the part of the population whose income was most affected by the

program. Similarly the lower bound can only account for 0.044 of a standard deviation decrease. The magnitude of these estimates are quite small relative to the magnitude of the estimated effect of maternal labor supply.

5. Conclusion

In 1998 the Norwegian government introduced a program that substantially increased parents' incentives to stay home with children under the age of three. We use the inception of the program as an exogenous source of variation in female labor force participation and income to measure the impacts of these variables on students' long-run outcomes. Many eligible children had older siblings, and we investigate how this program affected long-run educational outcomes of the older siblings. Using comprehensive administrative data, we estimate a difference-in-differences model which exploits differences in older siblings' exposures to the program.

Our empirical analyses document a small positive significant treatment effect on older siblings' 10^{th} grade GPAs. We explore mechanisms in an IV-approach by utilizing the fact that the Cash-for-Care program had differential effects on mother's labor force participation and family income across different families. The first stage estimates in our IV-approach demonstrate that there was a small income increase among low-income families. However, the second stage estimates reveal that these changes in income had a non-significant and small effect on student GPA. This is in contrast with the findings of Dahl and Lochner (2012) which suggest a causal relationship between increased family resources and child development. These differences may reflect that a change in family earnings means less for child development in a generous welfare state with relatively few children growing up in poverty.

Our IV analysis suggests that mother's labor force participation is the key mechanism through which the Cash-for-Care program affected the students. The IV-estimates indicate

that those children whose mother did not work at age ten because of the Cash-for-Care in average obtained a 1.2 increase in the grade point average.What does this imply about the size of the effect? The standard deviation of GPA is about 0.80. Hence our estimated effect is roughly 150 percent of a standard deviation. This effect is too large to be plausible in the overall population, but given that parents who expect to see the largest gains are the ones most likely to change their behaviour, it could be possible in this population. If an older child is struggling in school, the Cash-for-Care program may present an opportunity for a parent to stay at home and help the student. Norway's educational system is characterized by short school days and extensive homework assignments and an after school care program with little scholastic focus, so opportunities for helping a child with homework are significant. However, we note that this analysis is suggestive and we cannot reject that there are other potential channels which affect both students' success and mother's labor force participation.

The effect of parental labor force participation on child development likely depends on the substitutability of parental care (Becker 1981). Even if not conclusive, our study indicates that parental care is not *easily* substituted. This suggests that the increases in female labor force participation in Europe and the USA may affect child development. At least in Norway, the after school care that was available to the students in our sample does not seem to be of sufficient quality – in scholastic terms - to be an adequate substitute for parental care with respect to educational achievement. This suggests that in a world with historically high and still increasing female labor force participation, policies that provide high-quality care options for school children during parents' work hours could be positive for child development. However, even if our study indicates that parental care is not *easily* substituted, more research is needed on the substitutability between formal and informal after school care and parental time.

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Table 1. Descriptive Statistics

Academic Outcomes	Mean	N
GPA	4.067	68,695
	(0.790)	
Treatment Eligibility		
Students Age 6 at Birth of Younger Sibling (Age 6 Cohort)	0.254	68,695
Students Age 7 at Birth of Younger Sibling (Age 7 Cohort)	0.204	68,695
Students Age 8 at Birth of Younger Sibling (Age 8 Cohort)	0.145	68,695
Students Age 9 at Birth of Younger Sibling (Age 9 Cohort)	0.104	68,695
Student Ever Fully Treated	0.299	68,695
Student Ever Partially Treated	0.212	68,695
Mother's Labor Force Participation		
Age 4	0.440	68,695
Age 10	0.475	68,534
Father's Labor Force Participation		
Age 4	0.764	68,695
Age 10	0.785	68,505
Family Earnings		
Ln Family Earnings Age 10	5.265	68,437
	(0.381)	
Share of Income from Transfers at Age 10	0.155	68,482
	(0.715)	
Mother's Education at Older Sibling's Age 5		
High School or Less	0.625	68,695
1-3 Years College	0.198	68,695
Beyond BA	0.083	68,695
Father's Education at Older Sibling's Age 5		
High School or Less	0.622	68,695
1-3 Years College	0.137	68,695
Beyond BA	0.122	68,695

Note: Standard deviations for non-binary outcomes appear in parentheses.

