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Cutting from the future? Impact of a subsidy reduction on child care quality in the Netherlands

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Abstract

High quality child care has been consistently linked with child development and future life outcomes. We examine how process quality in child care centers is influenced by the reduction of child care subsidies. The analysis is based on a 2012 reduction in subsidies for Dutch parents. Exploiting the different types of funding for child care centers in the Netherlands, we provide linear and non-linear difference-in-difference estimates of the effects subsidy cuts have on child care quality. The results show that the subsidy reduction had a negative effect on quality, and the effects are especially strong for higher quality centers.

Keywords: child care, ECEC, quality, subsidy

JEL classification: J13, H42, L19

1. Introduction

With rising female labor force participation rates, most OECD countries invest in early childhood education and care (ECEC) through public schemes, benefits and subsidies (Kamerman, 2000). Recently, the discussion of the benefits of ECEC has recently become more focused on the child development aspect (Baker, 2011). Especially investment in high quality ECEC services for disadvantaged families seems to indicate significant benefits in the long term outcomes of participating children (Heckman, 2006). From a policy perspective, this implies that the quality of ECEC services are as important as the availability and access.

In this paper, we use a cut in child care subsidies in 2012 in the Netherlands and a simultaneous survey of child care centers' quality to identify whether adjustments in child care subsidies have an effect on child care quality. Our quasi-experimental identification strategy relies on the two-tiered child care system in the Netherlands where private daycare centers and publicly funded playgroups exist simultaneously. Playgroups were unaffected by the subsidy reduction and serve as our control group while daycare centers make up the treatment group. A difference-in-difference (DD) model is employed for baseline estimations. The results from the linear DD framework are supplemented by generalized, non-parametric DD model results. The main data source is a two-wave, geographically representative survey of child care centers in the Netherlands. The dataset is unique because it includes relatively scarce process quality measurement and has a panel structure with most centers visited in both waves. One wave of the survey was collected in the months before and the other after the subsidy cuts, allowing for a relatively simple estimation of the effects. The results show a small but robust and significant decline in ECEC quality that is more pronounced for higher quality child care centers. The negative effects appear to be driven by centers that are likely to be in rather thin markets with limited demand.

This paper contributes to the literature by showing the effects of a cut in subsidies on quality of child care. Very few studies analyze the link between spending and quality of ECEC. Johnson et al. (2012) have looked at the effect of subsidy receipt on the quality of child care purchased for a cross-section of 4 year old children and found a positive relationship. However, identification of the impact subsidies may have on quality is complicated in case of countries where there is no difference in eligibility and subsidy rates for parents with same income and working hours. The Netherlands provides a particularly suitable setting to identify effects of subsidies on quality since there is a natural control group of child care centers that are unaffected by changes in subsidies. Collection of process quality information before and after the subsidy reduction in both daycare centers and playgroups provide a valuable opportunity to identify the

link between child care subsidies and quality.

The following section discusses the previous findings in the literature on ECEC spending and quality as well as some of the potential links between child care subsidies and quality. Section 3 describes the context of the subsidy cut and the child care market in the Netherlands. Section 4 introduces the data and empirical strategy used. Section 5 presents the linear DD methodologies and their results. Section 6 presents the non-linear changes-in-changes model and its results. Section 7 concludes.

2. Child care quality and subsidies

A large and mostly recent economic literature has studied the relationship between child care and child development. Findings from case studies in the U.S. such as the Perry Highschool and STAR have indicated a positive impact from ECEC attendance on later life employment, wages and crime rates among the participants (Chetty et al., 2011; Heckman et al., 2010). Results indicating significant benefits on child development in both cognitive and non-cognitive ability from national reforms in Norway and Denmark have extended the scope of program specific findings from the U.S. to more comprehensive ECEC systems (Baker et al., 2008; Datta Gupta and Simonsen, 2010). Longer run effects of investments in comprehensive ECEC systems have been found in Norway by Havnes and Mogstad (2011b), who find higher education and income among cohorts born after an expansion in subsidized child care. A large body of evidence for a positive relationship between formal child care and child development has also been established by development psychologists (Bradley and Vandell, 2007). However, not all findings are positive. The causality of the relationship between development and child care found through OLS or fixed effects estimators is questioned by evidence from instrumental variable estimates provided by Bernal and Keane (2011); Herbst (2013), who find a negative effect on child development from attendance to formal child care. Herbst and Tekin (2010) also estimated a negative effect on child cognitive and non-cognitive development from subsidy receipt for formal child care.

