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SINGLE MOTHERS AND THEIR CHILDREN: EVALUATING A WORK-ENCOURAGING WELFARE REFORM

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Single Mothers and their Children: Evaluating a Work-Encouraging Welfare Reform*

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Abstract: Using rich administrative data from Norway, we evaluate a 1998 work-encouraging reform targeted at single parents. We especially focus on educational performances for children of the involved single mothers. For all children of single mothers, the effect on school grades at completion of junior high school at age 16 is near zero and insignificant. If one concentrates on younger single mothers, those most likely to be affected by the reform, the grade point average of their children drops significantly by 7% of a standard deviation. We isolate groups of mothers who are affected by the reform either primarily by having less time at home, or by reduced income. The children of both groups of mothers experience drops in school grades. We conclude that the mechanisms behind these grade-drops must involve both reduced available parental time and reduced income.

Keywords: Welfare reform, single mothers, child development, time and money investments.
JEL codes: I24, I38, J13.

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I. Introduction

Single parenthood is often associated with low attachment to the labor market, dependence on welfare, low income and reduced opportunities for children, a concern for many policy makers. In 1998 Norway introduced a work-encouraging reform targeted at single parents, where the maximum benefit period for support was substantially reduced. We study the long-term consequences of this reform, with particular emphasis on educational outcomes for the children of the involved single parents. One could hope that the reform would lead to higher incomes for single parent headed households and perhaps also to different attitudes towards work, education and welfare benefits.[1] This could in turn lead to better school outcomes for children. We find that for the whole population of single mothers, there is no significant impact on school grades upon leaving junior high school (at age 16). When we isolate the younger single mothers, their children actually experience a significant fall in school grades.

The Norwegian single parent reform is similar in spirit to reforms that have taken place in many other countries. The 1996 welfare reform in the US was a source of inspiration for the reforms that followed suit many other places, and is also the reform that has been most intensely evaluated.[2] Welfare benefits for the poor are in the US largely targeted at low-income families with children, and most of these are headed by a single mother. In 1996 the Aid to Families with Dependent Children (AFDC) was renamed Temporary Assistance to Needy Families (TANF). Credible and enforceable work requirements were introduced, as was time limits on the receipt of benefits. Following the reform, the employment rates of single mothers rose, income went up and poverty rates dropped.[3] Evidence on how the 1996 US welfare reform affected long-term outcomes for children is scant and points in various directions. Dunifon, Kalil and Danziger (2003) use survey data to investigate the effects of mothers moving from welfare to work. They conclude, for the selected group of mothers who find jobs after the reform, that "moving from welfare-reliance to combining welfare and work is associated with a decrease in harsh parenting, an increase in positive parenting, and decreases in both internalizing and externalizing behavior problems among children". Paxson and Waldfogel (2003) present a darker picture. They use state level data to suggest that welfare reforms may have increased child maltreatment. The studies closest to our are Miller and Zhang (2009, 2012). They

[1] Theoretical and empirical work on intergenerational transmission of work attitudes can be found in Crompton and Harris (1998), Fernández and Fogli (2009), Fernández (2013), Dahl, Kostøl and Mogstad (2013), Haaland, Rege, Telle and Vortruba (2013), and Alesina and Giuliano (2013).

[2] See for example Danziger, Corcoran, Danziger and Heflin (2000), Blank (2002), Moffitt (2003, 2007) and Grogger and Karoly (2009).

[3] Card and Blank (2008) cautions that while average earnings may have risen, jobs and earnings can also have become more unstable, and when public assistance is less available, within-year variability of income may rise. Kaushal, Gao and Waldfogel (2007) point out that while single mothers may have experienced an increase of income, expenditure data reveal that much of this income hike was spent on transportation, work clothes and the like, while little was used on what the authors term "learning and enrichment items" for children.

look at the effects of welfare reforms in the US on academic performance. Contrary to our findings of no (or negative) effects they find a positive effect of welfare reforms on children's education in the US. Our data allow us to delve deeper into questions related to heterogeneity among single parents and also the precise mechanisms through which welfare arrangements influence school outcomes. To cite Moffitt (2007), "... the reform has had generally positive average effects on employment, earnings, and income, and generally negative effects on poverty rates, although the gains are not evenly distributed across groups. A fraction of the affected group appears to have been made worse off by the reform". This precisely seems to suggest that the light should be turned on heterogeneity in response to single parent welfare reforms.

The US welfare reforms were a source of inspiration for many other countries, even countries with more comprehensive welfare systems than the US. Many countries enacted work requirements and limited benefit duration to get welfare recipients out of a perceived trap of benefit dependency, poverty and inactivity. Single mothers were often not the main target for these reforms, and some places single mothers were exempted from work requirements. For example, only in 2008, Britain introduced the Lone Parent Obligations which mandated that single parenthood alone should not entitle anyone to seek income support, and that single parents in general were expected to seek suitable work.[4] [5]

Why is the Norwegian case interesting? The reform followed rather shortly after the US one, so long-term outcomes have had time to play out, opposite many other countries. In particular, children affected by the reform now start to finish junior high school, so school outcomes can be studied. In Norway, researchers have access to excellent administrative registry data, covering the whole population, which obviously is an advantage if one wants to study heterogeneity in effects and underlying mechanisms behind the results. The Norwegian reform is very similar to the US experience, but unlike the US, Norway is a comprehensive welfare state. Since many countries seek inspiration in the US reform, it is important that this type of reform is evaluated in countries with different welfare systems. Mogstad and Prozato (2012) provided the first evaluation of the Norwegian reform, with an eye on outcomes for mothers. Similar to the US experience, they find that the reform increased labor market participation and earnings among single mothers. However, they find reduced income and increased poverty among a subgroup of single mothers who had been

[4]Britain initially relied on the so-called New Deal for Lone Parents, which was a voluntary program offering single parents advice and assistance to increase their employability. See Finn and Gloster (2010) for a review of LPO; Dolton and Smith (2011) evaluates NDLP.

[5]Australia, as part of a series of 'work first' welfare reforms, in 2006 demanded that single parents with children older than six should seek employment. The Netherlands is another case where work-first type welfare reforms were enacted from the 1990s onwards. In 1996 work requirements were extended to single parents, but rules have varied, and since 2008 single parents with small children can apply for exemption from job search requirements (Finn and Gloster (2010) do not only present the British case, but also contains relevant facts on Australia and the Netherlands). For futher information see for instance Ochel (2005) for details on the German Hartz reforms, and Knoef and van Ours (2014) for a report on a Dutch field experiment to encourage single mothers to leave welfare for work.

single for a prolonged period. Reiso (2014) shows that Norwegian welfare reforms increased single mothers' take-up of alternative benefits such as health-related benefits and social assistance. This illustrates the importance of heterogeneity when analyzing welfare reform effects on the children of single mothers. It also points to an important difference between comprehensive welfare states and the US; those single parents who do not find jobs after work-encouraging reforms will to a lesser degree fall into dire poverty when there are last-resort social assistance arrangements that always will provide everyone with some income. Norway also has a battery of family policy measures that provide the population with generous maternity benefits, various forms of cash support and highly subsidized day care.[6] This of course makes it different to be a single mom in a comprehensive welfare state than in the US, but some of the qualitative effects will remain. A work-encouraging reform will entice some single parents to a path with higher income and closer labor market integration. Others will not find work, and suffer from worsened benefit availability. The effects on children's outcomes should be expected to be as diverse as the effects on their mothers.

We use a differences-in-differences method where we define the treatment group as being single when the child is aged two and the control group as being married or cohabiting (with a common child) when the child is aged two. Throughout the paper we refer to the control group as married mothers, but this includes mothers cohabitating with the father of any of their children. We study children who are aged two in the ten years predating the reform (1988-1997), and we have final year school grades or all these individuals at completion of junior high school. The children of the single and married groups are split into three segments. The first segment, aged two in 1988-1990, is untreated throughout childhood (aged 3-10). The second segment, aged two in 1991-1994, is partially treated at the end of the childhood period (aged 6-10). Finally, the third segment, aged two in 1995-1997, is treated throughout childhood (aged 3-10). Notice that for each cohort within the segments, children get one more year of treatment. We explore this in a robustness test using a linear treatment variable. The main challenge to our estimation strategy is that single and married/cohabiting mothers are quite different, and face different labor market trends over time. This means that characteristics of single and married mothers when child is aged two are not constant over time. We conduct several robustness tests to separate the reform effect from any other differences between single and married mothers over time. This includes controlling for a range of observable characteristics, and to match the group of single mothers to a similar group of married mothers.

