Higher and Higher?
Can Cheaper Day Care Spur Female Labour Supply, when Supply is Already High?

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Abstract

This paper analyses the impact of reduced childcare costs on mothers' labour supply. We exploit potential exogenous variation in childcare prices induced by a public childcare price reform in 2006. The reform set a maximum level on what municipalities could charge for a fulltime slot. The reform led to a large reduction in childcare prices. The main question we ask is whether cheaper childcare can be an effective tool to spur mothers' labour supply in an environment where the female labour supply is already high. To answer this question we develop a triple difference approach especially suitable when evaluating reforms that are equally nationwide accessible to all mothers. The results show that the decrease in childcare prices led to a rise in mothers labours supply. The reform seems to have affected the participation decision, while working hour among working mother seem to have been almost unaltered. This result is in line with international studies suggesting that labour supply is more elastic on the extensive margin, than on the intensive margin. The results are robust along several sensitivity checks.

JEL classification: J13, J18, J22

Keywords: Labour supply, childcare costs, difference-in-differences-in-differences.

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1. Introduction and background

In an international context, Norway stands out as a country with an ambitious and generous public family policy OECD 2009). Subsidised childcare is one important part of this policy. Through subsidised childcare the ambition is to meet two goals: to supply parents with small children childcare of high quality at reduced costs, and to enable parents with small children to reconcile care and employment-related tasks.

The modern public family policy for childcare facilities started in the mid 1970's, with a rapid expansion of the number of childcare slots. From 1975 till 1985 the childcare coverage rate increased from approximately 10 per cent till approximately 40 per cent. During the same period the employment level of women increased considerably, from approximately 40 per cent to approximately 73 per cent in 1985, and further to approximately 83 per cent in 2008, and almost on par with men (88 per cent). In an international context the female labour market participation rate is very high in Norway. Together with Denmark and Sweden Norway has the highest female employment rate in the OECD area (OECD 2008).

The main question we ask in this paper is whether reduced childcare costs in such an environment –where female labour supply is already high - is an effective tool for increasing labour supply among mothers even further. To answer this question we exploit exogenous variation in the eligibility to reduced child care costs introduced by the introduction of public policy. Historically, municipalities in Norway have been free to set their own prices. This created in a large between municipality variations in prices. Partly as a consequence of the large variation in prices and the political ambition to decrease childcare costs for all, an important childcare reform was introduce in 2003 (Innst. S. nr. 50). The reform had two main objectives: to reduce childcare prices and to increase child care coverage. The price reform were introduced in two steps: in April 2004 a cap on the price the municipality could charge parents was set to 2750 Norwegian kroner (NOK) per month for a full time slot

(approximately 340 Euro). From January 2006, the cap was further reduced to 2250 NOK per month for a full-time slot. An integrated part of the reform was that the local governments were to improve child care coverage such that all families that wanted a childcare slot should be offered one. The combined result of the reform was a fall in childcare costs and a rise in capacity.[1]

There is a substantial economic literature that have analysed the importance of childcare costs on female labour supply (see for example, Blau and Robbins 1988, Ribar 1992; Connelly 1992, Averett et al. 1997, Connelly and Kimmel 2000, Blau and Tekin 2001, Gelbach 2002, Blau 2003, Baker et al. 2005, Schlosser 2006, Piketty 2005, and Lefebvre and Merrigan 2008). Despite the large number of analyses, there is considerable uncertainty about the magnitude of the maternal employment with respect to the price of child care (Blau 2003, Balu and Currie 2006). Blau (2003) concludes that one important reason for the large difference in results is differences in methodology and econometric modelling. One key problem identified in Blau (2003) is the use of household expenditure in day care when analysing the importance of child care costs. Even though several studies use selection corrected models, the identification is based on exclusion restrictions that can be questioned. Our "answer" to this critique is to use a natural experiment approach and exploit potentially exogenous variation in the eligibility to reduced child care costs.

Regarding studies using a natural experiment set-up, some recent studies are particularly relevant. Berger and Black (1992) analyse the impact of childcare subsidies on the labour supply of low-income mothers in the U.S. They find that single mothers that received subsidy were more likely to be employed. Subsidies did not seem to have an impact

[1] Initially, the reform was set up in a even more ambitious manner. The cap should be set to 2500 NOK by May 2004, and reduced further to 1500 NOK in 2005. Full coverage rate should be met during 2005. Public economic constraints and dispute over the timing of capacity rise versus price decrease hampered the process. In addition, the four parties that agreed on the reform were not part of the government at the time, and the government (which was a minority government) had as its goal to ensure a high capacity before prices were reduced to the full, and even though the capacity increased considerable from 2003 and onwards it did not quit reach up to the speed that was intended.

on hours worked. Baker et al. (2008) analyse the introduction of a subsidized universally-accessible childcare in Quebec in the late 1990s on mothers' labour supply. They find the labour supply effect to be highly significant. Lefebvre and Merrigan (2008) exploit the same natural experiment in the province of Québec in Canada to analyse the impact of reduced childcare costs on mothers' labour supply. The results show that the policy had a large impact on labour market participation of mothers with preschool children. Schlosser (2006) uses Israeli data to analyse the impact of free public preschool for children aged 3 and 4 on Arab mothers' labour supply and fertility. Regarding labour supply she finds that as a result of the reform Arab mothers labour supply increased sharply. In a study from France, Piketty (2005) analyses the impact of parental home care allowance for mothers giving birth to a third child who also decide to interrupt work (full-time or part-time) for up to three years. In 1994, the programme was extended to mothers giving birth to second child. The results show that for a second child born after July 1994, labour market participation of eligible mothers fell by between 11 and 19 per cent. Lundin et al. (2008) use a difference-in-differences regression matching estimator to evaluate the effect on female labour supply of a childcare price reform introduced in 2002, whereby a cap on childcare prices depending on family type. The analyses show no effect of the reduced childcare prices on labour supply, something which is interpreted as a suggesting that in a well developed and highly subsidised childcare system, further reductions seem to have a insignificant impact. Finally, Havnes and Mogstad (2009) use Norwegian data and analyse the impact of a large expansion in child care coverage in Norway in the 1970's on maternal employment of mothers. The group under study is mothers of children aged 3 to 6. Using a difference-in-differences approach they find no effect of the increased capacity on maternal employment. The results suggest that the new subsidized child care crowds out informal child care arrangements.

We contribute to this literature in several ways. Firstly, we procure further evidence on the relationship between childcare costs and labour supply exploiting a unique natural experiment generated from a public family reform which enables to identify the impact of the reform. Secondly, we use high quality panel register data with consistent information across a set of different data sets expected to increase the reliability of results. The panel data covers several years enabling us to perform tests for possible different pre-reform trends. A test that Meyer (1995) stresses as a very important one. Thirdly, we present evidence from a labour market environment where the labour market participation rate of women is already very high and for that reason believed to be more difficult to influence. Even though European evidence on the impact of childcare costs exists, the field is still dominated by studies from US and Canada. More studies from European countries characterised by a different institutional and family policy set up is needed. Together with Sweden and Denmark Norway rank on top among the OECD countries (OECD 2008). A question we ask in this paper is whether reduced childcare costs in such an environment can be an effective tool to spur female labour supply even higher. Finally, we use a triple difference DDD approach, which is very suitable when evaluating the effects of reform in countries where most reforms are nation wide as equally accessible for all.

Our econometric results support the hypothesis that reduced prices of child care slots has a positive impact on mothers' labour supply, as measured by their labour market participation. The size of the effect is in the range of 3-4 percentage points, or approximately 5 per cent. We find only small effects on hours worked, given participation. This result is in line with results suggesting that that stimulating economic incentives through reduced child care prices is more effective on the intensive margin (see e.g. Berger and Black 1992).

Prior to the reform Kornstad and Thoresen (2007) used a micro based simulation model and predicted that the reform would lead to an increase in mothers' labour supply of

approximately 8 per cent. We present results that are on the lower bound of this prediction. There are at least two possible explanations to this discrepancy: First, our study is based on realised choices, rather than expected choices. Secondly, the prediction in Kornstad and Thoresen (2007) are based on the initial proclaimed political reform which involved a maximum price of 1500 NOK and full coverage by 2005, i.e. a much more ambitious reform

The paper proceeds as follows. The next section contains a presentation of public childcare policy in Norway in general, and the childcare policy in particular. Section 3 presents the data, the sample and the variables. Section 4 presents the methods and the identification strategy. Section 5 presents the results, and section 6 concludes.

2. Publicly provided child care and the reform

2.1 The reform

Norway has a tradition of having rather generous family policy programmes. Long paid parental leaves and subsidised child care facilities are two important examples of such generosity. Since 1993, all working parents in Norway are entitled to 52 weeks' parental leave with 80 per cent wage compensation (alternatively 42 weeks with full compensation). To be entitled to parental leave the mother has to have worked at least 6 of the last 10 months. To increase the involvement of fathers in household responsibilities, an amendment in 1993 entitled four weeks' of the parental leave exclusively for the fathers. These weeks are not transferable to the mother which means that they are lost if the father does not use them.