Table 2. Treatment Status by Cohort and Age at Birth of Younger Sibling

Older Sibling Birth Year	Older Sibling Age at Birth of Younger Sibling (Potentially Treated Child)				
	5	6	7	8	9
1986	1991	1992	1993	1994	1995
1987	1992	1993	1994	1995	1996
1988	1993	1994	1995	1996	1997
1989	1994	1995	1996	1997	1998
1990	1995	1996	1997	1998	1999
1991	1996	1997	1998	1999	2000
1992	1997	1998	1999	2000	2001

Notes: Non-shaded cells refer to younger siblings who were unaffected by Norway's Cash-for-Care Program. Lightly shaded cells refer to younger siblings who were partially treated. Darkly shaded cells refer to younger siblings who were fully treated.

Table 3. OLS Estimates of Effects of Cash-for-Care on 10th Grade Tests Scores

	Dependent Variable = 10th Grade Test Score				
	Sample with Younger Sibling				Full Sample
	(1)	(2)	(3)	(4)	(5)
Fully Treated	.0246	.0327	.0331		.0194
	(.0174)	(.0159)	(.0159)		(.0075)
Partially Treated	.0181	.0229	.0252		.0125
	(.0109)	(.0101)	(.0101)		(.0058)
Fully Treated – Age 6 @ Sibling Birth				.0462	
				(.0243)	
Fully Treated – Age 7 @ Sibling Birth				.0493	
				(.0222)	
Fully Treated – Age 8 @ Sibling Birth				.0278	
				(.0214)	
Fully Treated – Age 9 @ Sibling Birth				.0192	
				(.0268)	
Added covariates					
Fixed Effects for Sibling Birth Category & Birth Cohort	Yes	Yes	Yes	Yes	Yes
Student Characteristics (gender, birth order, # siblings, quarter of birth)	Yes	Yes	Yes	Yes	Yes
Parental characteristics (Age at first birth, Age at student birth, Earnings before CFC, Education Level, marital status)		Yes	Yes	Yes	Yes
Municipality fixed effects			Yes	Yes	Yes
N		68,695			284,455

Notes: We report robust standard errors in parentheses. The sample in Column 5 includes all individuals in the birth cohorts between 1986 and 1992. We have included additional controls for the presence and spacing of siblings. The sample in Columns 1-4 restrict the sample to those who have spacing between siblings ranging from 5 to 9 years.

Table 4. OLS Estimates of Effects of Cash-for-Care on Family Employment and Income Variables

	Mother's LFP at Child's Age 10	Father's LFP at Child's Age 10	Ln(Total Family Income)	Share of Income from Transfers
	(1)	(2)	(3)	(4)
Dep. Var. Mean	0.4751	0.7855	5.265	0.1546
			(0.3809)	(0.7147)
Fully Treated	-0.0271	-0.0128	0.0064	0.0551
	(0.0107)	(0.0087)	(0.0075)	(0.0294)
Partially Treated	-0.0076	-0.0035	-0.0070	0.0266
	(0.0068)	(0.0055)	(0.0048)	(0.0167)
Added covariates				
Fixed Effects for Sibling Birth Category & Birth Cohort	Yes	Yes	Yes	Yes
Student Characteristics (gender, birth order, # siblings, quarter of birth)	Yes	Yes	Yes	Yes
Parental characteristics (Age at first birth, Age at student birth, Earnings before CFC, Education Level, marital status)	Yes	Yes	Yes	Yes
Municipality fixed effects	Yes	Yes	Yes	Yes
N	68,534	68,505	68,437	68,482

Notes: We report robust standard errors in parentheses for the treatment effects. The sample sizes correspond to the number of observations from our main sample (68,695) for which we have no missing observations in the respective dependent variables. In the dependent variable means, standard deviations for non-binary outcomes are listed in parentheses.

Table 5. IV Estimates of Effects of Maternal Labor Supply on 10th Grade Scores

	Dependent Variable = Mother's Labor Force Participation at Child's Age 10		Dependent Variable = Ln(Family Income at Child's Age 10)	
	Sample w/ Younger Sibling (1)	Full Sample (2)	Sample w/ Younger Sibling (1)	Full Sample (2)
A. First Stage Estimates on Instruments				
Fully Treated	-.0060 (.0185)	.0050 (.0133)	-.0423 (.0207)	-.0509 (.0140)
Fully Treated Interacted with Family Income in Lower Quarter from Age 0-4	-.0019 (.0131)	.0112 (.0112)	.0507 (.0139)	.0597 (.0104)
Fully Treated Interacted with Average Family Income During Child's Age 0-4	-.0172 (.0098)	-.0209 (.0079)	.0273 (.0130)	.0308 (.0091)
F-stat on Excluded Instruments	4.22 (p=.005)	12.91 (p=.000)	5.97 (p=.001)	13.54 (p=.000)