The reform had little average effects on children's school grades in junior high school. However, the heterogeneity in the reform responses by the mothers makes the average effects of the reform

[6]For presentations and evaluations of elements of Norwegian family policy, see Havnes and Mogstad (2011a, 2011b), Dahl, Løken, Mogstad and Salvanes (2013), Drange and Rege (2013), Rege and Solli (2013), Black, Devereux, Løken and Salvanes (2014), Carneiro, Løken and Salvanes (2014), and Dahl, Løken and Mogstad (2014).

less interesting. When we split the sample into younger and older mothers, defined as above/below the median age of single mothers, we find a negative effect for the children of younger single mothers. The effect is about 7% of a standard deviation both for grade point average and written/oral exams in the final year of junior high school. For the children of older single mothers, there is no significant effect on the educational outcomes. When studying the responses of younger single mothers to the reform, we find that younger single mothers worked more, however, just enough to offset the loss in benefits. Thus, apparently for this group, there is no income effect of the reform. However, there is a time effect away from home as these mothers work more. A further analysis where the sample is split according to mothers' pre-reform labor market attachment, reveals that for mothers not working pre-reform, there is no effect on work, however a big loss in income due to lower benefits. For mothers working pre-reform, there is an increase in work, however only a marginal increase in income. For both subgroups, we find negative effects on children's school grades. Linking this to mechanisms, we suggest that children of mothers not working pre-reform are affected through a reduction in income, and not a time effect, since these mothers do not work more post-reform (this is supported by Dahl and Lochner (2012) and Løken, Mogstad and Wiswall (2012) who find positive effects on child outcomes of increased family income in poor families). Mothers working pre-reform suffered no negative income effect, so the likely mechanism here is that mothers were more away from home. Depending on the quality of both the alternative care and maternal care, and also the age of the child, this reduction in time at home could be either positive or negative for the child (Becker, 1981; Baker, Gruber and Milligan, 2008; Havnes and Mogstad, 2011b; Carneiro, Løken and Salvanes, 2014). Since we find negative effects, it is likely that children are more at home unsupervised or that the quality of alternative after-school care is not of the same standard as mothers' time. Consistent with unsupervised time or low quality of after-school care, we also find stronger reform effects on the children when the mothers have a weak social network, measured as distance to the single mothers' own parents. Grandparents seem to be a good substitute to mothers' time at home.

The remainder of the paper proceeds as follows. Section II gives background information on single mothers and welfare reforms in Norway. In Sections III and IV, we discuss our data, and threats to identification. Section V presents our main findings, and Section VI explores possible mechanisms. Finally, Section VII offers some concluding remarks.

II. Background

A. Descriptives of single mothers in Norway

In Appendix Table A.1 we compare characteristics of single to married mothers in Norway. We see that single mothers are younger, less educated, work less and earn substantially less in the labor

market. They also have fewer children, presumably because they are less likely to be in, or have been in, stable relationships. Single motherhood is much more prevalent among teenage mothers compared to older mothers, 14% compared to 2%. Among single mothers, 70% take up the single parents support, or transitional benefits as it is called.[7] Even though institutions vary considerably among countries, the traits associated with single parenthood in Norway are the same as elsewhere.[8] They find themselves in the lower end of the income distribution and are more likely to live in poverty. What distinguishes the Norwegian case from less comprehensive welfare states is that other social assistance schemes become available as transitional benefits are cut. Reiso (2014) shows that single mothers utilize these options. Thus, single mothers may respond somewhat different to welfare reforms in Norway compared to the US (where work is the primary alternative to welfare benefits), and hence the mechanisms for child outcomes are likely to differ. However, both in Norway and the US, some mothers are worse off by the welfare reforms and may experience large income losses (in Norway even after changing to other benefits). For this group, the mechanisms for child outcomes are likely to be similar.

There is a lot of heterogeneity in the population of single mothers. A very important sample split throughout the paper is the split by mothers' age. Appendix Table A.1 also shows pre-reform characteristics of younger and older single mothers (split by median age which is around 26). Noteworthy is the large difference in the reason for being a single mother. Older single mothers are much more likely to be single following a divorce. They are also better off in terms of education and earnings. Younger single mothers usually have one child, while the older single mothers have closer to two children. In addition, younger single mothers are more likely to live close to their own parents. The effects of the welfare reforms are therefore likely to hit these mothers differently as they have very different backgrounds.

B. The reforms to the transitional benefit program for single mothers in Norway

The transitional benefit program secures income to single mothers, i.e. mothers who are sole caregivers for their children.[9] This welfare program has traditionally been relatively generous. Previously, single mother could receive benefits non-stop until their youngest child had finished 3rd grade of primary school (when the child was 9-10 years old). Also cohabiting single mothers, who were not married, could receive benefits as long as they were cohabiting with someone other than

[7] The data also tells us that 2% of mothers identified as married take up transitional benefits. This suggests that we have identified the single mothers group almost correctly.

[8] See for example comparisons across OECD countries in: http://ec.europa.eu/justice/gender-equality/files/documents/140502_gender_equality_workforce_ssr3_en.pdf.

[9] Single fathers may also be eligible for transitional benefits. The vast majority of single parents in Norway, however, are women. The uniqueness of being a single father suggests that this group is different from the group of single mothers. In fact, 14% of single parents were men in the 1990s, and their characteristics do differ from those of single mothers (Andersen, Birkeland, Epland and Kirkeberg, 2002). Thus, we focus solely on single mothers in this study.

the father of their children. Two reforms with restrictive features were introduced in 1998 and 1999. Table 1 displays the main changes introduced by these reforms.

Table 1. Features of the 1998 and 1999 reforms to the transitional benefit program

Characteristics	Before the reforms	After the reforms
1998 reform		
Time limit	None	Max 3 years of benefit receipt (may be taken non-consecutive)
Age limit	Youngest child finished 3rd grade of primary school (9-10 years old)	Youngest child less than 8 years old
Work requirement	None	Youngest child 3 years or older
Max benefit level	6 171 NOK(1998) per month	6 995 NOK(1998) per month
Means-tested in regard to assets	No	No
1999 reform		
Cohabitation status	Not eligible if children in common or married	Not eligible if lasted for at least 12 of the last 18 months

Notes: The time limit is related to the mother's youngest child and is reset to three years for every newborn child. Work requirements include working at least half time, taking education at least half time or being registered as unemployed at the government agency of Labour and Welfare Service. Benefits are reduced by 40% of excess earnings exceeding a level of 1 891 NOK(1998) per month. Also, benefits are reduced if the mother receives other types of benefits from The Norwegian income security system, like for instance sickness- or disability benefits. 100 NOK equals approx. 14 EUR and 17 USD.

The aim of the 1998 reform was to stimulate work and thereby reduce welfare dependency and lift income. A three year time limit was introduced, the age limit of the youngest child for eligibility was lowered, and work requirements for single mothers with youngest child aged three or older were implemented. On the other hand, benefit levels were increased to improve incomes for those still eligible. The reform was implemented over a three year period from the 1st of January 1998 to the 1st of January 2001.Within this implementation period, new applicants were awarded benefits according to the new rules, while mothers who were entitled to and had applied for benefits before the 1st of January 1998, could continue to receive benefits according to the old rules. A further restriction was imposed by the 1999 reform: single mothers in stable relationships with someone other than the father of their children were made ineligible. This reform was implemented for all the 1st of July 1999. In our data we cannot observe which single mothers were unaffected by the 1999 reform, and thus the 1999 reform is evaluated jointly with the 1998 reform. Note, however, that we do not aim at disentangle the effects of the different features of the 1998 reform either.

Birth year	Age of child 1	2	3	4	5	6	7	8	9	10	16	Treatment status
1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	2002	Untreated
1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	2003	Untreated
1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2004	Untreated
1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2005	Partially
1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2006	Partially
1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2007	Partially
1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2008	Partially
1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2009	Fully
1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2010	Fully
1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2011	Fully

Figure 1. Treatment status by cohort and age of child

Notes: Non-shaded cells refer to years children (within the respective cohorts) are unaffected by the reforms to the transitional benefit program. Light-shaded cells refer to years children (within the respective cohorts) of some single mothers are potentially affected (the implementation period of the 1998 reform). Dark-shaded cells refer to years children of all single mothers (within the respective cohorts) are potentially affected.

Since our aim is to estimate the effect of these reforms on children's school grades, we need to know which children are affected. Figure 1 displays in what years a single mother is exposed to the reforms, depending on the birth year of her child. For instance, a single mother with a child aged two in 1993 is unaffected by the reforms during the years her child is 0-6 years old. These are pre-reform years (1991-1997). When her child is 7-10 she is potentially affected by the new rules. These are implementation and post-reform years (1998-2001). As Figure 1 shows, single mothers are increasingly exposed to the reforms the later their children are born. Single mothers with children aged two in 1988 are not affected at all, while single mothers with children aged two in 1997 are potentially affected by the reforms all years when the their children are 3-10 years old. In our analysis we exploit this variation across cohorts in single mothers' exposure to the reforms. Note that, given the three year implementation period of the 1998 reform, no cohorts are fully exposed to the reforms before the age of 6.

C. *Other reforms*

Cash subsidies to families with children aged one and two years old, who did not (or only partly) made use of publicly subsidized daycare centers were introduced in 1998 and 1999, respectively. These cash-for-care subsidies reduced mothers' labor market participation (Naz, 2004; Schøne, 2004; Drange and Rege, 2013). Even though cash-for-care could not be received for children in the cohorts of this study, these children may have been indirectly affected by having younger siblings. This is confirmed by Bettinger, Hægeland and Rege (2014) who find a small, but statistically significant, positive cash-for-care effect on grade point average the final year of junior high school among children with younger siblings eligible for cash-for-care. Note that cash-for-care did not target single mothers in particular. Heterogeneous cash-for-care responses in regard to education and earnings levels (Naz, 2004; Drange and Rege, 2013), however, indicate that its impact on single and married mothers may differ. Thus, to separate out the effect of the reforms to the transitional benefit program for single mothers from a potential cash-for-care effect, we exclude children with younger siblings in a robustness analysis. Reassuringly, the results from this exercise are similar to the main results.