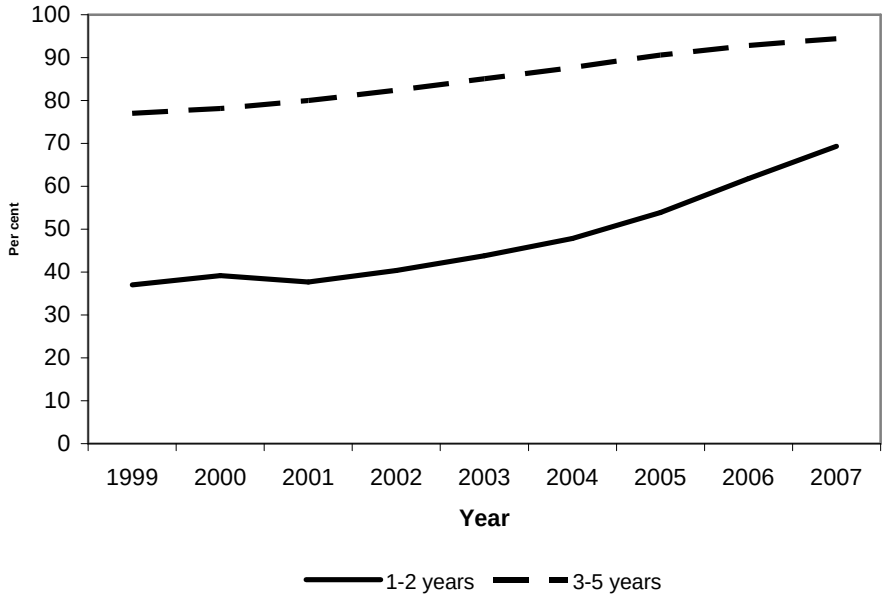
Common for most of the family programmes is that they aim to improve work incentives for parents (see e.g. Rønsen and Sundstrøm 1996). The generous parental leave schemes have, for instance, payments tied to previous employment and guarantee return to your old job after the leave. Such a system gives young women incentives to start their labour market career before giving birth and starting a family. This, in turn, may give them a stronger

attachment to the labour market and a specific job, and ease their later re-entry into the labour market.

Child day-care centres in Norway are publicly or privately owned. As long as they are publicly approved, however, both types receive public subsidies. Roughly 50 per cent of the market consists of private day-care centres. The costs of a publicly approved day-care centre are shared between the state, the municipality and the parents. Historically, subsidised child care has been rationed in Norway, mainly due to economic shortfalls in the local municipalities. However, the coverage rate has increased considerably during the last two decades, with a remarkable lift after the shift of the millennium. The increase in the coverage rate together with the reduction in childcare prices were the main goals of the so-called "Child day-care centre agreement ("Barnehageforliket") reached in spring 2003, by broad political consensus (Innst. S. nr. 50200-2003). The idea was that neither private economic conditions nor lack of day-care slots should prevent families from using formal child care, hence increasing the families' freedom of choice regarding child care mode.

Regarding reduced childcare prices the first cap of 2750 NOK (approximately 340 Euro) per month for a full time slot was set in April 2004. From January 2006, the cap was further adjusted to 2250 NOK per month for a full-time slot. Parallel to these reductions in day-care prices there was a large increase in the capacity of day-care slots. This was due to the second part of the reform which imposed all municipalities to offer day-care slots to all parents with children in age range 1-5 that wanted one. Figure 2.1 shows the development in coverage rate for 1-2 years olds and 3-5 year olds in the period 1999-2007.

Figure 2.1. Fraction of children attending publicly provided childcare



As figure 2.1 shows the share of children attending publicly subsidized day-care centres has increased steadily since 2001. Even though the coverage rate has not increased as rapidly as initially intended (the proclaimed goal was full coverage by 2005), when the cap of 2250 was set in 2006 the coverage rate was increasing from an already high level, particularly for age group 3-5 years old.[2]

From Statistics Norway, information is available on the development in the price of full-time day-care slots in 109 of the 439 Norwegian municipalities in the period 2003-2006. The sample is drawn so as to capture the diversity of municipalities. The system in Norway is such that municipalities are free to vary day-care prices according to the income level of the household. The municipalities operated with three income brackets: 250.000, 375.000, and

[2] Coverage rate is the share of children in a given age with a slot in a day-care centre, and this is the standard measure of childcare coverage. However, it says nothing about the number of children who actually demand and are offered a slot. Waiting lists give a good indication of how much supply meets demand. A domestic analyses by Asplan Viak (2006) shows that by September 2006, 6.2 per cent of all children in age group 1-5 applied but were not offered a slot in a day-care centre, of which 11 per cent were less than 1 year old, 67 per cent were in age group 1-2 years old and the remaining 22 per cent were 3 years old or older. The survey shows a clear relationship between the size of the municipality and the share of children in a waiting list, such that the bigger the municipality the more children not receiving an offer.

500.000 or more. Figure 2.2 shows the distribution of monthly child day-care prices for a full-time slot in 2003, 2004, 2005, and 2006 for a household with 375.000 NOK in yearly income.

Figure 2.2. Distribution of monthly child day-care costs

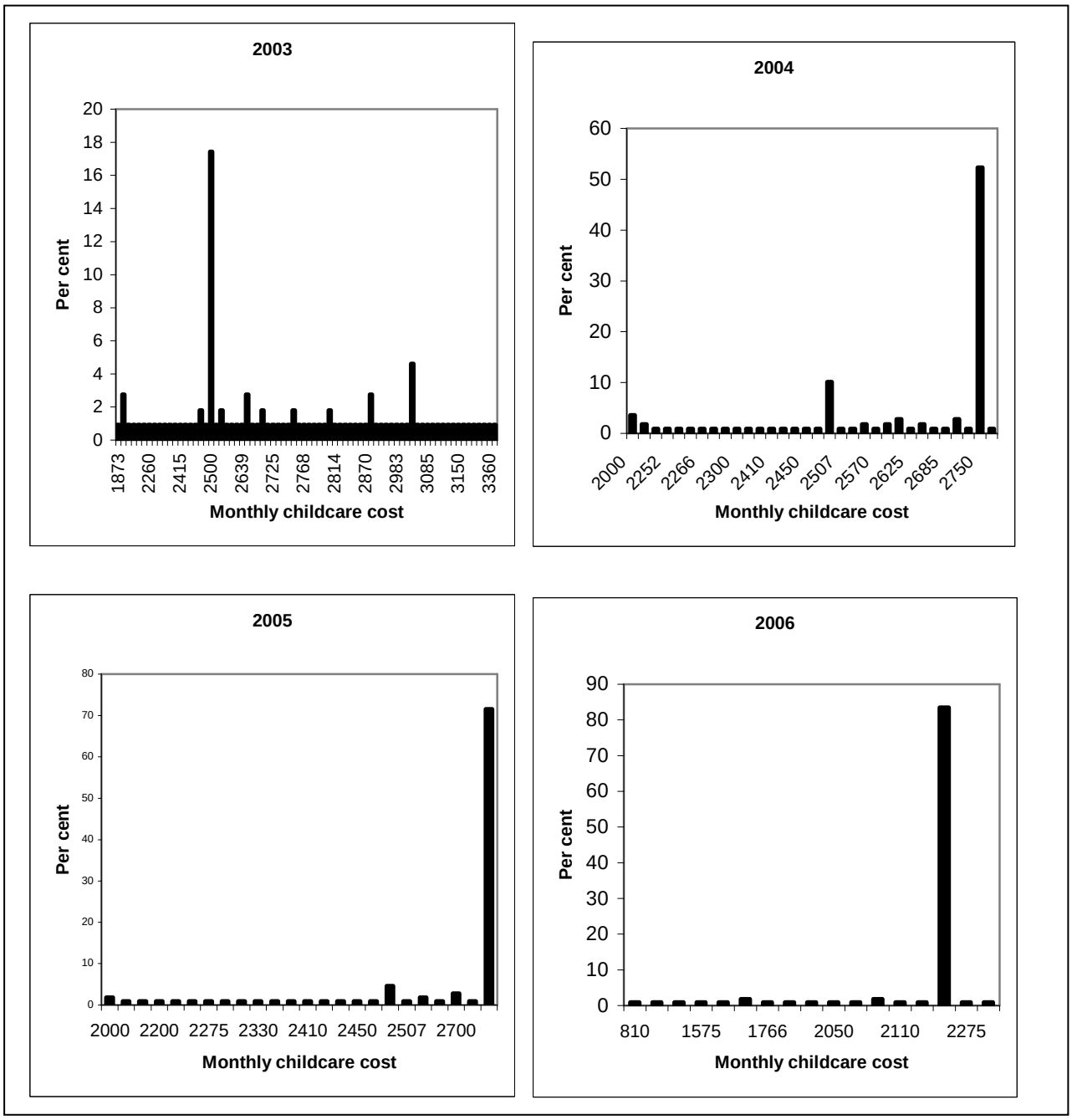
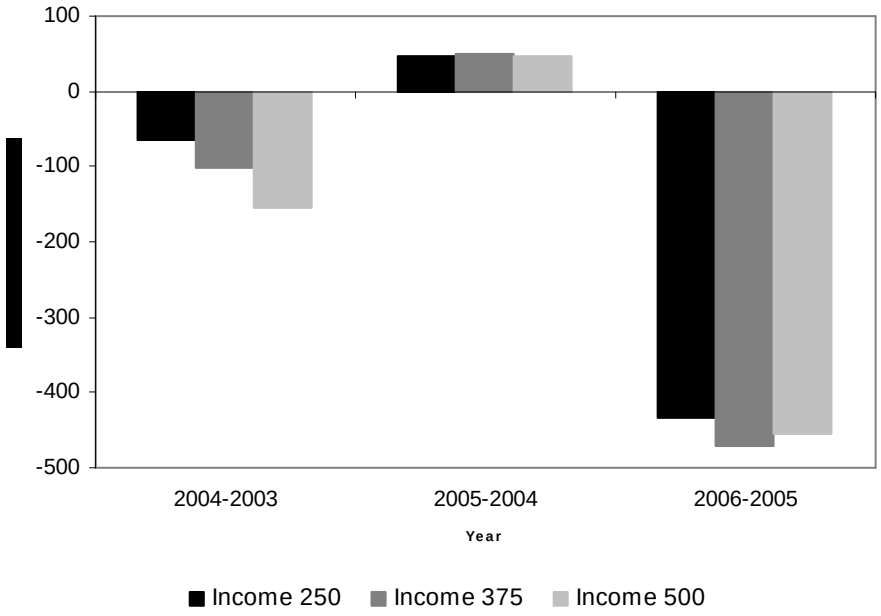