The mixed evidence regarding the relationship between child development and formal child care suggests that there is a mediating factor that shapes the direction of the effects formal child care investment has on child development. Quality of child care is the natural culprit to examine but is typically treated as an unobservable variable, most likely due to data constraints. The studies that analyze the relationship between quality of child care and development generally find positive effects from quality. Chetty et al. (2011) show that having experienced teachers or a smaller class size has led to higher earnings in later life for students in the STAR study. Studies using process quality measures of child-caregiver interaction

consistently find that child development is positively affected by high quality child care (Duncan, 2003; Peisner-Feinberg et al., 2001). Overall, the existing literature suggests an ambiguous relationship between formal child care and child development and a positive relationship between the quality of child care and child development. The missing link from a policy perspective appears to be how investments and subsidies in ECEC affect quality.

Just as investments in ECEC are made to increase the use of formal child care services, the cut in Dutch child care subsidies that this paper analyzes can be envisaged as causing a negative demand shock in the child care market. Havnes and Mogstad (2011a) find that the expansion of subsidized child care in Norway had little effects on maternal employment because decreases or increases in formal care accessibility lead to substitution towards or from informal child care. Similarly, Bettendorf et al. (2012) find that higher subsidies in the Netherlands resulted in a switch from informal to formal child care with small effects on female employment. In the same vein, we may presume that the subsidy cuts lower the demand for formal child care prices, without a corresponding decrease in labor force participation. However, there is no prior evidence as to how subsidy cuts affect child care quality.

Depending on the characteristics of the market whether parents know about child care quality and its effects, a subsidy cut can have either no effect or a negative effect on quality. Parents have been found to value convenience and prices over quality and may be unaware of quality in their centers (Mocan, 2007; Kim and Fram, 2009). With a reduction in subsidies, centers may cut costs and lower quality in order to compete on prices. Even if parents have perfect information and foresight about child care quality and its future effects, an increase in prices may lead them to prioritize finding cheaper child care over higher quality child care. Investments in child development can still be maintained by substituting high quality and high price child care with lower quality child care and higher consumption. However, negative effects are only plausible if quality can actually be reduced further. Given the regulations on basic characteristics of child care such as caregiver qualifications, quality may not be affected at all. The market equilibrium in that case would be set at providing low quality child care without any more room to drop due to quality regulations acting as a minimum quality standard.

Treating the national child care market as one homogenous market would be a mistake given the local character of most service markets including child care. In thick markets where demand is high, price elasticity of child care use is likely to be lower than in thin markets where subsidies may cause a larger shift in demand. Cleveland and Krashinsky (2009) have found that non-profit child care centers that are expected to provide higher quality care are only able to do so in thick markets where there is sufficient

demand to pay premiums for higher quality child care. Centers operating in thin markets where price elasticity is high would be more sensitive to changes in child care subsidies and are likely to react to a subsidy cut by lowering costs and quality to maintain acceptable prices.

There are multiple other mechanisms through which subsidies can influence child care quality. If competition has a positive effect on child care quality as it does on schooling (West and Woessmann, 2010), centers shutting down as a result of lower demand can also decrease competition and parental choice, resulting in a lowering of quality. Positive effects on quality are also plausible. A smaller market can raise the average quality of the labor force. Centers that provided low quality care in the first place should be the ones losing customers first, which would raise average quality. Possible imperfections in the child care market generally make it difficult to give apriori predictions about the effects of policy changes without empirical support.

3. Child care in the Netherlands

The structure of the Dutch child care sector is central to our identification strategy. Formal child care centers in the Netherlands for children aged between 2 and 4 can be divided into daycare centers (kinderdagverblijf) and playgroups (peuterspeelzaal). Daycare centers are generally used by dual-income families and can be utilized for enough hours to allow for full-time employment of both parents. Playgroups are generally used for shorter periods of time: between two to four half days a week. Both center types essentially provide the same ECEC service, but for different groups and for different hours. Playgroups are traditionally education rather than care oriented, but most daycare centers now also use the educational curriculum (VVE) that was initially designed for playgroups.