In 1997 an educational reform that lowered mandatory school starting age from seven to six was implemented. Thus, children aged two in 1993-1997 have one more year of mandatory schooling compared to children aged two in 1988-1992. This additional year of schooling is, however, more comparable to a year of kindergarten than a year of formal schooling. Learning through play was essential.[10] According to Drange, Havnes and Sandsør (2012), 89% of all non-immigrant families had enrolled their six year old in a kindergarten program in the year prior to the change in school stating age, i.e. in 1996. Thus, for most children, the additional year of schooling is unlikely to present a significant change in educational attainment. Focusing on the group of children that is most likely to be affected (unlikely to be enrolled in kindergarten at age six), Drange et al. (2012), find no effect of the additional year of schooling on children's long-run educational performance. Most importantly, they show that this applies to a subsample of children of single parents as well. Thus, we are not worried that our findings are contaminated by this educational reform.

Another educational reform was implemented the school year 2007/2008, and may have affected children aged two in 1994-1997. The aim of the reform was to increase the overall quality in elementary school. A content-oriented curriculum was replaced with a goal-oriented one. Schools and teachers were given more autonomy and freedom. There was also an increased focus on the development of basic skills (defined as reading and writing, calculus, oral presentation skills, and computer skills). However, there were no changes to the main structures of elementary schooling, and in junior high school courses and the number of teaching hours per course remained mainly

[10] See Drange, Havnes and Sandsør (2012) for further details.

unchanged (Bakken and Elstad, 2012, p. 31-32). The fact that the reform was not specifically targeted towards weak students, or especially vulnerable groups, makes it likely that children of single and married mothers were affected in the same manner. If not so, we would expect children of single mothers to be similarly affected by this reform in all sample splits. Finding significant estimates only in certain sub-samples (younger mothers) as we do, is not consistent with school reform effects.

III. Data

A. Data

We use data from Statistics Norway drawn from administrative registers, covering all Norwegian residents. Families are linked through personal identifiers. The data contains information on a variety of demographic and socioeconomic characteristics, in addition to employment and income records. Information on educational performance the final year of junior high school is available for the years 2002 to 2011, and we have information on welfare use from the income security system registers from 1992 to 2008.

The sample consists of children aged two in 1988-1997, for which we have measures of children's school grades in 2002-2011. It is split in two groups depending on the mother's pre-reform marital status in the beginning of the year their child turns two years old: a treatment group of children of single mothers and a comparison group of children of married mothers. Mothers are defined as single in the data if they are neither married nor cohabiting with a partner with whom they have children. Thus, mothers defined as single, may be cohabiting with someone other than the father of their children. In the data, unmarried mothers cohabiting with someone other than the father of their children are not distinguishable from mothers living alone. It follows that children of mothers with unclear material status the year their child turns two, and children not in the family registers by age two, are excluded.[11] In addition, the sample is restricted to children who turn 16 years old during their final year of junior high school, which is the norm. It is uncommon in Norway to repeat classes. The remaining sample of 534 977 children constitutes 88% of all individuals with registered grades the final year of junior high school for the years 2002-2011.

Our outcomes of educational performance are based on children's grade records the final year of junior high school. The main outcome is the overall grade point average (GPA) of 13 teacher-awarded grades in 13 different courses.[12] In addition, we use outcomes of average grades in

[11] These could be children who had not yet moved to Norway by the age of two.

[12] These 13 courses are: written (two courses) and oral Norwegian, written and oral English, mathematics, nature and science, social science, religion, home economics, physical education, music, and arts and crafts. The educational reform of 2007/2008 introduced an additional grade in (foreign) language. For consistency, this grade is not included in the calculated GPA. In 2008, the GPA is based on the average of 12 grades since students were awarded only one grade

randomly drawn written and oral exams. The written exams are equal across the country, and are graded by external sensors. Also the oral exams are evaluated by an external sensor in addition to the teacher. The grading scale ranges from one to six, where one indicates inadequate competence and six excellence. In the analysis, we use standardized grades with mean of zero and standard deviation of one.

To control for possible compositional changes across cohorts, we include a number of child and mother characteristics measured the year the child turns two, i.e. prior to the reforms to the transitional benefit program for all cohorts. These controls are: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation.[13] The earnings measure includes labor earnings, in addition to welfare benefits such as unemployment benefits, sickness benefits and parental leave benefits. Earnings are measured yearly in fixed NOK 1998 prices. In line with the study by Mogstad and Pronzato (2012), a mother is defined as participating in the labor market if her earnings exceed one "basic amount" that year. Basic amounts are used by the Norwegian Social Insurance Scheme to determine the magnitude of and eligibility for a number of benefits as unemployment benefits and old age pension. In 1998, a basic amount was about 45 000 NOK, corresponding to about $7500. We do not exclude children with missing information on control variables. Rather we construct a dummy variable for missing that is included in the analysis.

To study mechanisms, we analyze mothers responses to the reforms using a variety of outcomes measured in the years when the child is 6-10: Number of years receiving transitional benefits, number of years working (yearly earnings exceed one basic amount), number of years working full-time (yearly earnings exceed four basic amounts), number of years with ongoing education, average yearly earnings, average yearly transitional benefit payments, and average yearly income.[14] The income measure includes earnings, transitional benefit payments, in addition to other welfare benefits being disability benefits and social assistance payments. Payments from these other welfare benefits are important to capture as one response of the mothers to the reforms, apart from working more in the labor market, is to switch to other benefits (Reiso, 2014).

in written Norwegian that year. For students with less than 13 grades (immigrants may be exempted certain courses), the average GPA is calculated based on the attained number of grades.

[13]The 46 regional labor markets are defined according to commuting distances statistics (Bhuller, 2009).

[14]By the 1st of January 2002, and the 1st of January 2004, medical and work-related rehabilitation benefits and time limited disability benefits are included in the earnings measure, respectively. For consistency, when measuring mothers' outcomes, medical- and work-related rehabilitation payments are included in the earnings measure for the years 1992-2001.

IV. Identification strategy

A. Identification strategy

To estimate the effect of the reforms on children's school grades, we exploit the variation in exposure across cohorts. As Figure 1 depicts, children aged two in 1988-1990 are not exposed to the reforms. These children are referred to as "untreated". Children aged two in 1991-1994 are, as they are getting older, increasingly exposed to the reforms, and children aged two in 1995-1997 are exposed throughout childhood. These children are referred to as "partially treated" and "fully treated", respectively. Of main interest is the comparison of school grades of the fully treated children relative to those of the untreated children. In addition, we also compare school grades of the partially treated children to those of the untreated children. To avoid confounding the effects of the reforms with unrelated cohort effects, we use children of married mothers as a comparisons group. Formally, this difference-in difference (DinD) model may be expressed as:

$$y_{ic} = \alpha_1 + \alpha_2 Single_i + \gamma(Part_c \times Single_i) + \mu(Full_c \times Single_i) + \lambda_c + X_{ic}\theta + \varepsilon_{ic} \qquad (1)$$

where y_{ic} is the outcome of child i in birth cohort c. $Single$ is a binary variable taking the value 1 if the child's mother is single, and 0 if the child's mother is married. $Part$ and $Full$ are binary variables taking the value 1 if the child is aged two in 1991-1994 or 1995-1997, respectively, and 0 otherwise. λ_c is a vector of year fixed effects. X_{ic} is a vector of child and mother's pre-reform characteristics; child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. ε_{ic} is the error term. The coefficient of interest is μ , which measures the difference in mean outcome between fully treated and untreated children of single mothers – relative to those of married mothers. Correspondingly, γ captures the difference in mean outcome between partially treated and untreated children of single mothers – relative to those of married mothers. We measure the intention to treat (ITT) effect of the reforms. Unfortunately, we do not have take-up rates of transitional benefits for all cohorts when the child is aged two (these data starts in 1992, thus 1990 is the first cohort for which we have this information). However, when we look at take-up rates for later cohorts (child aged two in 1992-1997), it is as high as 70% for the total sample and 80% for the sample of younger single mothers. This means that most of our sample is affected by the reforms, and hence ITT should not be far from the average treatment effect (ATE). The reforms are affecting a whole range of outcomes of the single mothers so we will only be able to estimate the reduced form effect of the reforms. However, with our rich data, we will explore likely mechanisms.

B. Threats to identification

The underlying assumption for this DinD model to produce consistent estimates is that, in the absence of the reforms, the average outcome of children of single mothers would have changed in the same way across cohorts as the average outcome of children of married mothers. This assumption is commonly referred to as the common trend assumption. As we will show in Section V.B., the common trend assumption holds for the untreated cohorts. The difference in children's school grade measures of single and married mothers are constant in the pre-reform period (see Figure 5). In addition, the characteristics of single and married mothers across cohorts should not have patterns similar to the reforms (for instance, single mothers' earnings should not start to increase for treated cohorts relative to untreated cohorts). If so, the reform effects may be confounded with changes in these underlying characteristics. This is the main challenge of the paper as single and married mothers (although defined pre-reform and at the same age of the child) do not follow the same trends in education, labor market earnings and age over time. Single mothers are lagging somewhat behind on educational attainment and earnings compared to married mothers. They are also becoming relatively older across our sample cohorts. Figures 2-4 illustrate these patterns. Figure 2 shows the average level of education of the mothers when the child is aged two. The upper two figures are the raw total sample, and the lower two figures are the sample after a matched control group of married mothers to the whole sample of single mothers is constructed. In the figures to the left, the solid line is for single mothers and the dashed line is for married mothers. In the figures to the right we take the difference between the two groups with a 95% confidence interval. Married mothers have one more year of educational attainment compared to single mothers. The level of education is increasing across cohorts, however, single mothers are slightly lagging behind married mothers. After matching, the groups are much more similar and the differences over time are smaller, although we are not able to eliminate the differences completely. In Figure 3 showing mothers labor earnings, the matching is more successful. Here we see a large divergence between single and married mothers over time. Notice that this difference is almost linear; there is no tendency of a reform pattern, i.e. no effect for the untreated cohorts compared to treated cohorts (indicated by vertical lines). After matching, the groups are very similar. Finally, when we study mothers age in Figure 4, we see that single mothers become slightly older compared to married mothers across cohorts. Matching is not fully taking care of this, however, we are closer to similar samples. Our strategies to deal with the single and married mothers not having the same pre-reform characteristics over time is firstly to control for as many observable characteristics as possible. We will show later that after controlling for education, earnings and age, no other controls (child's gender, number of siblings, mother's labor market participation, non-Norwegian country of birth, regional labor market of residence) matter. Our modified underlying assumption is then that after controlling for observable characteristics, the average outcomes of children of single mothers

would have changed in the same way across cohorts as the average outcome of children of married mothers, in the absence of the reforms. A second strategy is to use matching as shown in the Figures 2-4. We use a one-to-one nearest-neighbor propensity score matching method to create a control group of married mothers that is as similar as possible to out treatment group of single mothers. The propensity scores are estimated using a logistic regression of mothers' single status on all controls used in the main analysis. Then, the estimated propensity score of each single mother is matched with the nearest propensity score of a married mother. This gives a matched control group of one married mother per single mother. Our last strategy is to dig into subgroups that we believe will respond differently to the reforms (while we would not expect to find different effects if the results were driven by changes in underlying characteristics).