Figure 2.2 shows that prior to both reforms there was more variation in the price of day-care slots across municipalities. After the introduction of the maximum price (MP) guarantee

however, the vast majority of municipalities chose the cap as their monthly price. In 2006, 85 per cent of the sample communities chose the 2250 NOK cap.

Figure 2.3 shows the change from one year to the next in the average monthly price for a full-time day-care slot.. We present the change for all three income brackets; 250.000; 375.000, and 500.000.

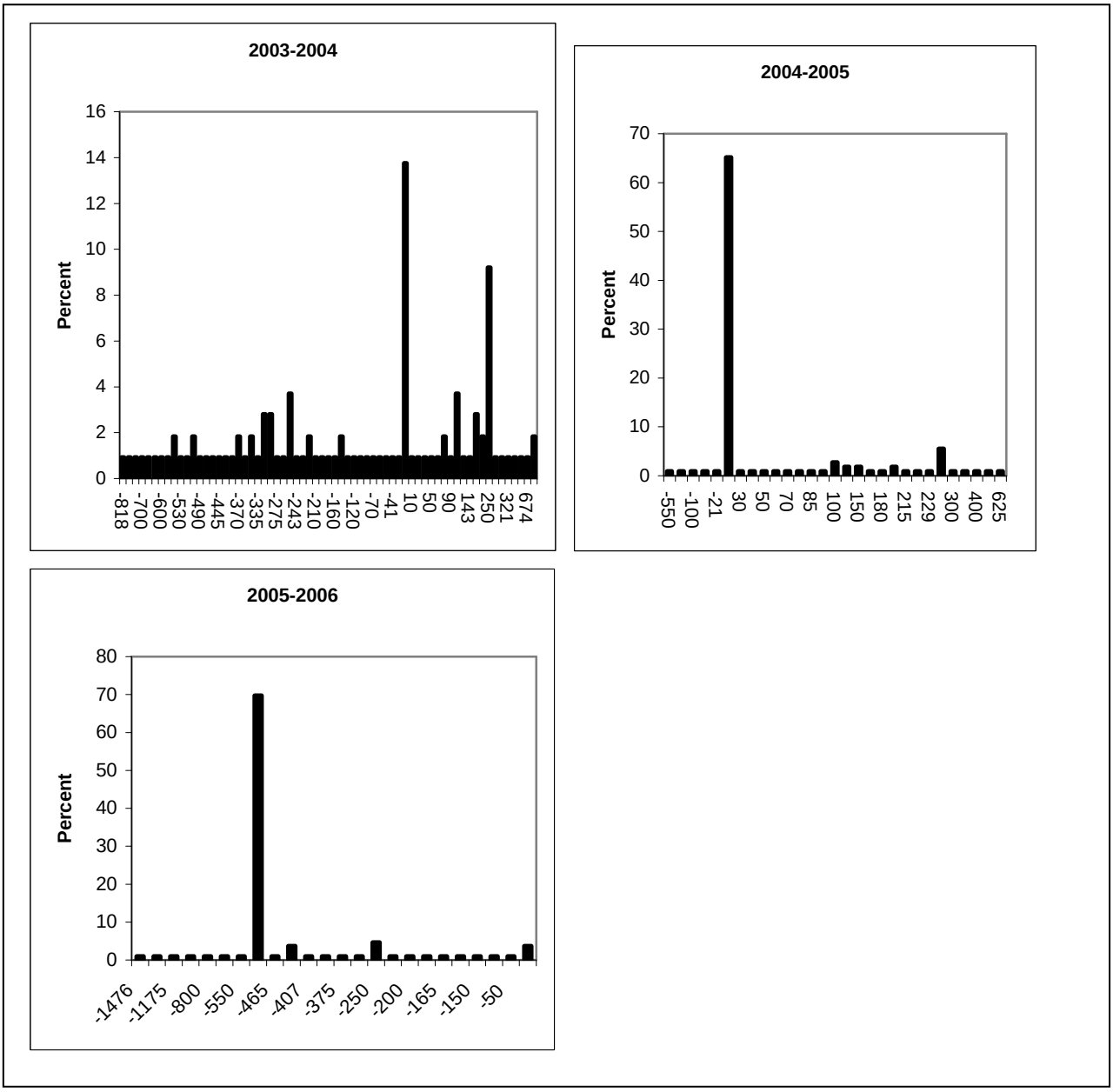
Figure 2.3. Mean monthly change in day-care costs between pair of years. In Norwegian kroner



As figure 2.3.clearly shows it is mainly the 2006 reform that has resulted in any significant price reduction. Between 2005 and 2006 the average price reduction is between 400 and 500 NOK per month. Measured relative to the average price in 2005 this equals a reduction of approximately 20 per cent.

Figure 2.4 shows the distribution of the price change between the same pair of years as in figure 2.3 for income bracket 375.000 NOK. Between 2003 and 2004 there is a greater dispersion in the distribution of price changes compared to the change from 2005 to 2006: 70 per cent of households in the 375.000 income bracket experienced a reduction in day-care cost of 500 NOK, which was the sum necessary to reach the new cap of 2250 NOK in 2006.

Figure 2.4. Distribution of the price change in monthly child day-care costs from 2004 to 2006. Income bracket 375.000 NOK

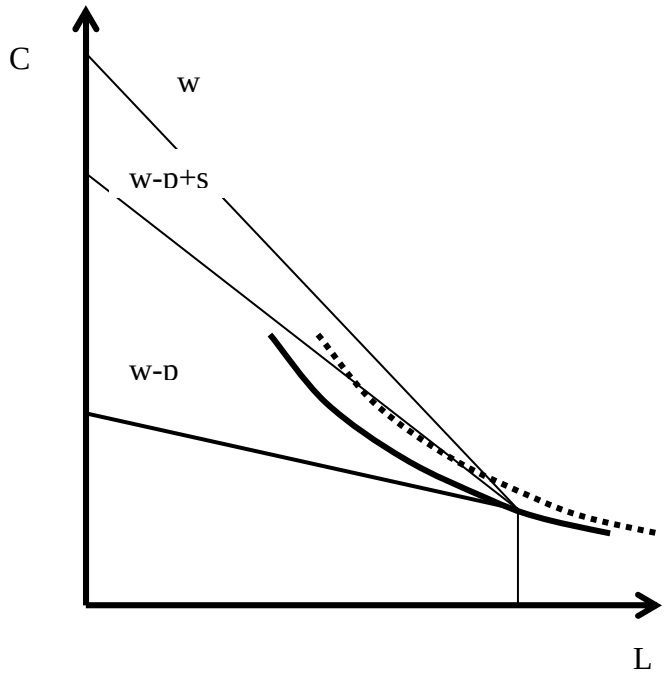


2.2. Work incentives and the MP-reform

To motivate the empirical analyses we can illustrate the impact of the reform on mothers' labour supply within a simple neoclassical model of labour supply (see for instance Blau 2003 for a more elaborate presentation). We assume that the mother is the caretaker, and that childcare is homogenous in quality. Childcare can be bought at a market price p NOK (which the mother takes as given) per hour of care per child. While the mother works she cannot care

for the child, so one hours of work implies one hour of childcare (we assume that there is no informal childcare available). According to standard theories of labour supply, the mother will adjust her labour supply such that she maximises the value of consumption (C) and leisure (L), that is U(C, L), subject to a budget constraint. The budget constraint is: c=I=y+(w-p)h, where c is consumption expenditure other than childcare, I is income net of childcare expenditure, y is nonwage income, w is hourly wage, and h is hours of work. The childcare cost p reduces the net wage by (w-p). The childcare costs make the slope of the budget line less steep, compared to a situation where childcare was free (w). This is illustrated in Figure 2.5.