Daycare centers operate in a private market and parents are free to choose the daycare center they prefer. Child care subsidies are paid directly to parents, meaning that the demand side is subsidized rather than the supply side. Subsidies can be paid up to an hourly price that is adjusted each year and depend on income and the number of children in daycare. Since 2005, the daycare sector was boosted through increases in subsidies that effectively cut prices by half for parents between the period 2005 and 2009 (Bettendorf et al., 2012). With the onset of the financial crisis, the Dutch government cut a number of social programs including child care subsidies. The change in subsidies that took place in 2012 can be seen in figure 1. Subsidies were cut over the board for the first child by several percentage points and subsidies for the care of a second child was reduced substantially. These subsidies are paid for a set maximum hourly price. The portion of the price that is above the maximum does not factor in the subsidy calculation. In addition

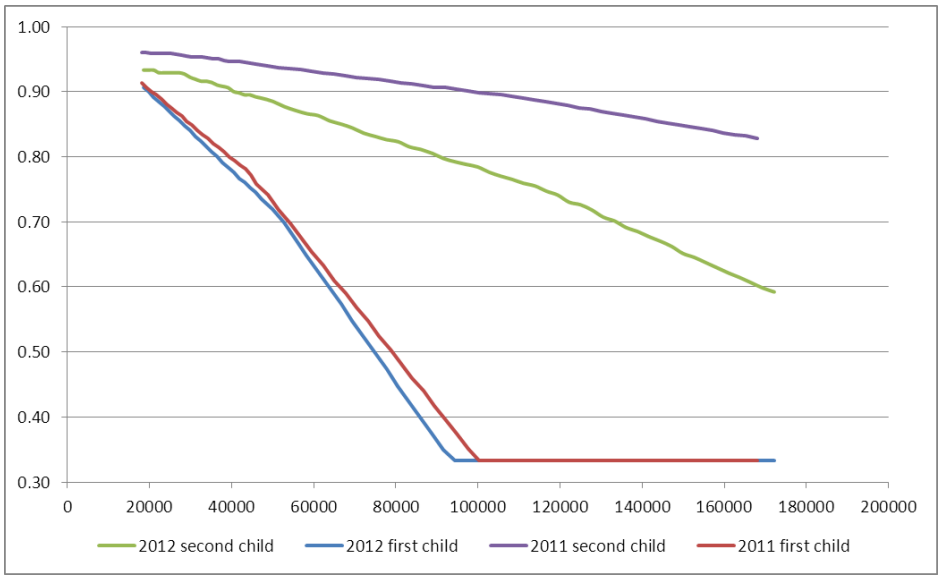

Figure 1: Child care subsidies in the Netherlands: 2011 and 2012

to the reduction in subsidies, the maximum hourly price was not increased from €6.36 in 2012 while the average prices continued to rise from €6.32 to €6.45. The rise in prices without a corresponding increase in maximum hourly price implies that there is on average €0.13 extra that parents have to pay for which they do not receive any subsidies.

Appendix 1 shows in detail the changes in net cost of monthly child care for different family configurations, income and number of children in child care. The increases in net monthly costs are around 20% for parents with a single child and over 33% for parents with two children in child care. The cuts in 2012 led to the first decrease in the number of parents making use of daycare centers since 2005 as the number of child care subsidy allowances dropped from 738,000 to 709,000 (SZW, 2013). In the first half of 2012, the number of children in daycare dropped by 3% while the average hours of care decreased by 5%. Playgroups are funded by municipalities with minor parental contributions and playgroup use is not subsidized on the demand side. While playgroups may also be affected by the recession and general austerity in the Netherlands, these effects would have been felt in the daycare center as well regardless of the subsidy cuts. We thus expect playgroups to serve as a reasonable control group to test the impact of the subsidy reduction.

Both daycare centers and playgroups are regulated in terms of structural quality factors such as child to staff ratios and space specifications. These regulations are monitored through different channels. Daycare centers' are inspected by municipalities for whether or not they confirm to the quality regulations agreed upon between parental organizations and daycare providers. Similarly, playgroups are also inspected by

municipalities but their regulations are set by national law. Both centers need to pass the inspection of Municipality Health Service (GGD): daycare centers in order for the parents who use the daycare center to be eligible for subsidies and playgroups in order to receive funding.

4. Data and methods

The data on child care quality in the Netherlands is retrieved from a longitudinal survey of Dutch child care centers, parents and children named Pre-Cool. The Pre-Cool survey consists currently of two waves, one collected in 2010 and 2011 and the other in 2012. The primary purpose of the dataset is to track the development of Dutch children. Quality information was collected from the child care centers that the children in the study attended, along with additional centers for regional representation. Future waves will track children into primary schools and will no longer measure child care centers' quality.