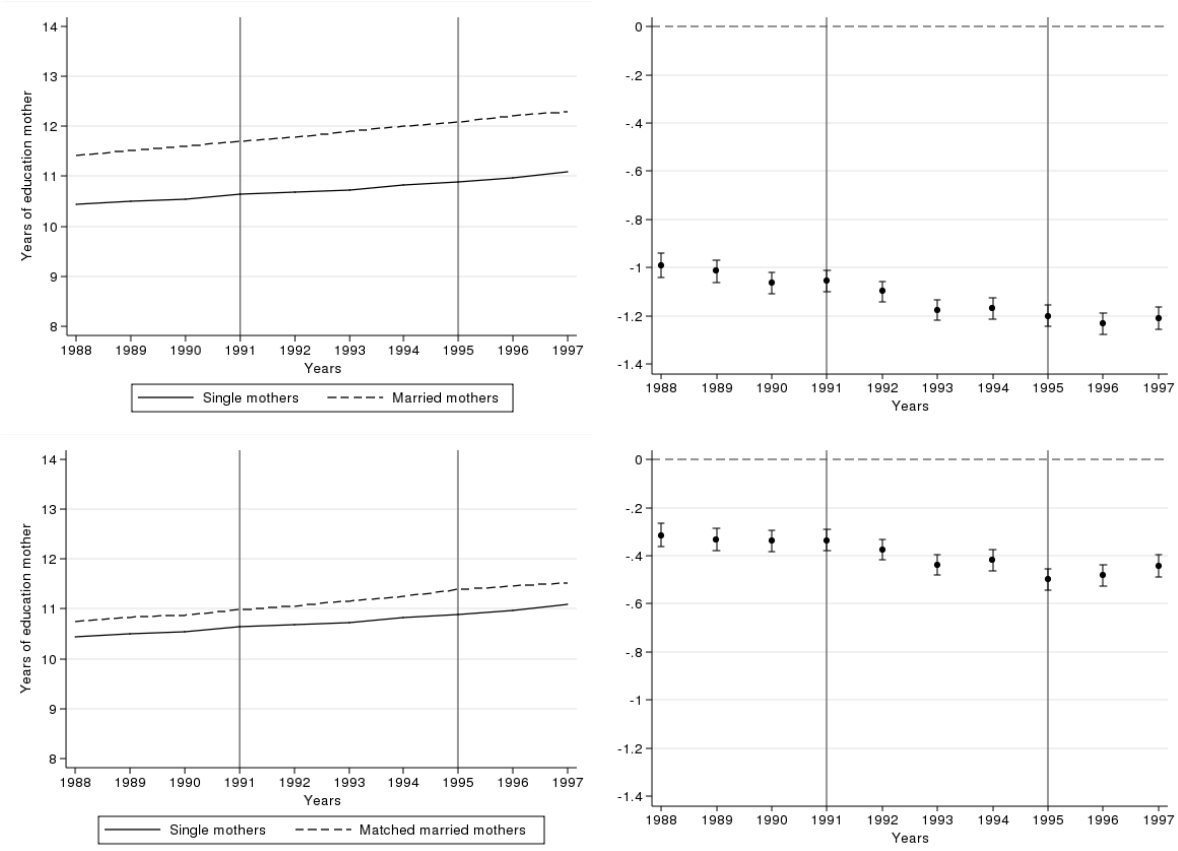

Figure 2. Pre-reform characteristics of the mothers: years of education

Notes: The two left figures show the average years of education for single (solid line) versus married (dashed line) mothers in the raw total sample (upper figure) and the matched sample (lower figure). The two right figures show the corresponding differences between single mothers and married mothers with a 95% confidence interval. The vertical lines indicate untreated, partially treated and fully treated cohorts of children.

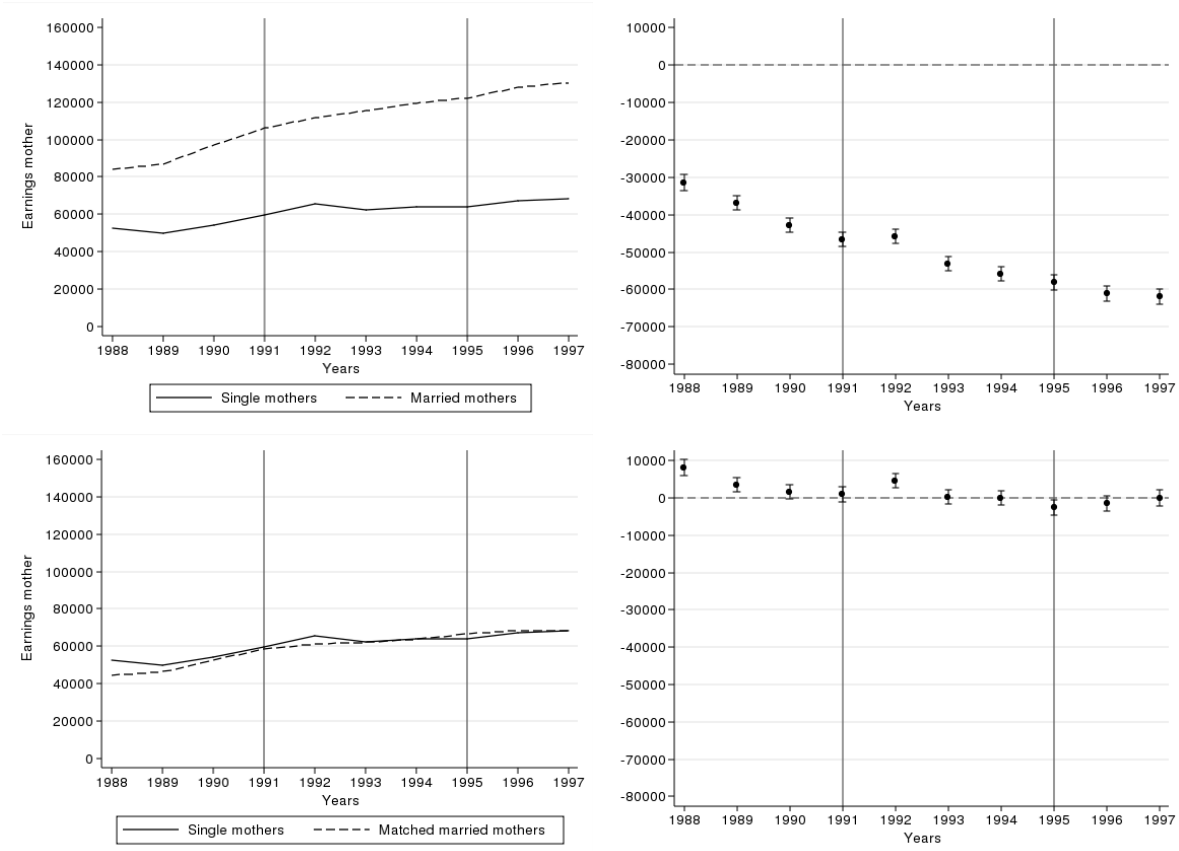

Figure 3. Pre-reform characteristics of the mothers: earnings

Notes: The two left figures show the average yearly earnings of single (solid line) versus married (dashed line) mothers in the raw total sample (upper figure) and the matched sample (lower figure). The two right figures show the corresponding differences between single mothers and married mothers with a 95% confidence interval. The vertical lines indicate untreated, partially treated and fully treated cohorts of children.