Figure 2.5 Childcare prices and labour supply



When childcare prices are high this will increase the chance that the net wage is below the reservation wage, and the mother will not support labour, as shown in Figure 2.5. If a linear childcare subsidy (s) is introduced, net wages is increased to (w-p+s). This makes the budget line steeper compared to the situation without subsidies. In Figure 2.5 the subsidy would be

large enough to induce the mother to enter the labour market, illustrated by the dotted indifference curve. For mothers initially not working, reduced childcare costs will only have a substitution effect, pushing in the direction of higher labour supply. For initially working mothers, reduced childcare will have an ambiguous impact on labour supply, as it creates a substitution and income effect, and the income effect goes in the direction of reduced labour supply. In the empirical analyses we distinguish between effects on the extensive margin (participation/no participation) and the intensive margin (working days given participation). Most systems for childcare subsidies are not linear as in the stylised example above. In Norway and in most countries the subsidy is decreasing with income. As a consequence we will get kinks in the budget constraint. This will not however change the general result that cheaper childcare should increase the economic incentive to participate in the labour market.

3. Data and sample

The data set used is gathered from several different registers, collected by Statistics Norway. The starting point is a public demographic register with information on all children born for year to year, as well as information on the mother and the father. The data set contains detailed information on the child's mother regarding spells of employment, non-labour income, work experience, education, place of residence, the presence of older children in the family, marital status and age. If the mother is married we have information on the husband as regards income, age, and educational attainment. Moreover, since our main goal is to analyse the effect of reduced child day-care prices and this reform occurred parallel to improved day-care coverage to isolate the price effect it is important to include information on child day-care coverage in the municipality. Therefore, we include information on child day-care coverage rates for both 1-2 year old and for 3-5 year old children.

Education is measured by four dummy variables: compulsory school, secondary school, university/college degree low level, and university/college degree high level. Non-labour income is measured by capital income. Work experience is measured by the number of years with income above the minimum social security level. Place of residence is measured by a dummy variable that takes the value of 1 if the mother lives in Oslo (the capitol) and 0 otherwise. The presence of older children is measured by two variables: number of children under 6 years, and number of children less than 11 years.

Our two measures of labour supply are a binary measure of labour market participation and a continuous measure of working days. *Labour market participation* is a dummy variable, measuring whether the mother was registered as an employee during the period of observation. *Working days* is a continuous variable measuring the number of full-time equivalent working days during the same observation period. By full-time equivalent we mean that we weight the number of working days with information on working time.[3] Both variables are taken from The Register for Employers and Employees, administered by the National Insurance Administration.

Our four cohorts of mothers are those with children born in 1995, 1999, 2001, and 2005. The reason will become clear in the next section, where the methodology is described. The analyses are restricted to mothers who were between 20 and 45 years of age in the year they became mothers. Furthermore the sample is restricted to mothers who gave birth to their *youngest* child in these years. For all cohorts of mothers, we have panel information for the whole period of observation. This is taken advantage of in the analyses by requiring that, to be included in the analyses, all mothers must be present in both the pre- and post-year periods. In the analyses of working days, we additionally require that all mothers included must be

[3] There are three categories of working time: i) Full-time (30 hours or more per week), ii) Long short time (15-30 hours per week), and iii) Short part-time (less than 15 hours per week). If a worker works full time, she gets weight 1, if she works long part-time she gets weight 2/3, and if she works short part-time she gets weight 1/3.

present with positive working hours in both the pre- and post-year periods. By utilising the repeated observation structure of the panel data, we reduce problems related to composition effects, potentially present in repeated cross-sections samples.

4. Methodological approach

The aim of the empirical analysis is to measure the effect of the maximum price (MP)-reform by identifying changes in labour supply for mothers affected by the reform, and to compare the change in labour supply with the change in labour supply of mothers not affected by the reform.

Since the cap on child day-care prices was made accessible nation-wide to all parents with children of the same age we do not have a natural comparison group. Our strategy in this article is the following: We start by comparing the change in labour supply from 2002 and 2003 to 2006 and 2007 for mothers who gave birth in 2005 (MP-eligible mothers). We choose to use a two year prior window and two year post window. We compare this change with the change in labour supply from the two year window 1999 and 2000 to the two year window 2002 and 2003 for mothers who gave birth in 2001 (mothers not eligible for MP). This implies that we are comparing the change in labour supply from a before to an after-period for similar mothers (mothers with children of the same age) in different time periods. This is a version of the standard difference-in-differences (DD) approach.

However, if some contemporaneous macroeconomic shocks occurred during the period of the introduction of the MP-reform that affected mothers with small children - independent of the introduction of the MP-reform - the DD-estimate will yield biased estimates for the effects of the MP-reform on labour supply. To deal with this problem we compare the change in labour supply for the mothers presented above with the change in labour supply for the same two periods for mothers with *older* children, who are not eligible

for MP-guarantee. This latter group consists of mothers giving birth in 1999 and 1995. If some macroeconomic shock occurred at the same time as the introduction of the MP-reform, we assume this to affect mothers with older children in the same manner as mothers with younger children.

This approach takes into account that the MP-reform, as we evaluate it, creates variation along three dimensions, (1) between mothers with children of different ages, (2) between pre- and post-periods, and (3) between periods with MP-guarantee and periods without MP-guarantee. The identification assumption of this DDD-estimator is that there is no contemporaneous shock that affects the relative outcome of the treatment group (mothers with young children relative to mothers with older children) in the same treatment period as the introduction the MP-reform.

The DDD approach may be illustrated as follows:

$$\begin{aligned} DDD = & \underbrace{\{(Y^{T}_{2007\_2006} - Y^{T}_{2004\_2003})^{\text{gave birth in 2005}} - (Y^{T}_{2003\_2002} - Y^{T}_{2000\_1999})^{\text{gave birth in 2001}}\}}_{DD} \\ & - \underbrace{\{(Y^{C}_{2007\_2006} - Y^{C}_{2004\_2003})^{\text{gave birth in 1999}} - (Y^{C}_{2003\_2002} - Y^{C}_{2000\_1999})^{\text{gave birth in 1995}}\}}_{DD} \end{aligned} \quad (1)$$

The first bracket shows DD-estimates for mothers with young children, called the *treatment group*. First, $(Y^{T}_{2007\_2006} - Y^{T}_{2004\_2003})^{\text{gave birth in 2005}}$ measures the change in labour supply of MP-eligible mothers with young children from 2002 and 2003 to 2006 and 2007. Similarly, $(Y^{T}_{2003\_2002} - Y^{T}_{2000\_1999})^{\text{gave birth in 2001}}$ measures the change in labour supply of mothers *not* eligible for MP, having had young children in 2001. The difference between these two components is the DD-estimate.

To control for calendar effects we run the same exercise in the same period for mothers with older children. The second bracket presents DD-estimates for mothers with older children, called the *control group*. First, $(Y^{C}_{2007\_2006} - Y^{C}_{2004\_2003})^{\text{gave birth in 1999}}$ measures

the change in labour supply from the period 2004-2003 to 2006-2005 of mothers with older children from 1999. Finally, $(Y^{C}_{2003\_2002} - Y^{C}_{2000\_1999})^{\text{gave birth in 1995}}$ measures the change in labour supply of mothers with older children from the pre period 1999-2000 to 2002-2003. The difference between these two components gives us the second DD-estimate. The difference between the two DD-estimates gives us the DDD-estimate. The hypothesis that the MP-reform has increased labour supply is a test of whether the DDD-estimate in equation (1) is positive. In our context, running a familiar DD-estimation would mean leaving out the effect of contemporaneous macroeconomic shocks, i.e. leaving out the contribution from the second bracket in (1).

The world is not a laboratory; it is difficult to find a complete clean experimental environment. In our case the cleanness of the experiment is potentially disturbed by the smaller "pre-reform". The DDD-set up in equation 2.1 contains year 2004 as one of the pre-periods. Mothers with MP-eligible children this year will be treated by the first round of the reform. Even though the 2004-part of the reform had a minor impact on prices (see Figure 2.2 which showed that it is mostly the 2006 reform that matters) we check for the severity of this matter by doing two exercises; first, we carry out a DDD-analysis separately for mothers giving birth to their firstborn child. Doing this we leave out mothers that are affected by the 2004 part of the reform. Secondly, we look for differences in pre trends in labour market participation rates between treatment and control groups. We return to the results from this exercise in the result section.