B. IV Estimates	Dependent Variable = 10th Grade Test Score	
	Sample w/ Younger Sibling (1)	Full Sample (2)
Mother's Labor Force Participation at Child's Age 10	-1.9159 (0.6812)	-1.1931 (0.2962)
Family Income at Child's Age 10	-0.2283 (0.6234)	-0.0174 (0.3407)
Added covariates		
Fixed Effects for Sibling Birth Category & Birth Cohort, Student and Parental characteristics	Yes	Yes
Municipality fixed effects	Yes	Yes
Main Impacts of Variables Interacted with Instruments	Yes	Yes
N	68,436	283,447

Notes: We report robust standard errors in parentheses for the treatment effects. Student characteristics include gender, birth order, number of siblings, and quarter of birth. Parent characteristics include age at first birth, age at student birth, earnings prior to CFC, education level, and marital status.

Appendix Table 1. Additional Covariates in Regression Model

Additional Controls in Regression Model	Mean	N
Number of Siblings		
One	0.261	68,695
Two	0.572	68,695
Three	0.132	68,695
Four	0.025	68,695
Five or More	0.009	68,695
Birth Order		
Second Oldest	0.293	68,695
Third Oldest	0.059	68,695
Fourth Oldest	0.011	68,695
Fifth Oldest or More	0.004	68,695
Number of Half-Siblings		
One	0.111	68,695
Two	0.060	68,695
Three	0.038	68,695
Four	0.018	68,695
Five or More	0.010	68,695
Quarter of Birth		
Second	0.261	68,695
Third	0.261	68,695
Fourth	0.239	68,695
Mother's Age at First Birth		
20-24	0.421	68,695
25-29	0.371	68,695
30-34	0.096	68,695
35-39	0.022	68,695
40-44	0.003	68,695
45+	0.000	68,695
Mother's Age at Pupil Birth		
20-24	0.342	68,695
25-29	0.450	68,695
30-34	0.149	68,695
35-39	0.015	68,695
40-44	0.000	68,695
45+	0.000	68,695
Father's Age at First Birth		
20-24	0.259	68,695
25-29	0.455	68,695
30-34	0.208	68,695
35-39	0.048	68,695
40-44	0.011	68,695
45+	0.003	68,695
Father's Age at Pupil Birth		
20-24	0.178	68,695
25-29	0.430	68,695

30-34	0.287	68,695
35-39	0.075	68,695
40-44	0.017	68,695
45+	0.004	68,695
Gender		
Female	0.483	68,695
Relative Income (i.e. Income relative to avg earner in Norway)		
Mother, Pupil Ages 0-4	0.374	68,695
Father, Pupil Ages 0-4	0.892	68,695
Year Ending Lower Secondary (10th Grade)		
2003	0.136	68,695
2004	0.142	68,695
2005	0.146	68,695
2006	0.149	68,695
2007	0.148	68,695
2008	0.138	68,695

Appendix Table 2. Covariates by Treatment Status

Academic Outcomes	Control Mean	Fully Treated Mean	Partially Treated Mean
GPA	4.065	4.048	4.082
	(0.784)	(0.804)	(0.790)
Treatment Eligibility			
Students Age 6 at Birth of Younger Sibling (Age 6 Cohort)	0.286	0.173	0.259
Students Age 7 at Birth of Younger Sibling (Age 7 Cohort)	0.179	0.257	0.206
Students Age 8 at Birth of Younger Sibling (Age 8 Cohort)	0.081	0.294	0.144
Students Age 9 at Birth of Younger Sibling (Age 9 Cohort)	0.031	0.277	0.103
Student Ever Fully Treated	0	1	0
Student Ever Partially Treated	0	0	1
Mother's Labor Force Participation			
Age 4	0.425	0.441	0.462
Age 10	0.472	0.455	0.472
Father's Labor Force Participation			
Age 4	0.759	0.766	0.769
Age 10	0.788	0.774	0.789
Family Earnings			
Ln Family Earnings Age 10	5.274	5.251	5.260
	(0.384)	(0.382)	(0.375)
Share of Income from Transfers at Age 10	0.144	0.181	0.153
	(1.003)	(0.209)	(0.168)
Mother's Education at Older Sibling's Age 5			
High School or Less	0.618	0.641	0.625
1-3 Years College	0.200	0.185	0.203
Beyond BA	0.082	0.084	0.138
Father's Education at Older Sibling's Age 5			
High School or Less	0.599	0.650	0.639
1-3 Years College	0.141	0.128	0.138
Beyond BA	0.130	0.113	0.114