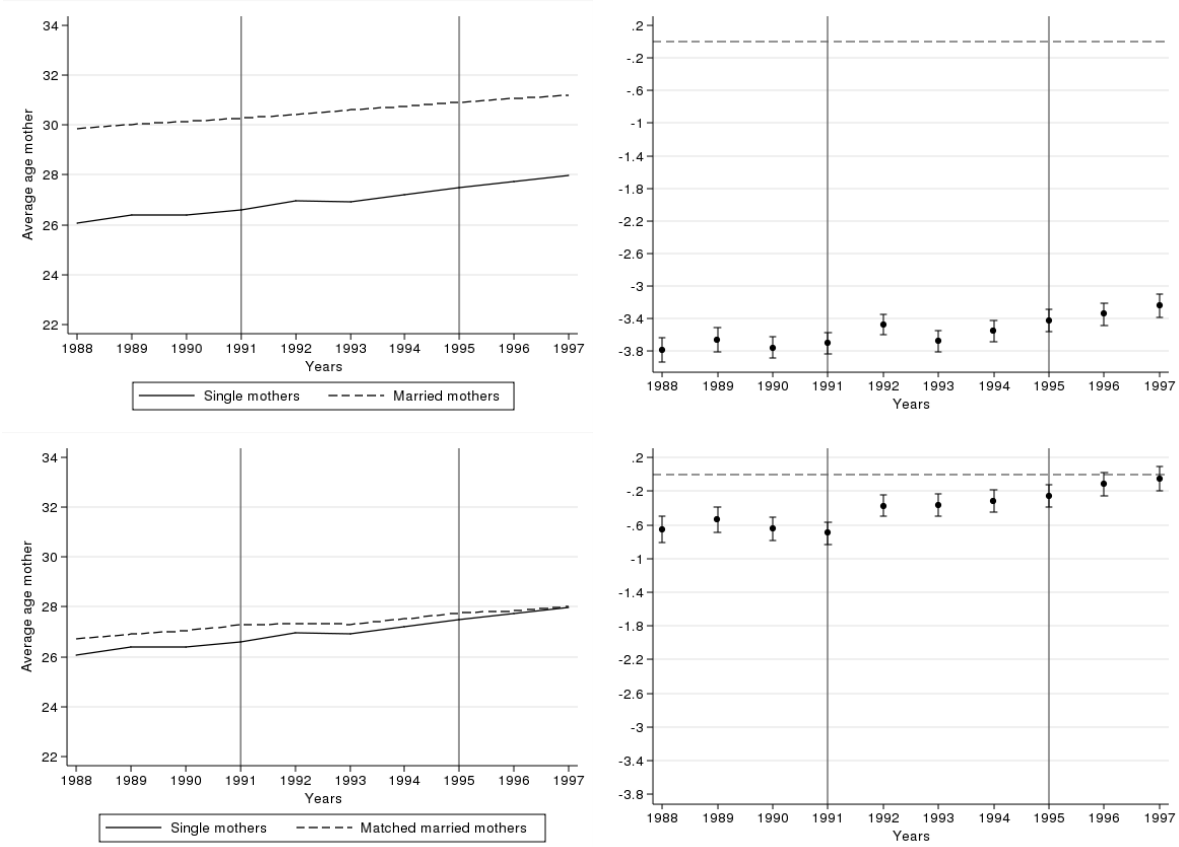

Figure 4. Pre-reform characteristics of the mothers: age

Notes: The two left figures show the average age of single (solid line) versus married (dashed line) mothers in the raw total sample (upper figure) and the matched sample (lower figure). The two right figures show the corresponding differences between single mothers and married mothers with a 95% confidence interval. The vertical lines indicate untreated, partially treated and fully treated cohorts of children.

V. Results

A. Regression results

We will first show regression-based estimates. The DinD model is estimated using a linear probability model. Table 2 presents the baseline DinD estimates of the reforms on children's school grades in junior high school for the total sample of single and married mothers. The following control variables are included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. These are all measured when the child is aged two (pre-reform).

Column 2 of Table 2 displays estimates of the intention to treat (ITT) effects of the reforms on the partially treated cohorts, and column 3 displays estimates of the ITT effects of the reforms on the fully treated cohorts (both compared to the untreated). Column 1 shows the average of the

Table 2. Difference-in-difference estimates of the reforms on children's school grades

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
GPA	3.60	-0.004	-0.010	534,977
		(0.010)	(0.011)	[60,782]
Written exam	3.09	0.027**	0.001	512,791
		(0.010)	(0.011)	[56,766]
Oral exam	3.88	-0.016	-0.014	473,243
		(0.011)	(0.012)	[52,029]

*Notes: Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

outcome variables for the untreated (pre-reform) cohorts of children of single mothers. Finally the last column gives the number of observations in total and in brackets the number of single mothers. For the three outcomes, grade point average (GPA), written exam, and oral exam, we see no effect of the reforms on the fully treated cohorts. The estimates are close to zero and insignificant. The same holds for GPA and oral exam for the partially treated cohorts, while there is a small positive effect on written exam. Studying the figure for this outcome (not shown), it turns out that this is driven by a relatively high average written exam score for the cohort of children of single mothers aged two in 1992. We do not consider this to be related to the reforms (excluding this cohort from the analysis produces an insignificant estimate).

In Table 3 the sample is split by mothers' age (median age of single mothers). In panel A, we see negative effects for the fully treated cohorts on all three school grade outcomes. We also see that the effects are about half for the partially treated cohorts (only present for GPA and oral exam). The effects for the fully treated cohorts are about 7% of a standard deviation.[15] In Section VI.E., after having studied mechanisms in more detail, we will compare this estimate to other studies focusing on work-encouraging/discouraging welfare reforms.

B. Graphical results

We now turn to graphical analysis of the results in Section V.A. As there is no effect for the full sample nor the sample of older mothers, we will only show figures for the sample of younger single mothers. If we are to believe the negative estimates, we need to convince that the common trend assumption holds. Figure 5 shows the average outcomes for GPA, written exam and oral exam,

[15] We have studied whether the effects vary by gender and find very similar effects for boys and girls.

Table 3. Difference-in-difference estimates of the reforms on children's school grades by mothers' age

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
A: Younger mothers				
GPA	3.51	-0.031**	-0.069***	131,423
		(0.015)	(0.016)	[32,607]
Written exam	2.98	0.007	-0.052***	125,050
		(0.015)	(0.016)	[30,441]
Oral exam	3.77	-0.032*	-0.066***	115,704
		(0.017)	(0.018)	[27,998]
B: Older mothers				
GPA	3.71	-0.006	0.000	403,554
		(0.015)	(0.016)	[28,175]
Written exam	3.20	0.020	0.018	387,741
		(0.015)	(0.017)	[26,325]
Oral exam	4.02	-0.022	-0.002	357,539
		(0.016)	(0.018)	[24,031]

*Notes: The sample is split such that the younger mothers are aged equal to- or below the median age of single mothers in each respective cohort. Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

respectively. The three upper graphs show the average outcomes for children of single mothers (solid line) and children of married mothers (dashed line). We see that children of single mothers in general perform worse on all school grade outcomes than children of married mothers. There is a slight upward trend in school grades across cohorts, however after the reforms, children of single mothers are starting to lag further behind children of married mothers for all three outcomes. The lower three figures better illustrate the common trend assumption and the differences between children of single and married mothers. For the untreated (pre-reform) cohorts, children of single mothers score around 20% of a standard deviation lower on GPA than children of married mothers. The common trend assumption looks good: it is stable for the untreated cohorts. Then there is a divergence for the partially treated cohorts, and for the fully treated cohorts the difference is around 30% of a standard deviation. For written exam, the common trend assumption looks even better and we see a very similar pattern as for GPA. The figure for oral exam is not as convincing, however, it shows a similar pattern as for GPA and written exam.