Treatment and control groups may differ systematically with respect to important labour supply determinants such as education, age, place of residence, the presence of other children in the household and marital status. Observed differences in outcomes may therefore reflect differences between the treatment and control group rather than a treatment effect. To deal with this problem, we run a regression adjusted DDD:

$$
\begin{aligned}
Y_{ijkt} \quad &= \alpha_1 + \alpha_2 Z_{ijkt} + \alpha_3 MP_{ijk} + \alpha_4 POST_{itk} + \alpha_5 TREAT_{ik} \\
&+ \alpha_6 (MP_{ijk} x POST_{itk}) \\
&+ \alpha_7 (MP_{ijk} x TREAT_{ik}) \\
&+ \alpha_8 (POST_{itk} x TREAT_{ik}) \\
&+ \alpha_9 (MP_{ijk} x TREAT_{ik} x POST_{itk}) + \varepsilon_{ijkt}
\end{aligned} \tag{2}
$$

where i indexes individuals, t indexes time (1 = after, and 0 = before), k indexes group of mothers (1 if mother of young children, and 0 if mother of older children), and j indexes MP-status (1 if the period is between 2003 and 2007, 0 if the period is 1999-2003), Z is a vector of variables affecting labour supply, containing individual as well as regional variables. It is important to notice that variables related to day-care coverage are municipality specific and that we have distinct variables for day-care costs for 1-2 and for 3-5 year old children. MP is a dummy variable that assumes the value 1 if the period is the maximum-price period (2003-2007), and 0 if it is not the maximum-price period (1999-2003). POST is a dummy variable that takes the value 1 if the years are 2006 and 2007 (for the MP-group) or 2002-2003 (for the non-MP-group), and 0 if the year is 2003-2004 (for the MP-group) or 1999-2000 (for the non-MP group). TREAT is a dummy variable that assumes the value 1 if the mother has small children (born in 2005 and 2001) and 0 if the mother has older children (born in 1999 and 1995).

The interpretation of the coefficients are as follows; α_3 controls for effects of the MP period, α_4 controls for changes in labour market participation between the before and after period, α_5 controls for effects of the treatment group (mothers with young children), α_6 controls for changes from the before to the after period in the MP period, α_7 controls for characteristics of the treatment group in the MP period, and α_8 controls for changes between the before and after period for the treatment group. Finally, α_9 – the *DDD estimator* – measures the impact of the interaction term between MP, *POST*, and *TREAT*. This

coefficient measures all variation in labour market participation for the MP group relative to the non-MP group, for mothers with young children (treatment group), relative to mothers with older children (control group), between the before and after period.

When testing for the presence of second-order interactions, it is important to also include first-order interactions. If this is not done, the second-order interaction effect will be confounded with the omitted first-order interactions, and this will most likely lead to biased estimates. The key identifying assumption is that $E[\varepsilon_{ijkt} \mid MP\text{xTREATxPOST}] = 0$. This means that there is no correlation between the error term measuring unobservable individual-transitory shocks and the variables measuring the effect of the MP reform. In other words it means that the error term is assumed to be independent of the group indicators measuring the effects of the MP reform.

The identifying assumption implies that there are no contemporary shocks that affect the relative outcome of the treatment group (mothers with young children relative to mothers with older children) in the same treatment period as the introduction of the MP cap. The identifying assumption will be violated if the change in labour market participation between treated and controls evolves differently between periods with and without MP – independent of the introduction of the MP reform.

In general, there are two important assumptions that must be fulfilled when using DD and DDD (Blundell and Macurdy 1999). The first is that time effects in equations (1) and (2) must be common across treated and controls. The second assumption is that the composition of both treated and controls must remain stable before and after the policy change (Blundell and Macurdy 1999). In the next section we present some results from simple exercises trying to shed light on these matters.

A DD approach

The DDD approach as shown above is the main methodological approach we use in this paper. However, to further look into the impact of the MP-reform on labour supply and to include mothers with somewhat older children in the treatment group we supplement the DDD analyses with two DD-analyses. First, we estimate the following DD regression model:

$$Y_{ijkt} = \beta_1 + \beta_2 Z_{ikt} + \beta_4 POST_{it} + \beta_5 TREAT_{ik} + \beta_8 (POST_{it} x TREAT_{ik}) + u_{ikt} \qquad (3)$$

where i indexes individuals, t indexes time, and k indexes group of mothers, Z is a vector of variables affecting labour supply, containing individual and child day-care related characteristics as well as regional variables. In (3) POST is a dummy variable taking the value 1 if the year is 2007 (post MP-period) and 0 if the year is 2005 (Pre MP-period). TREAT is a dummy variable taking the value 1 if the mother has MP-eligible children (age 1-5), and 0 if the mother does not have MP-eligible children (6-8 years). The interaction term between these two variables measures the change in labour supply between the treatment and control group from the pre to the post period. This gives us the DD-coefficient β_8. The identification criterion in (3) is that $E[u_{ikt} \mid \text{TREATxPOST}] = 0$. This means that there is no correlation between the error term measuring unobservable individual-transitory shocks and the variables measuring the effect of the MP reform. The identification criterion implies that there is no contemporaneous economic shock arising at the same time as the introduction of the MP-reform that affects the treatment and control group differently.

A regional DD approach

Finally, we utilize the information on development in childcare prices over time between communities as reported in Figure 2.2-2.4. The information on childcare prices is limited to a sample of communities, and the between community variation in the development in childcare

prices are modest. However, some municipalities have reduced prices more than others as a consequence of the reform. We use the geographical variation to construct treatment and control municipality. We estimate the following equation:

$$Y_{ikt} = \lambda_1 + \lambda_2 Z_{ikt} + \lambda_3 POST_{it} + \lambda_4 TREAT_{ik} + \lambda_5 (POST_{it} x TREAT_{ik}) + v_{jkt} \qquad (4)$$

where i indexes individuals, t indexes time, and k indexes type of municipalities (1 if the municipality has reduced prices a lot, 0 otherwise). Z is a vector of variables affecting labour supply, containing individual and child day-care related characteristics as well as regional variables. We define municipalities that have reduced monthly prices child day-care slots considerably as the *treatment* group (TREAT). The *control group* is municipalities that have reduced the price by less than the treatment group. As in (3) POST is a dummy variable taking the value 1 if the year is 2007 and 0 if the year is 2005. The DD-coefficient is λ_5. Since there are no clear distinction between treatment and control municipalities the distinction must be made on some subjective cut-off rule. Municipalities that have reduced monthly prices child day-care slots by 500 NOK or more are defined as the treatment group. The control group is municipalities that have reduced the price by less than 500 NOK The sample of mothers is now confined to those with children 1-5 years old, i.e., only MP eligible mothers are included. The identification criterion in (4) is that $E[v_{ikt} \mid TREATxPOST] = 0$. This means that there is no correlation between the error term measuring unobservable individual-transitory shocks and the variables measuring the effect of the MP reform. The identification criterion implies that there is no contemporaneous economic shock arising at the same time as the introduction of the MP-reform that affects the treatment and control municipalities differently.

5. Results

This section presents the results. Section 5.1-5.3 contains all the results from the DDD approach, as shown in equation (1) and (2), while section 5.4 contains the results from the DD approach, as shown in equation (3) and (4).

5.1. Descriptive results

Table 5.1 presents descriptive statistics for our two groups: the *treatment group*, consisting of mothers with young children, and the *control group*, consisting of mothers with older children. For both groups, the mean values are taken from the "pre" years.

Table 5.1. Descriptive statistics. Treatment and control group. Mean values. Mean values are taken from the "before"- years

	Treatment group Mothers with young children		Control group Mothers with older children	
	Birth year (observation year)	Birth year (observation year)	Birth year (observation year)	Birth year (observation year)
Variables	2005 (2003)	2001 (1999)	1999 (2003)	1995 (1999)
Work Experience	7.463	7.119	12.761	12.252
Compulsory school	0.186	0.217	0.218	0.281
Secondary education	0.350	0.409	0.436	0.430
University/college – low level	0.345	0.303	0.277	0.236
University/college – high level	0.074	0.058	0.053	0.037
Unknown education	0.045	0.012	0.015	0.016
Married	0.392	0.401	0.611	0.635
Divorced	0.049	0.050	0.109	0.109
Child care coverage rate 1-2 years	44.201	37.430	43.630	37.074
Child care coverage rate 3-5 years	85.158	78.717	85.048	78.601
Number of children under 6 years	0.653	0.656	0.805	0.801
Number of children under 11years	0.873	0.889	1.145	1.133
Capitol (Oslo)	0.156	0.138	0.096	0.097
Capital income	8280.60	5468.170	9116.780	5760.140
Unemployment rate municipality	3.269	2.116	3.208	2.119
N	40340	41492	27546	27134

The length of work experience is naturally longer among the control group (parents of older children are older themselves), but there is little variation within each group. The fraction having less than a university or college degree is somewhat lower for "newer" mothers, i.e.,

for mothers of 2005 in the MP period and for mothers from 1999 in the not-MP period. The share married is lower among mothers in the treatment group. Again, this is of course mainly due to them being younger.

Table 5.2 presents DDD-estimates of the effects of the MP guarantee on labour supply, based on the set-up presented in equation (1).. Labour supply is measured by participation rates (top half) and working days (bottom half). Each cell contains the mean level for the group specified, along with standard errors.