The unit of analysis in our study is the classroom. Pre-Cool survey involved sending trained observers to measure the quality of classrooms in each center. The average observation period was about 20 minutes for each classroom and multiple observations are made from each center. The full sample consists of 166 child care centers but several centers are dropped due to missing data issues. Furthermore, 15 of the centers were not included (or had missing data issues) in the second wave which consists of 748 observations from 137 centers. We use a balanced panel of 124 centers for which there is complete date in the linear portion of the analysis but use 132 centers for non-linear models where control variables are not included. The centers used in the analysis are from 37 different Dutch municipalities which are shown in figure 4. The variation in location is due to the explicit goal of the Pre-Cool study to achieve geographical representation.

Quality is measured using the Classroom Assessment Scoring System (CLASS), one of the scales introduced by developmental psychologists to measure the quality of child-caregiver interaction and ECEC in the classroom. CLASS consists of two domains: instructional support and emotional support. Each domain is made up of several dimensions on which the observers grade the classroom interaction. Positive climate, teacher sensitivity, behavior guidance and regard for child perspectives are the emotional support dimensions. Instructional support consists of three dimensions: facilitation of learning and development, quality of feedback and language modeling. Each dimension is graded by the observer on a discrete scale from 1 to 7. Scores between 1 and 3 are considered to be low, 3 and 5 average and above 5 high. The domains are constructed by simply taking the means of the dimensions. The overall quality score is the mean of the two domain scores. The two domain scores and the overall quality score are the dependent variables in the DD estimates. Development psychologists often use factor analysis in constructing the quality scores but the

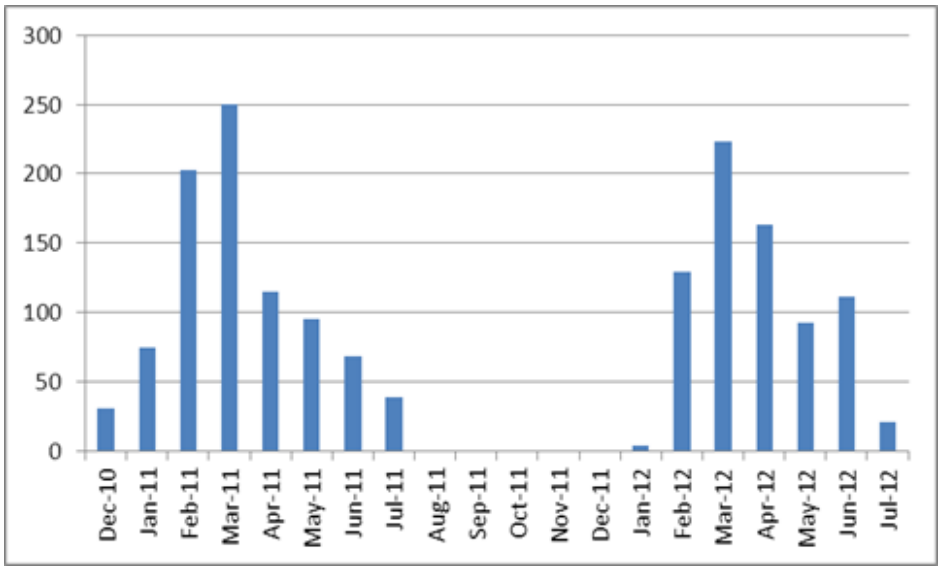

Figure 2: # of classroom observations each month

means are somewhat easier to interpret in terms of economic significance. The direction of the results do not differ when factor variables are used in place of means.

Wave 1 observations were made in late 2010 and early 2011. Wave 2 was collected exclusively in 2012. Figure 2 presents the number of observations made in each month. A minority observations were made in 2010 and limiting wave 1 observations to those collected in 2011 or wave 2 observations to those made before June 2012 did not significantly alter the results. 15 time fixed effects are included in all estimations, to control for the month and year in which the observation was made.