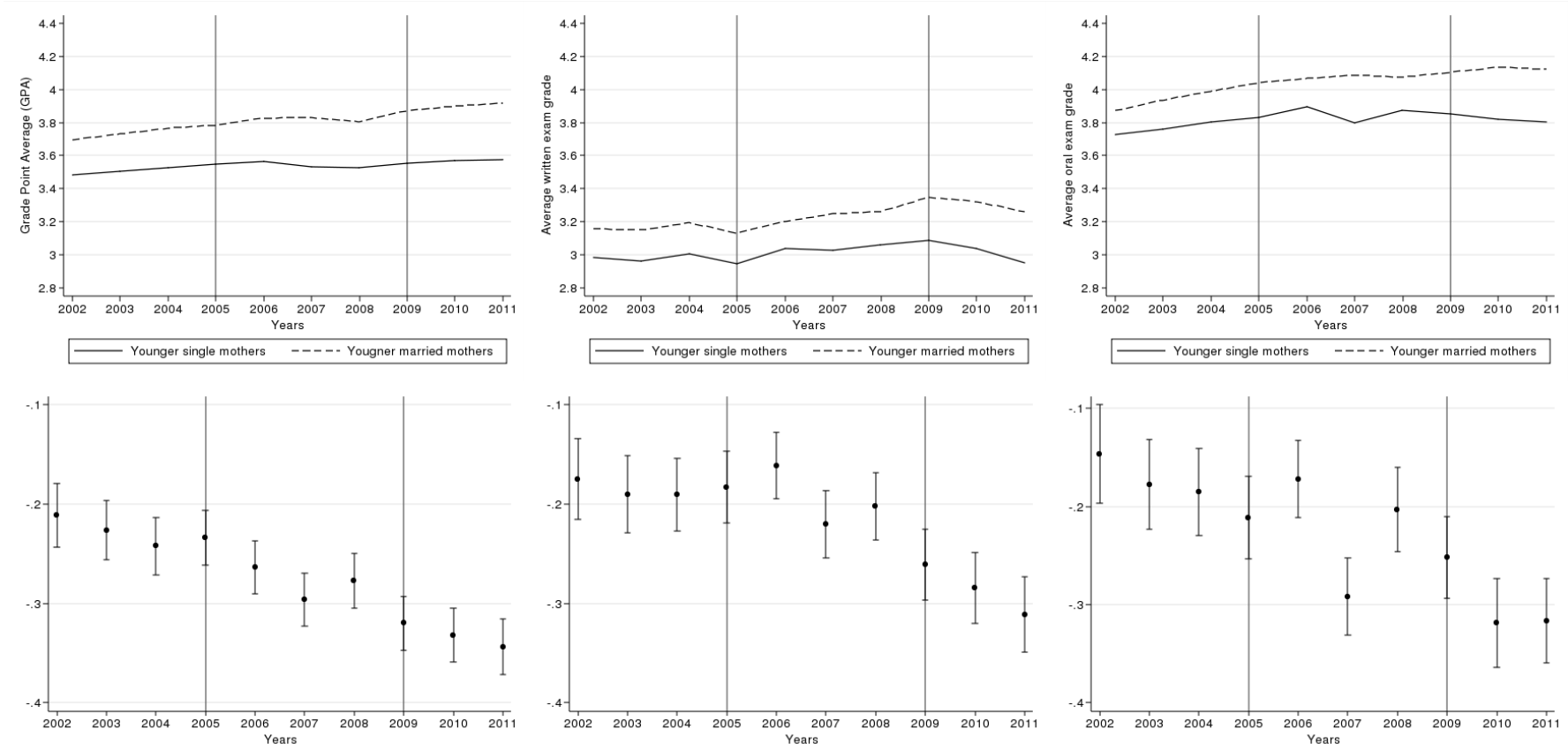

Figure 5. Children's school grades

Notes: The upper three figures show the average outcomes (grade point average, written exam and oral exam, respectively) for children of younger single mothers (solid line) versus children of younger married mothers (dashed line). The lower three figures show the corresponding differences between children of younger single mothers and younger married mothers with a 95% confidence interval. We have kept the y-axis similar for all outcomes to highlight that the average outcomes vary across different types of school grade measures. The vertical lines indicate untreated, partially treated and fully treated cohorts of children.

C. *Robustness checks*

In this section we probe the stability of our baseline estimates to alternative specifications. We conclude that our estimated negative effects on children's school grades in the group of younger single mothers are remarkably robust to a large number of alternative specification checks.

In Table A.2, we present estimates for children's school grades after we have matched a group of similar married mothers to the group of single mothers (one-to-one matching). See Section IV.B. for details. We see that the main estimates of ITT for the fully treated are very similar to the baseline in Table 2. If anything, they are slightly more negative. This is very reassuring given that we saw the levels and trends of the most important background variables for single and matched married mothers are almost identical.

The next exercise is to look more closely at control variables. In Table A.3 we first show the baseline estimates from Table 2. Then we compare this to specifications with no control variables, and only education, earnings, and age as controls. The specification without any control variables produces substantially larger estimates than the baseline estimates. This suggests that if we do not control for pre-reform characteristics we overestimate the effect of the reforms. However, after controlling for education, earnings and age, the estimates are very similar to the baseline estimates. Adding additional controls do not move the estimates much.

We perform a variety of additional robustness checks. First we estimate the effect for a subsample where the child does not have younger siblings at age 16. This is in order to show that our effect is not driven by the cash-for-care subsidy (see Section II.C.). We see from Table A.4, panel A, that our results hold up for this subsample. Next we drop teenage mothers from the sample of younger mothers. The reason is that teenage mothers may differ from older mothers along multiple dimensions (they are for instance more likely to live with their parents), and we want to show that our results are not driven by this particular group of single mothers. We see from panel B that the results excluding teenage mothers are very similar to our baseline estimates. In panel C, we exclude non-Norwegian born mothers. The results hold up, albeit a little weaker, suggesting that some of the effect is also present for children of foreign born mothers. Unfortunately, we do not have the necessary sample size to dig further into the group of foreign born mothers. Finally, we check whether our results for younger mothers are driven by the way we split the sample; by the median age of single mothers in each respective cohort (when the child is aged two). Panel D confirms that this is not the case. If we split by age 26 instead, we get very similar results [16]

We can also study treatment by year of birth. Table A.5 shows a pattern consistent with the reforms. There are no effects for the first two cohorts relative to the cohort aged two in 1988. The effects are very close to zero and, if anything, slightly positive. For the next four cohorts (partially

[16] Also, splitting the sample by ages 25 and 27, give negative, significant effects for child outcomes.

treated) we also see few significant effects compared to the cohort aged two in 1988. However, many of the coefficients have started to turn negative. Finally for the last three cohorts, fully affected by the reforms, all coefficients are negative and 6 of 9 are statistically significant. It is important to note that this model is expected to have higher standard errors than a three-split DinD model.

Another alternative to the three-split DinD is to use a model with a linear treatment variable which is 0 for the untreated cohorts, 1 for the first cohort (partially) effected, 2 for the second, and so on. As we saw in Figure 5, this seems like a valid setup as the differences gradually increase over time after the reforms. Table A.6 shows that the effect is around 1% of a standard deviation for each additional year of treatment for all the three school grade outcomes.

As a final check, we run a placebo test. Mothers that earn more than about 195 000 NOK (in 1998 prices) pre-reform are not affected by the reforms as they are not eligible for transitional benefits. In the sample of younger single mothers there are too few mothers who earns above this threshold to perform a placebo test, however, we can run a placebo for the total sample of single mothers earning above the threshold. This is still useful since if there are other reasons (apart from the reforms) why we find diverging trends in outcomes between children of single and married mothers, they are likely to show up also for this sample. Finding no effects for this sample is therefore reassuring. Indeed Table A.7 shows that there is no effects of the reforms in the placebo sample on any of the children's school grade outcomes.

VI. Mechanisms

A. Mothers' responses

To understand why we find negative effects of the reforms on a subgroup of single mothers (younger), we need to analyze how the mothers responded to the reforms. An important aspect of this is the underlying background characteristics. Although both younger and older mothers might respond to the reforms by working more, it could be different to work more from a basis of not working than from already being attached to the labor market. We look at the following outcomes for the mother: How many years she received transitional benefits when the child was aged 6-10 (maximum 5 years). How many years she was in the labor force when the child was aged 6-10, and how many years she worked full-time. Years of ongoing education when the child was aged 6-10, average yearly earnings when the child was aged 6-10, and average yearly payments of transitional benefits when the child was aged 6-10. Finally, we measure average yearly income when the child was aged 6-10. The results are shown in Table 4, for younger mothers (panel A) and older mothers (panel B), separately. First, we focus on the younger mothers and the effects for the fully treated cohorts (column 3). We see that single mothers in the untreated cohorts received, on average, transitional benefits for 2.4 years (out of 5 years) when their child was aged 6-10 (column 1). After the reforms,

for the treated cohorts, this dropped by almost an entire year. The single mothers responded to this by increasing their labor market participation, both on the extensive and intensive margin. They worked an additional .25 years from a base of 3.12 years and were more likely to work full time (.19 years from a base of only 1.7 years out of 5 years). There was no response on years of ongoing education for the fully treated cohorts. Turning to earnings and benefits, we see an increase in earnings and a decrease in transitional benefit payments. Finally, we see that there was no effect on income. This means that single mothers were, on average, only able to work exactly enough to offset the loss in benefits, holding income constant. This turns out to be very useful when discussing mechanisms as there was no income effect for the family. We can therefore focus on the time effect - how does it affect children to have mothers more away from home as they work more? In panel B we present the results for older mothers. Basically, the estimates are very similar to the ones for younger mothers. Note, however, that the baseline pre-reform averages are very different. This means that although the families of older single mothers also experienced changes because of the reforms, the changes happened at different margins than for the families of younger mothers. This could be the reason why we do not see negative reform effects for the children of older mothers.[17]

[17]For example, having a mother more away from home if she is already working could be very different from having a mother more away from home with being at home as a starting point.

Table 4. Difference-in-difference estimates of the reforms on mothers' outcomes by mothers' age

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
A: Younger mothers				
Years of trans.benefit take-up	2.41	-0.205***	-0.890***	13,1423
when child is 6-10 (max:5)		(0.030)	(0.029)	[32,607]
Years of work	3.12	0.134***	0.255***	131,423
when child is 6-10 (max:5)		(0.028)	(0.029)	[32,607]
Years of full-time work	1.70	0.112***	0.189***	131,423
when child is 6-10 (max:5)		(0.028)	(0.030)	[32,607]
Years of ongoing education	0.58	0.045***	-0.018	131,423
when child is 6-10 (max:5)		(0.017)	(0.018)	[32,607]
Average yearly earnings	94925	3629***	6012***	131,423
when child is 6-10		(1184)	(1314)	[32,607]
Average yearly trans. benefit payments	21907	-1186***	-7619***	131,423
when child is 6-10		(331.449)	(322)	[32,607]
Average income	121244	2494**	-123	131,423
when child is 6-10		(1085)	(1207)	[32,607]
B: Older mothers				
Years of trans.benefit take-up	1.97	-0.249***	-1.095***	403,554
when child is 6-10 (max:5)		(0.030)	(0.028)	[28,175]
Years of work	3.57	0.071***	0.251***	403,554
when child is 6-10 (max:5)		(0.024)	(0.026)	[28,175]
Years of full-time work	2.46	0.063**	0.191***	403,554
when child is 6-10 (max:5)		(0.027)	(0.029)	[28,175]
Years of ongoing education	0.42	-0.005	-0.039**	403,554
when child is 6-10 (max:5)		(0.015)	(0.016)	[28,175]
Average yearly earnings	134748	3850***	7209***	403,554
when child is 6-10		(1240)	(1439)	[28,175]
Average yearly trans. benefit payments	17100	-1441***	-9197***	403,554
when child is 6-10		(318)	(296)	[28,175]
Average income	156311	2484**	-593	403,554
when child is 6-10		(1151)	(1350)	[28,175]