Table 5.2. DDD-estimates. Labour market participation and working days

	Participation rates				
	Treatment group Mothers with young children				
Birth year	Evaluation period	Pre	Post	Change	DD-estimate
2005	2003_2004-2006_2007	0.851 (0.001)	0.811 (0.001)	-0.040 (0.002)	
2001	1999_2000-2002_2003	0.854 (0.001)	0.757 (0.001)	-0.097 (0.002)	0.057 (0.003)
	Control group Mothers with older children				
Birth year	Evaluation period	Pre	Post	Change	DD-estimate
1999	2003_2004-2006_2007	0.790 (0.002)	0.821 (0.002)	0.031 (0.002)	
1995	1999_2000-2002_2003	0.797 (0.002)	0.814 (0.002)	0.017 (0.002)	0.014 (0.003)
DDD-estimate					0.043
	Working days				
	Treatment group Mothers with young children				
Birth year	Evaluation period	Pre	Post	Change	DD-estimate
2005	2003_2004-2006_2007	504.847 (1.288)	455.693 (1.255)	-49.154 (1.798)	
2001	1999_2000-2002_2003	499.766 (1.323)	429.150 (1.328)	-70.616 (1.874)	21.462 (2.590)
	Control group Mothers with older children				
Birth year	Evaluation period	Pre	Post	Change	DD-estimate
1999	2003_2004-2006_2007	505.343 (1.572)	554.469 (1.469)	49.126 (2.150)	
1995	1999_2000-2002_2003	491.241 (1.598)	526.647 (1.535)	35.406 (2..215)	13.72 (3.081)
DDD-estimate					7.742 (4,035)

Note: Mean values and standard errors in parentheses.

First, we look at the DDD estimate for *the participation rate*. We commence by looking at the change in labour market participation for the treatment group (mothers with young children). For MP-eligible mothers the average participation rate declines from 85.1 per cent to 81.1 per cent from the pre- to the post-birth period – a decrease of 4 percentage points. For mothers not eligible for MP, the comparable change is a decline of twice that size, equal to 9.7 percentage points. The difference between these two values is the DD estimate, equal to 5.7 and statistically significant.

To control for trend difference we run the same exercise for the control group and reveal a DD estimate of 1.4 percentage points. Therefore, the positive development in labour market participation is positive but much smaller for mothers with older children, not eligible for the MP-guarantee. The difference between the two DD estimates gives us the DDD estimate, equal to 4.3 percentage points (5.7-1.4), and statistically significant. Therefore, the DDD exercise suggests that the MP reform has increased the labour supply by 4.3 percentage points. Compared to mean level of labour market participation rate in the pre period for the treatment group in the MP-period, this represents an increase of approximately 5 per cent.

The lower half of the table presents estimates for the continuous measure that is *working days*. We confine the exercise to workers registered with a positive amount of working days in both pre and post-period. Therefore, we estimate whether the MP has changed working hours for mothers already present in the labour market. In short, the results show that there is a positive, small and only significant at 10 per cent effect of MP on labour supply for working mothers. The DDD estimate is equal to approximately 8 days. Measured relative to the mean number of working days for the treatment group in the MP-period, this corresponds to a one per cent reduction. . Together, the results in Table 5.2 suggest that the MP reform has had a positive effect on the participation decision, but it has not affected the labour supply for mothers already working. These results are in line with previous studies

reporting higher labour supply elasticities on the extensive margin than in the intensive margin (see e.g. Berger and Black 1992).

In equation 2.2 in section 2 we presented an alternative DDD-estimate removing 2004 as one of the pre-period years. We have run the same exercise as in Table 5.2 with this set-up. The results do not change in any significant way (results available upon request). Therefore, in the rest of the paper we proceed with the specification in equation 2.1 and the correspondingly regression equation 2.3, to which we now turn.

5.2. Regression results

For the participation variable we estimate a linear probability version of equation (2).[4] We have also estimated the models with a probit maximum likelihood procedure. Since the results were qualitatively the same, we choose to use the linear probability model. We estimate two models: the first model includes the key explanatory variables only. In the second model we add all the control variables. The results are presented in Table 5.3.

[4] As Angrist (2001) has noted, even if the dependent variable is limited dependent, the problem of causal inference for these type of variables is not different from causal inference with continuous variables.

Table 5.3. DDD regression results. Binary measure and duration measure

	Binary measure				Duration measure			
	Without controls		With controls		Without controls		With controls	
	Coeff	St.error	Coeff	St.error	Coeff	St.error	Coeff	St.error
Treat	0.056***	0.003	0.116***	0.003	8.535***	2.036	47.714***	2.021
Post	0.017***	0.003	-0.001	0.003	35.406***	2.223	16.722***	2.152
MP	-0.007***	0.003	-0.017***	0.003	14.102***	2.212	5.820***	2.203
TreatxPost	-0.114***	0.004	-0.145***	0.004	-106.032***	2.880	-127.156***	2.732
TreatxMP	0.005	0.004	0.009***	0.004	-9.031***	2.862	-10.363***	2.687
PostxMP	0.014***	0.005	-0.002	0.005	13.720***	3.129	4.000	3.107
DDD	0.042***	0.006	0.041***	0.006	7.753*	4.048	6.305*	3.796
Work experience			0.044***	0.000			26.506***	0.296
Work experience sq			-0.001***	0.000			-0.649***	0.011
Secondary education			0.065***	0.002			28.299***	1.400
University/college – low level			0.130***	0.002			76.917***	1.491
University/college – high level			0.148***	0.003			134.382***	2.303
Unknown education			-0.074***	0.005			79.094***	4.709
Married			-0.006	0.004			9.157***	2.786
Divorced			-0.039***	0.004			4.228*	2.837
Number of children under 6 years			-0.008***	0.002			-15.354***	1.123
Number of children under 11years			-0.044***	0.001			-34.032***	0.943
Capitol (Oslo)			-0.055**	0.002			10.776***	1.907
Capital income			1.000***	0.000			1.000***	0.000
Age husband			-0.002***	0.000			-0.457***	0.074
Sec education - husband			0.043***	0.002			0.622	1.692
University/college – low level –husband			0.036***	0.003			9.867	1.949
University/college – high level –husband			0.019***	0.004			-4.271**	2.423
Child day-care cov rate 1-2 years - II			-0.002	0.002			8.178***	1.318
Child day-care cov rate 1-2 years - III			0.007**	0.003			19.946***	1.784
Child day-care cov rate 1-2 years - IV			0.015***	0.003			30.359***	2.187
Child day-care cov rate 3-5 years - II			0.019	0.027			-2.592*	1.344
Child day-care cov rate 3-5 years - III			-0.013	0.024			-7.467***	1.676
Child day-care cov rate 3-5 years - IV			-0.014	0.023			-12.031***	2.018
Unemployment rate municipality			-0.005**	0.001			-2.057***	0.546
N	273024		273024		200530		200530	
R^2 adj	0.01		0.164		0.026		0.152	

Note. Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent.

The model with core explanatory variables only shows a positive and significant effect of the MP reform equal to 0.042, and highly significant. This almost identical to the DDD estimate in Table 5.2. Adding the full battery of controls leaves the DDD estimate almost unaltered. This is reassuring considering the natural experiment approach we employ in this paper. The message from the first two models is that the MP-reform has increased labour market participation by approximately 4 percentage points, or approximately 5 per cent.[5]

The last two models show the results for the continuous labour supply variable. We find a positive, but small and insignificant DDD effect, both before and after introduction of control variables. This result is in line with our previous finding for this variable, and confirms that the MP reform has not affected the labour supply for mothers already participating in the labour market.

The results for the control variables do not reveal any surprises. Labour supply increases with work experience and the level of education. It is lower for married and divorced mothers compared to mothers that are not married or divorced. Labour supply decreases with the number of older children. Regarding the child day-care coverage rate we find a positive correlation between the coverage rate for 1-2 year olds and the participation likelihood. The coverage rate for 3-5 year olds on the other hand is not significantly related to the participation rate.

As mentioned earlier, due to the closeness of the 2004 and 2006 reform it is difficult to find a 100 per cent "clean" pre-period. To check for the severity of this we have run the regression in Table 5.3 separately for mothers that gave birth to their firstborn. This leaves out mothers that were potentially affected by the 2004 reform. This is done to check whether

[5] We have also carried out analyses using a somewhat stricter definition of labour supply. As an alternative approach we defined employed as: 1) being registered in employment as above, and 2) having an income above the minimum threshold in social security system. For instance, in 2006 this sum was equal to 62892 NOK (approximately 7.8 Euro). The use of this alternative measure of labour supply did not alter the results in any significant way. Therefore, we proceed with the original measure.

mothers that were eligible for the 2004-reform – affects the results. The results from this exercise show that the results do not change in any significant way. We still find a positive, sizeable and highly significant effect of MP-reform on labour supply (results available upon request).

Analyses for subgroups

In this section we present DDD-regression results for different subgroups, defined by household size, education, household income, and ethnic origin.

Table 5.4. DDD regression results for different subgroups. Binary measure

	Additional children in child care age			Education		Household income		Ethnic origin	
	Zero	One	Two or more	Low	High	Low	High	Natives	Non-western
DDD	0.027***	0.047***	0.054***	0.065***	0.022***	0.065***	0.021***	0.040***	0.036
	(0.006)	(0.006)	(0.007)	(0.011)	(0.007)	(0.011)	(0.007)	(0.009)	(0.028)
R^2 adj	0.141	0.157	0.235	0.228	0.082	0.228	0.135	0.115	0.261
N	109642	133746	29636	96185	100682	96185	176389	246100	19633

Note: In all models we control for the other MP core variables and the full battery of controls reported in Table 5.3. Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent.