Table 1: Quality indicators of Dutch child care centers before and after the subsidy reduction

	Pre-Treatment		**Post-Treatment**	
	Daycare centers	Playgroups	Daycare centers	Playgroups
Emotional support	5.02	5.03	4.54	4.62
	(0.65)	(0.66)	(0.47)	(0.51)
Instructional support	3.12	3.54	2.61	3.27
	(1.05)	(1.13)	(0.81)	(0.82)
Average quality	4.07	4.29	3.53	3.94
	(0.66)	(0.70)	(0.43)	(0.48)
# of adults	1.95	2.18	1.99	2.23
	(0.54)	(0.86)	(0.60)	(0.89)
# of children	9.58	10.01	9.18	10.49
	(3.11)	(3.98)	(3.17)	(3.49)

Table 1 presents the averages and standard deviations of the quality indicators for daycare centers and

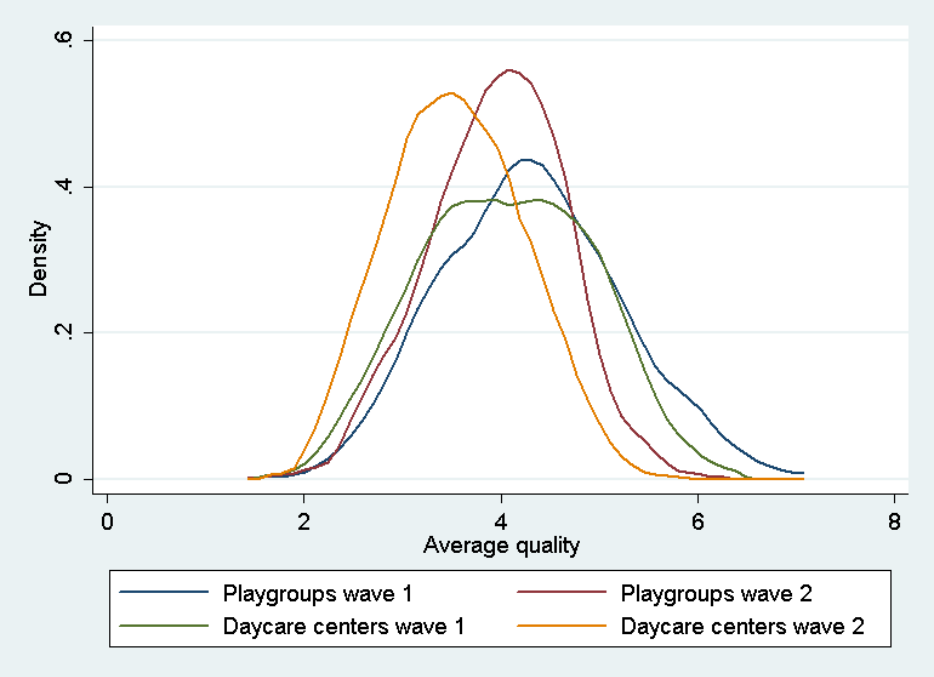

Figure 3: Distribution of child care quality in daycare centers and playgroups

playgroups before and after the subsidy reduction. The mean quality of Dutch child care centers in the sample is around the average level 4 and the scores are higher for emotional support than for instructional support. Pre-treatment scores for average quality are around 4 for both center types. Post-treatment scores are slightly lower for both but the drop in scores is more noticeable and significant for daycare centers, mostly due to the drop in instructional support. While table 1 shows the means and standard deviations, figure 3 presents the kernel distributions of the quality scores. Quality score distributions of playgroups and daycare centers are remarkably similar in wave 1 while in wave 2 daycare centers' distributions shift noticeably to the left. Figure 3 also clarifies the reason for the small drop in playgroup scores; there are fewer playgroups with high quality scores in wave 2 compared to wave 1 and the right side of the distribution is almost truncated.

Most estimators designed for natural experiments exploit the impact of a treatment exclusive to one group that can be compared with another group that serves as the control group. To analyze the effect the subsidy reductions had on quality, we make use of three estimators. Our standard, linear estimations elicit the impact of the subsidy reduction on the mean values of daycare quality in comparison to the mean values of playgroups' quality. We test the robustness of the linear results using the synthetic control