*Notes: The sample is split such that the younger mothers are aged equal to- or below the median age of single mothers in each respective cohort. Partially refers to mothers of children aged two in 1991-1994, and Fully refers to mothers of children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

B. Pre-reform attachment to the labor market

To dig further into mechanisms, we split the sample of younger mothers in two groups by their pre-reform work status (when child is aged two). In panel A, of Table 5, we present the results for children of mothers not working pre-reform, and in panel B, we present the results for children of mothers working pre-reform. Interestingly, we see negative effects of the reforms for both groups, although the effects for children having a mother working pre-reform are almost double the size. The mechanisms for these two groups are likely to be quite different. This we see in Table 6 where we present mothers' outcomes for these two groups. In panel A, we see no response in the labor market for mothers not working pre-reform. However, they received less transitional benefits, and therefore they experienced a large drop in income. A likely mechanism for the negative effect we observe for the children of non-working mothers is therefore the reduction in family income that they experienced. In panel B, we have a very different picture. Here the mothers were already working pre-reform, and they increased their work amount in response to the reforms. Income increased somewhat (although not significant). The large negative reform effect for the children of these mothers is not consistent with an increase in income. Thus, a likely mechanism here is that these mothers were more away from home after the reforms. Also, the finding that these mothers were more likely to work full-time after the reforms supports the idea that these mothers were less present at home when their children came home from school. Consistent with this, we find stronger negative reform effects on children of younger mothers who worked in sectors where shift-work is overrepresented (the health sector and the hotel industry) compared to other industries (not shown in table). To be able to increase their work load in these shift-work industries, the mothers may have had to work more afternoons and irregular hours after the reforms, causing them to have even less after-school time with their children.

Table 5. Effects by mothers' pre-reform work status -children's school grades, younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
A: Non-work (child 2)				
GPA	3.45	-0.024	-0.073***	57,673
		(0.020)	(0.021)	[22,137]
Written exam	2.93	0.008	-0.056**	54,216
		(0.020)	(0.022)	[20,519]
Oral exam	3.71	-0.032	-0.095***	49,933
		(0.022)	(0.024)	[18,834]
B: Work (child 2)				
GPA	3.66	-0.090***	-0.129***	73,750
		(0.025)	(0.026)	[10,470]
Written exam	3.13	-0.053**	-0.134***	70,834
		(0.026)	(0.027)	[9,922]
Oral exam	3.91	-0.062**	-0.095***	65,771
		(0.028)	(0.030)	[9,164]

*Notes: The sample is split according to the mothers' labor market participation pre-reform (the year the child turns two). Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

Table 6. Effects by mothers' pre-reform work status -mother outcomes, younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
A: Non-work (child 2)				
Years of trans.benefit take-up	2.65	-0.189***	-0.909***	57,673
when child is 6-10 (max:5)		(0.039)	(0.038)	[22,137]
Years of work	2.73	0.055	0.071*	57,673
when child is 6-10 (max:5)		(0.039)	(0.041)	[22,137]
Years of full-time work	1.30	-0.039	-0.054	57,673
when child is 6-10 (max:5)		(0.035)	(0.038)	[22,137]
Years of ongoing education	0.61	0.057**	-0.010	57,673
when child is 6-10 (max:5)		(0.022)	(0.024)	[22,137]
Average yearly earnings	76854	-518	-1528	57,673
when child is 6-10		(1489)	(1711)	[22,137]
Average yearly trans. benefit payments	25297	-796*	-7770***	57,673
when child is 6-10		(447)	(438)	[22,137]
Average income	107476	-1069	-7071***	57,673
when child is 6-10		(1375)	(1579)	[22,137]
B: Work (child 2)				
Years of trans.benefit take-up	1.74	-0.049	-0.554***	73,750
when child is 6-10 (max:5)		(0.052)	(0.049)	[10,470]
Years of work	4.19	0.043	0.106***	73,750
when child is 6-10 (max:5)		(0.038)	(0.038)	[10,470]
Years of full-time work	2.78	0.074	0.176***	73,750
when child is 6-10 (max:5)		(0.052)	(0.054)	[10,470]
Years of ongoing education	0.48	0.031	-0.014	73,750
when child is 6-10 (max:5)		(0.028)	(0.029)	[10,470]
Average yearly earnings	144147	-31	5032**	73,750
when child is 6-10		(2309)	(2445)	[10,470]
Average yearly trans. benefit payments	12672	507	-3383***	73,750
when child is 6-10		(482)	(463)	[10,470]
Average income	158747	516	2044	73,750
when child is 6-10		(2153)	(2295)	[10,470]

*Notes: The sample is split according to the mothers' labor market participation pre-reform (the year the child turns two). Partially refers to mothers of children aged two in 1991-1994, and Fully refers to mothers of children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

C. More evidence that time matters

If time is the mechanism for the strong negative effects we find for children's school grades, access to networks that can help mothers to take care of children after school might be very important. In table 7 we see a much stronger effect if there is no grandparents living close (on both mother's and father's side). We find similar effects if we only condition on having grandparents on mother's side living close.

Table 7. Effects by access to network (grandparents) -younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
At least one grandparent live close (both father's and mother's side)				
GPA	3.49	-0.038**	-0.052***	106,035
		(0.016)	(0.017)	[27,298]
Written exam	2.97	0.004	-0.034*	100,894
		(0.017)	(0.018)	[25,490]
Oral exam	3.75	-0.035*	-0.051***	93,352
		(0.018)	(0.020)	[23,424]
No grandparents live close (both father's and mother's side)				
GPA	3.57	0.006	-0.135***	25,388
		(0.038)	(0.039)	[5,309]
Written exam	3.08	0.014	-0.132***	24,156
		(0.039)	(0.041)	[4,951]
Oral exam	3.85	-0.018	-0.129***	22,352
		(0.042)	(0.044)	[4,574]

*Notes: The sample is split into mothers who live in the same municipality as at least one of the grandparents of their child (both mother's and father's side) when child is two, and mothers who do NOT live in the same municipality as at leat one of the grandparents of their child (both mother's and father's side) when child is two. Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

One source to which mothers are important in the after-school time is through help with homework. In Table 8 we see stronger effects at the top of the grade distribution. This is consistent with mothers having less time and energy for after school care as it is less likely that lower ability students will get parental help with homework anyway (Hill and Tayler, 2004).

Table 8. Effects on educational distribution -younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
GPA above 2	0.97	0.003	0.001	131,423
		(0.003)	(0.003)	[32,607]
GPA above 3	0.70	-0.016**	-0.016**	131,423
		(0.007)	(0.007)	[32,607]
GPA above 4	0.27	-0.006	-0.026***	131,423
		(0.007)	(0.008)	[32,607]
GPA above 5	0.02	-0.007***	-0.019***	131,423
		(0.003)	(0.003)	[32,607]

*Notes: Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

D. Other potential mechanisms

We define treatment (single) and control group (married) when the child is aged two, while we study mothers' outcomes when the child is aged 6-10. This means that mothers could have changed single status as a response to the reforms by the time we measure their outcomes. Another response to the reforms could be to have more or fewer children. By having another child, single mothers may remain eligible for transtional benefits also after the reforms. From Table 9 we see that there is no effect of the reforms on changing single status. Our estimates are therefore not driven by single mothers being more likely to remarry. However, there is some evidence that the reforms affect fertility. If having more siblings have a negative effect on the child's school grades this could be part of the mechanism. However, Black, Devereux and Salvanes (2005) do not find a relationship between family size and educational attainment. Also, remember that in the robustness test using a sample without younger siblings, we still find negative reform effects (although conditioning on number of younger siblings might be endogenous to the reforms so we have to be careful).

Table 9. Effects on single status and fertility -younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
Single when child is 10	0.50	-0.010	-0.010	127,232
		(0.008)	(0.008)	[31,087]
No. children when child is 10	2.13	0.026**	0.047***	131,423
		(0.013)	(0.013)	[32,607]

*Notes: Mothers with uncertain status (neither single nor married) when child is aged 10 are excluded in the single status analysis. Partially refers to mothers of children aged two in 1991-1994, and Fully refers to mohters of children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

E. Comparisons to other studies

Are the negative effects we find for children's school grades large or small? To look into this, we compare our estimates with other studies that have also looked at time vs income mechanisms. Dahl and Lochner (2012) study the effect of increased income on children's test scores using EICT (Earned Income Tax Credit) reforms in the US. They find that a $1000 increase in income increases math and reading test scores by 6% of a standard deviation. For the group of younger mothers who are not working pre-reform, we also interpret the mechanism for negative reform effects as an income effect and our estimate is very similar to Dahl and Lochner (2012): A 7700 NOK (approx. $1300) decrease in income corresponds to a 7% of a standard deviation reduction in school grades. Bettinger, Hægeland and Rege (2014) looks at the effects on school grades of having mothers more at home when the children are around 10 years old, using a reform in Norway (cash-for-care) giving mothers incentives to stay more at home with younger children (indirectly affecting older siblings). They find that a 3% points drop in labor force participation of mothers when the child is 10, increases GPA by 3% of a standard deviation. Our estimate for the group of children where time is a likely mechanism (mothers working pre-reform) is around 10% of a standard deviation. For this group, we see an increase in mothers working full-time when the children are aged 6-10 corresponding to an estimate of about 2-3% points. Thus, our school grade estimates are in the same range, though somewhat larger compared to their findings. However our measure of working full time is not the same.