Regarding household size we distinguish between three groups; i) those with no other children in day-care age; ii) those with one additional child in day-care age, and iii) those who have 2 or more additional children in child day care age. The more children eligible to the day-care cap the lower total costs in child day-care. Hence, we would expect that the effect of the reform should increase with the number of children eligible to the MP-reform. This is exactly what we find: the effect of the MP-reform is higher for those households with 2 or more children in the age range eligible for the MP-guarantee, compared to household with 1 child at the most. Moreover, the effect is smallest for household with no children in the eligible age group. This result is also in accordance with our hypothesis.

Regarding education we distinguish between high and low educated. High educated are those with a university or college degree. Low educated are those with secondary school at the most. The results show that the MP reform has had a stronger impact on the labour supply of low educated mothers than on high educated mothers. Expenditure on day-care accounts for a larger fraction of the total income in low educated households, and hence more of an impact on the labour supply decision.

Household income does also play a role. We divide between two types of households: Low income and high income. Low income households are those who have a maximum 300000 NOK per year. High income households are all those with higher yearly income than 300.000. Household income includes all income posts: wage income, bonus, capital income, public transfers, etc. Table 5.4 shows that low income households are by far the most responsive. Again, child day-care costs will take up a larger fraction of income of low income families. Hence low income households are likely to be more responsive to price changes of child day-care centres.

Finally, the DDD-coefficients for natives and non-western immigrant mothers do not differ much, but is only for native mothers that we find a significant effect. The non-significant effect for non-western immigrant mothers suggests that economic incentives through reduced childcare prices is not necessarily as effective tool for increasing labour supply compared to natives. However, since we are analysing impacts of the MP-reform on mothers with relatively young children, this could present a lower bound on the estimate for non-western immigrant mothers if cultural and/or religious norms limit mothers from many non-western countries to put their children in a day-care centre when the child is very young, even if the price is lowered. Kavli and Nadim (2009) analyse behaviour and beliefs of whether women with children aged 1-5 should work or not. The survey is conducted in Norway and targeted at persons from some of the major immigration countries, Vietnam,

Pakistan, Iran and Iraq, as well as ethic Norwegian and second generation Pakistani. The general pattern seems to be that it is more common to find persons among migrants from non-western countries that believe that women should be at home while the children are small. Approximately 60 per cent of first generation migrants from Pakistan believe that children 3 years of age or younger should be at home with their mothers. The equivalent figure for ethnic Norwegian is 11 per cent. When it comes to attitudes towards women with children 4-6 years old there are few that believe that mothers should not work at all. We shed some light on this issue by presenting labour supply analysis for mothers with somewhat older children in the next section.

5.3. Sensitivity analyses

Pre trends in labour market participation

One important assumption when using DD and DDD is that time effects must be common across treatments and controls. We approach the severity of this problem by presenting some simple analyses of labour market participation in the pre-reform period. Figures 5.1 and 5.2 present mean values of the share of mothers in employment. Figure 5.1 presents results for the treatment group and Figure 5.2 presents results for the control group. For both groups we show separate estimates for the MP and the non-MP period.

Figure 5.1. Share employed for the treatment group. MP and not-MP periods

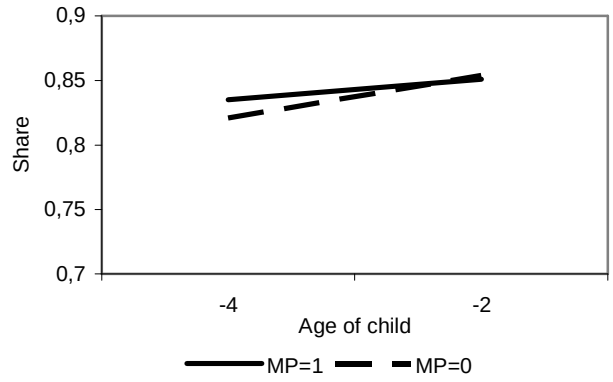
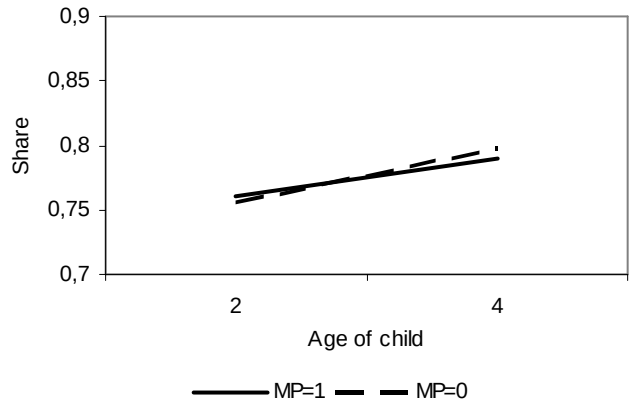


Figure 5.2. Share employed for the control group. MP and not-MP periods



For both the treatment and the control group we find that the mean labour market participation rate is somewhat steeper in the MP-period. We find no evidence indicating that labour supply evolved differently between the treatment and control group in the pre-periods.

Test for composition effect

A second important assumption when using DD and DDD analysis is that the composition of both treatments and controls are stable before and after the policy change. There are no standard ways of controlling for this. We shed light on the issue by regressing equation 3,

replacing the dependent variable with key explanatory variables. The DDD equation for the variable secondary education can be illustrated as follows:

$$\text{Secondary education}_{ijkt} = \alpha_1 + \alpha_2 MP_{ijk} + \alpha_3 POST_{itk} + \alpha_4 TREAT_{ik} + \alpha_5 (MP_{ijk} x POST_{itk}) + \alpha_6 (MP_{ijk} x TREAT_{ik}) + \alpha_7 (POST_{itk} x TREAT_{ik}) + \alpha_8 (MP_{ijk} x TREAT_{ik} x POST_{itk}) + \varepsilon_{ijkt}$$

In this test we only include the core explanatory variables. A simple test of no composition effects would be that $\alpha_8 = 0$. Table 5.5 presents results for two sets of variables: education and the presence of older children. The models include all the core explanatory variables, but we only present the results for the DDD variable.

Table 5.5. Composition test

	Education				Older children	
	Compulsory	Secondary	University/ college low	University/ college high	N children <6	N children <11
DDD	0.001	0.003	-0.006	0.001	0.002	-0.001
	(0.006)	(0.008)	(0.007)	(0.004)	(0.003)	(0.003)
R^2 adj	0.011	0.008	0.007	0.009	0.011	0.010
N	273024	273024	273024	273024	273024	273024

Note: Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent.

The test for composition effects reveals no significant relationship between the DDD variable and education or the presence of older children. This result is as expected if no composition effects are present. Even though this is not a water proof test it suggests that composition of treatments and controls remain stable before and after the policy change.

MP and birth behaviour

One important identifying assumption is that mothers' birth behaviour is exogenous to the reform. This has at least two implications: firstly, that the births in 2005 are exogenous to the reform, and secondly, that the subsequent births in the evaluation period, i.e. 2006 and 2007, are not influenced by the MP reform. Regarding the first implication, the MP reform was

publicly debated and became a law in 2003. Hence, it would be time enough to act on information on the MP-reform to have a child in 2005. It is difficult to test this, as we lack a comparison groups. To shed some light on this issue we have done one simple exercises. We have run the main regression in Table 5.2 for all mothers, i.e., not limiting the analyses to mothers that gave birth to their youngest child in the relevant years. If endogenous short-term birth behaviour is a severe problem we should expect the DDD results to differ between the two specifications. The exercise shows that the DDD coefficient is almost unaltered. Although this is clearly no proof-test of fertility effects of the MP reform, it suggests that the MP-eligible mothers did not change the spacing of births in the period under observation.

Any effects for fathers?

Finally, we carry out the analyses as presented in Table 5.3, but for men with children. That is, the sample is the same as in Table 5.3 except the gender. We do not expect to find any labour supply effects for fathers since we know that the mother is still the main caregiver for small children. Reduced child day-care should therefore have a minor effect of the fathers labour supply effect. If we do find an effect this would make us suspicious that the DDD-set up might be picking up some simultaneous labour market trend or occurrence affecting the general demand for parents with children of different ages taking place at the same time as the introduction of the MP-reform. We estimate two models, one with control variables and one without control variables.

Table 5.6. DDD regression results. Binary measure. Fathers

	Without controls		With controls	
	Coeff	St.error	Coeff	St.error
DDD	-0.003	0.005	-0.005	0.007
Included controls	No		Yes	
R^2 adj	0.010		0.073	
N	263836		263836	

Note: In the second model we control for the full battery of controls reported in Table 5.3. In both models we include (but do not present) the other core variables. Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent.

Table 5.6 shows that the effect of the MP-reform for fathers is equal to zero. This as expected and is reassuring in the sense that it gives us a stronger reason to believe in the results for mothers.

5.4. A difference-in-differences approach

In this section we present some supplementary results based on DD-regression approach. The motivation for doing this is to check the robustness of the results, and to include mothers with somewhat older children in the treatment group. The set-up is explained in equation (3). Remember that the treatment group is now all mothers with children 1-5 years old. The control group is mothers with children 6-8 years old. Hence, we do not confine the analyses to mothers that gave birth in one specific year, as in the DDD-analyses. We limit the presentation of results to the participation variables, since the results for the duration variable are insignificant also in this set up. Table 5.7 presents the results.

Table 5.7. *DD regression results. Binary measure. Year 2005 and 2007*

	Without controls		With controls	
	Coeff	St.error	Coeff	St.error
Post	0.001	0.002	0.004	0.002
Treat	-0.045***	0.002	-0.044***	0.002
PostxTreat	0.029***	0.003	0.029***	0.003
Included controls	No		Yes	
R^2 adj	0.010		0.095	
N	547676		547676	

Note: In the second model we control for the full battery of controls reported in Table 5.3. Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent.

In both models we find a positive effect of MP on labour supply. At face value the coefficient is somewhat smaller compared to the DDD-coefficient in Table 5.3. Due to the different set-ups it is difficult to compare the results head to head, but the main result is that we find a positive and sizeable effect of MP on labour supply, irrespective of set up.

Table 5.8 presents separate DD-results depending on the number of children, the educational level of the mother, household income, and ethnic origin. Regarding the number of children, for the treatment group it is number of children 1-5 years old while for the control group it is the number of children 6-8 years old. We distinguish between two groups: Mothers with one child and mothers with two children or more. The hypothesis is that the effect should be higher for mothers having several children, in line with previous arguments and findings.

Table 5.8 DD regression results. Binary measure. Year 2005 and 2007. Different subgroups

	Children		Education		Household income		Ethnic origin	
	One	Two or more	Low	High	Low	High	Natives	Non-western
PostxTreat	0.027***	0.035***	0.039***	0.011***	0.060***	0.022***	0.020***	0.047
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.003)	(0.003)	(0.010)
R^2 adj	0.094	0.120	0.053	0.010	0.146	0.086	0.065	0.109
N	431866	176389	308131	212779	138853	408823	246100	52587

Note: In all models we control for the other MP core variables and the full battery of controls reported in Table 5.3. Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent.

The results show that the DD coefficient is larger for mothers having two or more children. The difference in labour supply between treatment and controls from the pre to the post period should increase with number of children, as the treatment group will have more MP-eligible children in the post-period. The result in Table 5.7 is in line with the results in Table 5.4. The results for mothers with different levels of education show that the effect of the MP-reform is larger for low skilled mothers. Finally, we find that households with low income are more responsive to the reform than households with high income. All these results are in line with the results in Table 5.4.

Finally, we present separate estimates for native mothers and non-western immigrant mothers. In contrast to the DDD-estimate results in able 5.4, the DD estimates in Table 5.8

show that the effect is stronger non-western immigrant mothers than for native mothers. One possible explanation for this discrepancy is that the treatment group in Table 5.8 contains mothers with somewhat older children as well. As mentioned in the previous section, cultural or religious norms may limit non-western immigrants' mothers' labour market entry when the children are small, even if prices of child care is reduced. But, if these cultural or religious norms are most present when the children are very small, the impact of reduced child care prices may show up when we include mothers with older children in the treatment group. To follow up this hypothesis we have estimated two separate regressions for non-western immigrant mothers; in the first regression we define the treatment group as mothers which youngest child is 2 years or younger (i.e., we leave out 2-5 year olds from the original treatment group). In the second regression we define the treatment groups as mothers which youngest child is *older* than two years (i.e., we leave out mothers with children where the youngest child is 2 years or younger). The results from this regressions show that the effect of the MP-reform for non-western immigrant mothers is much stronger for the latter group (results not shown but available upon request), i.e., for mothers with somewhat older children. This result is in line with the above hypothesis. This result lends support to arguments saying that also non-western immigrant mothers are responsive to economic incentives. Generally, a positive impact of reduced childcare costs for immigrant workers is also in line with results in Schlosser (2006), reporting that the labour supply of Arab mothers in Israel increased sharply after reduction in childcare costs.

A regional approach

So far we have not utilized the information on the development in child day-care prices in different municipalities before and after the introduction of the MP-reform in 2006. Since some municipalities reduced prices more than others this geographical variation can be used

to construct treatment and control group in a difference in difference framework. The analyses in this section are limited to the sample of municipalities (109 of 439 communities) that reported childcare prices. Since all municipalities reduced childcare prices as a consequence of the 2006 reform (varying from 1463 NOK to 50 NOK), the definition of treatment and control groups must be based on some subjective judgment. We define municipalities that have reduced monthly prices of child day-care slots by 500 NOK or more as the treatment group (TREAT=1). The control group is municipalities that have reduced the price by less than 500 NOK (TREAT=0). The POST variable is defined in the same manner as in Table 5.6. The sample used in the analyses are now limited to mothers with MP-eligible children (1-5 years old)e. The hypothesis is that we expect to find a larger increase in mothers' labour supply in municipalities that have reduced childcare prices a lot. Table 5.8 presents the results:

Table 5.8. *DD regression results. Binary measure. Year 2005 and 2007. Regional approach*

	Without controls		With controls	
	Coeff	St.error	Coeff	St.error
Post	0.029***	0.002	-0.001	0.007
Treat	-0.057***	0.002	-0.056***	0.006
PostxTreat	0.022***	0.003	0.023***	0.007
Included controls	No		Yes	
R^2 adj	0.010		0.119	
N	547676		227676	

Note: In the second model we control for the full battery of controls reported in Table 5.3. Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent.

The results show that the effect of the MP-reform is larger in municipalities that have reduced the child day- care prices the most. The DD-coefficient is almost identical to the one reported in Table 5.6, and suggest that the MP reform has increased the labour supply by 2.3 percentage points. In sum, irrespective of set-up we find results that support the hypothesis that reduced childcare costs increase mothers' labour supply.

6. Conclusion and discussion

In an international context, Norway has a generous public family policy. Subsidised childcare is one important part of this policy. In an international context the female labour market participation rate is also very high in Norway. Together with Denmark and Sweden Norway has the highest female employment rate in the OECD area (OECD 2008). The main question we ask in this paper is whether reduced childcare costs in such an environment –where female labour supply is already high - is an effective tool for increasing labour supply among mothers even further. To answer this question we exploit exogenous variation in the eligibility to reduced child care costs introduced by the introduction of public policy.

In the spring of 2003, a broad political agreement was reached. The goal of the reform was twofold: To increase child day-care coverage rates and to reduce the day-care prices paid by parents (Innst. S. nr. 50200-2003). The intention was that all parents that wanted a child day-care slot should get one, and that the costs of a slot should be reduced. The overall goal of the reform was that neither private economic conditions nor lack of child care slots should exclude families from using formal child day-care.

Regarding reduced child day-care prices, the first part was introduced in 2004 while the second and larger part was introduced in 2006 respectively. In April 2004 a cap on the price the municipality could charge parents was set. The cap was set to 2750 Norwegian kroner (NOK) per month for a full time slot (approximately 340 Euro). In January 2006, a second reform was introduced, reducing the cap further to 2250 NOK per month for a full-time slot. Statistics show that it was mainly the reform of 2006 that resulted in any significant reduction in child day-care prices, and consequently this is the reform we exploit in this paper. The cap of 2006 resulted in a large and almost uniform nationwide reduction in child day-care prices. Parallel to the decrease in prices there was also a large increase in the day-care

capacity. In the analyses we control for the build up of the coverage rates by including municipality specific coverage rates for the whole period under study.

All analyses are conducted using high quality and very detailed register data for the whole population of mothers. The group under study is mothers in age range 20-45.

We use two measures of labour supply; participation and number of working days. Participation is measured by a dummy variable taking the value 1 if the mothers participate in the labour market, and 0 otherwise. Number of working days is measured by number of working days, conditional on participation. Therefore, the first measure gives us the effect on the extensive margin, and the second measure gives us the effect on the extensive margin.

The results show that the decrease in child day-care prices did lead led to a rise in mothers‘ labour market participation rate. The impact is in the range of 4 percentage points, or approximately 5 per cent. The reform seems to have only a minor impact on number of working hours (days), given participation. The positive and significant participation result and the positive but small and insignificant duration result is on line with previous results suggesting that labour supply is more elastic on the extensive margin.

The positive and sizeable impact on participation is robust after controlling for pre trend differences and composition effects. The result is also robust across different model specifications. In summary, our results lend support to the hypothesis that cheaper childcare can be an effective toll for increasing labour supply among mothers, even in an environment characterised by already high female labour supply.

Finally, it seems relevant to compare our results with two previous mentioned studies: First, the Swedish results in Lundin (2008) reporting almost zero effects for a reform with similar attributes as the Norwegian. Sweden are Norway are similar in many ways relevant for analysing the labour market; high labour market participation among women and a generous public family policy are two common attributes. One possible explanation for the divergent

results is that child day-care prices historically have been somewhat higher in Norway than in Sweden (OECD 2007). Reduced childcare costs may therefore be more effective when they initially are at a higher level. Another factor that might have some influence on differences in behaviour is that Sweden has had full coverage for both younger and a bit older infants for several decades. Hence there might be some normative implications as to whether mothers with small children should work or not that are different in these two countries. Secondly, Havnes and Mogstad (2009) use Norwegian data and find no impact of a large expansion in child care coverage in Norway in the 1970's on maternal employment of mothers. One possible explanation for the divergent results is that they consider mothers of children aged 3 to 6, somewhat older compared to our preferred DDD-mothers. Furthermore, they consider maternal employment after the passage of the Kindergarten Act in 1975. We consider maternal employment in a different context, almost thirty years later.

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