How to relate the positive findings in Miller and Zhang (2009, 2012) to our finding of negative effects for a subgroup of younger mothers? They find an overall effect around 5-10% of a standard deviation in math test scores in fourth grade. They cannot link their data to mothers' responses and thereby dig into mechanisms - it is therefore hard to directly compare their studies to our study.

However, there are other studies from the US suggesting that the US reform was more successful than the Norwegian reform in increasing income and getting single mothers out of poverty. As we do not find positive income effects of the Norwegian reform in our total sample, finding no effects for the children in the total sample is consistent with the positive findings for children in the US if income is a likely mechanism. Our result of negative effects for children of mothers who were worse off by the reforms is therefore a likely scenario also for subgroups facing negative income effects in the US.

VII. Conclusion

Investigating the effects of a work-encouraging welfare reform targeted at single mothers in Norway, we find that, for the majority, the educational performance of single mothers' children were unaffected. However, children of younger single mothers compared to children of younger married mothers perform relatively worse in junior high school after the reform. Using the rich administration data available, we disentangle the likely mechanisms through which this negative effect may work. For children of younger single mothers working pre-reform, the likely mechanism is that mothers are more away from home as they now increase their time in the labor market. This implies that the alternative care for these children (after-school care, unsupervised time at home or informal networks) is not a perfect substitute for mothers' time. For children of younger single mother with low attachment to the labor market pre-reform, the likely mechanism is a reduction in income as these mothers are not able to work enough to offset a big drop in welfare benefits.

Taken together, our results have important implications for the full evaluation of welfare programs targeted at single mothers. Policy makers should take into account the potential negative effects on child development. Encouraging single mothers to work could still be a positive policy, however, policy makers then need to ensure that there are good substitutes to maternal time at home. An interesting avenue for future research is whether work-encouraging welfare reforms effect mothers health. For instance, difficulties combining work with having the sole responsibility for children could affect the mother's health and levels of stress which in turn could influence the child (Berger, Hill and Waldfogel, 2005). For this paper, we do not have access to health data so we cannot study this potential mechanism.

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Appendices

Table A.1. Pre-reform characteristics of mothers

Means (Sd)	(1) Single mothers	(2) Married mothers	(3) Younger single	(4) Older single
Age	27.01	30.55	22.96	31.69
	(5.45)	(4.84)	(2.10)	(4.25)
Years of education	10.74	11.87	10.38	11.18
	(1.75)	(2.22)	(1.28)	(2.10)
Work	0.42	0.71	0.32	0.54
	(0.49)	(0.45)	(0.47)	(0.50)
Earnings NOK(1998)	61,294	111,068	39,016	87,077
	(79,280)	(89,872)	(56,806)	(92,869)
Number of children	1.56	2.10	1.28	1.87
	(0.84)	(0.98)	(0.53)	(1.0)
Teenage mother	0.14	0.02	0.26	0
	(0.35)	(0.12)	(0.44)	0
Non-Norwegian	0.05	0.07	0.04	0.07
country of birth	(0.22)	(0.25)	(0.19)	(0.25)
Take-up transitional benefits	0.70	0.02	0.80	0.58
	(0.22)	(0.25)	(0.40)	(0.49)
Divorced/widowed	0.20	0.03	0.07	0.35
	(0.40)	(0.17)	(0.26)	(0.48)
At least one grandparent	0.75	0.67	0.84	0.66
live close	(0.43)	(0.47)	(0.37)	(0.47)
(both father's and mother's side)				

Notes: The sample is split such that the single mothers are not married nor cohabiting with the father of any of their children when the child turn two years old. The sample is further split such that the younger mothers are aged equal to- or below the median age for single mothers in each respective cohort. Characteristics are measured the year the child turns two years old. Mothers take-up shares of transitional benefits are calculated for the cohorts aged two in 1992-1997 (data available from 1992). 100 NOK equals approx. 14 EUR and 17 USD.

Table A.2. Matched sample -younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
GPA	3.51	-0.037*	-0.082***	61,575
		(0.019)	(0.020)	[32,607]
Written exam	2.98	-0.008	-0.081***	58,008
		(0.019)	(0.021)	[30,441]
Oral exam	3.77	-0.034	-0.092***	53,622
		(0.021)	(0.022)	[27,998]

*Notes: Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

Table A.3. The role of control variables -younger single mothers

		Baseline		No control variables		Only education, earnings and age controls		
	(1)	(2)	(3)	(4)	(5)	(8)	(9)	(10)
Dependent variable	Mean singles untreated	ITT Partially	ITT Fully	ITT Partially	ITT Fully	ITT Partially	ITT Fully	No of obs. [singles]
GPA	3.51	-0.031**	-0.069***	-0.051***	-0.129***	-0.030*	-0.079***	131,423
		(0.015)	(0.016)	(0.016)	(0.017)	(0.016)	(0.016)	[32,607]
Written exam	2.98	0.007	-0.052***	-0.006	-0.095***	0.007	-0.060***	125,050
		(0.015)	(0.016)	(0.016)	(0.017)	(0.016)	(0.017)	[30,441]
Oral exam	3.77	-0.032*	-0.066***	-0.042**	-0.107***	-0.030*	-0.073***	115,704
		(0.017)	(0.018)	(0.017)	(0.018)	(0.017)	(0.018)	[27,998]

*Notes: Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included in baseline specification: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

Table A.4. Alternative samples -younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
A: No younger siblings (while child<16)				
GPA	3.53	-0.015	-0.074***	59,480
		(0.025)	(0.026)	[12,340]
Written exam	3.02	0.008	-0.054**	56,446
		(0.025)	(0.027)	[11,480]
Oral exam	3.82	-0.035	-0.083***	51,904
		(0.028)	(0.029)	[10,468]
B: Teenage mothers excluded				
GPA	3.55	-0.025	-0.062***	115,485
		(0.018)	(0.018)	[24,092]
Written exam	3.04	0.002	-0.066***	110,072
		(0.018)	(0.019)	[22,485]
Oral exam	3.81	-0.017	-0.044**	101,905
		(0.020)	(0.021)	[20,695]
C: Norwegian born mothers only				
GPA	3.51	-0.012	-0.045***	122,181
		(0.015)	(0.016)	[30,900]
Written exam	2.99	0.024	-0.032*	116,254
		(0.015)	(0.017)	[28,845]
Oral exam	3.77	-0.018	-0.049***	107,587
		(0.017)	(0.018)	[26,549]
D: Alternative age split mothers <=26 years (child 2)				
GPA	3.52	-0.030**	-0.044***	133,189
		(0.014)	(0.016)	[32,802]
Written exam	3.00	0.004	-0.034**	126,706
		(0.014)	(0.016)	[30,631]
Oral exam	3.78	-0.031**	-0.050***	116,947
		(0.016)	(0.018)	[28,148]

*Notes: Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

Table A.5. Treatment by year of birth -younger single mothers

	Dependent variable		
	(1)	(2)	(3)
Linear treatment	GPA	Written exam	Oral exam
2003*Single mother	0.024	0.019	0.002
	(0.030)	(0.030)	(0.034)
2004*Single mother	0.001	0.014	-0.006
	(0.029)	(0.030)	(0.033)
2005*Single mother	0.011	0.018	-0.034
	(0.029)	(0.030)	(0.033)
2006*Single mother	-0.011	0.051*	0.011
	(0.028)	(0.029)	(0.031)
2007*Single mother	-0.046	-0.001	-0.086***
	(0.028)	(0.029)	(0.032)
2008*Single mother	-0.041	0.003	-0.024
	(0.029)	(0.029)	(0.033)
2009*Single mother	-0.069**	-0.039	-0.049
	(0.028)	(0.029)	(0.032)
2010*Single mother	-0.055*	-0.035	-0.084**
	(0.028)	(0.029)	(0.033)
2011*Single mother	-0.056**	-0.050*	-0.071**
	(0.029)	(0.030)	(0.032)
No of obs.	131,423	125,050	115,704

*Notes: 20XX*Single mother (interaction terms between cohorts aged 16 in year 20XX and having a single mother) measure yearly treatment effects relative to year 2002 (children aged two in 1988). Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

Table A.6. Linear treatment -younger single mothers

Dependent variable	(1) Mean singles untreated	(2) ITT Linear	(3) No of obs. [singles]
GPA	3.51	-0.011***	131,423
		(0.002)	[32,607]
Written exam	2.98	-0.010***	125,050
		(0.003)	[30,441]
Oral exam	3.77	-0.011***	115,704
		(0.003)	[27,998]

*Notes: The linear treatment variable is an interaction variable between a coutning variable which takes the value 0 for children aged two in 1988-1990, the value 1 for children aged two 1991,..., and 7 for children aged two in 1997, – and the indicator variable for being a single mother. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

Table A.7. Placebo test -mothers earning more than treshold for receiving transitional benefits pre-reform (child 2)

Dependent variable	(1) Mean singles untreated	(2) ITT Partially	(3) ITT Fully	(4) No of obs. [singles]
GPA	4.06	0.065*	0.037	85,392
		(0.036)	(0.037)	[4,733]
Written exam	3.61	-0.008	-0.007	82,777
		(0.040)	(0.042)	[4,529]
Oral exam	4.42	0.027	-0.016	76,568
		(0.039)	(0.041)	[4,152]

*Notes: The treshold for receiving transitional benefits pre-reform was about 195 000 NOK in 1998 prices. Partially refers to children aged two in 1991-1994, and Fully refers to children aged two in 1995-1997. Controls included: child's gender, number of siblings, and mother's age, years of education, non-Norwegian country of birth, regional labor market of residence, earnings and labor market participation. Robust standard errors in parenthesis. *p<0.10, **p<0.05, ***p<0.01.*

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