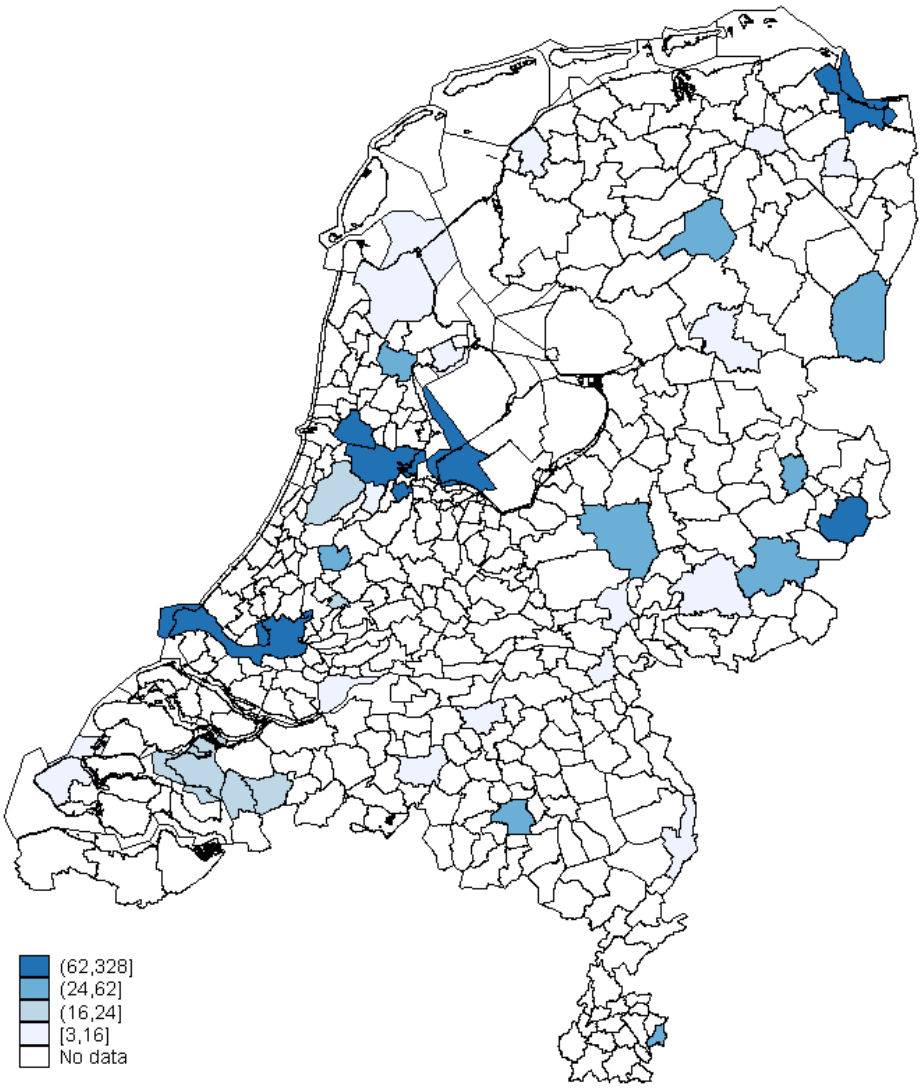

Figure 4: Number of class observations per municipality

method designed by Abadie et al. (2010). The synthetic control method allows us to put more weight to changes in quality of those playgroups that are more similar to daycare centers in terms of other observable characteristics such as area income or center age.

The issue with the linear DD models for our estimation is the significant change in distributions of both daycare centers and playgroups in wave 2 that can be seen in figure 3. For both center types, the quality observations become less varied in wave 2. Furthermore, linear DD models assume additivity and homogenous effects on all daycare centers. To take the change in distributions and potential heterogeneity of effects into account, we make use of the non-linear DD model introduced by Athey and Imbens (2006) and named changes-in-changes (CIC). The CIC model takes into account changes in the complete distribution of the quality values of playgroups and daycare centers. In addition, it allows the calculation of the effects at different levels of quality.

There are several common causes of bias in DD estimates beyond the issues addressed by the CIC estimator. The primary question of validity is whether the subsidy reduction is unrelated to a sudden decrease in child care quality. Since the reduction in 2012 was a part of a general austerity drive in the Netherlands and its potential costs and benefits were analyzed mostly from a labor supply perspective, the reduction in subsidies is most likely exogenous from centers' quality. A further weakness of our particular data is that we cannot control for compositional effects with regards to parents' characteristics. Subsidy cuts may cause a switch between formal and informal care, especially for low income parents. If having fewer children in classrooms from lower income families has a positive impact on quality, there may be an underestimation of the complete effects of subsidy cuts on process quality.

5. Analysis using linear DD models

5.1. Empirical methodology

As the first step in our analysis, we use linear DD models to estimate the effects of the subsidy reduction. The classroom observations belong to one of two categories given by the group variable $D_i \in 0, 1$ which is 0 for observations from playgroups and 1 for daycare observations. In the second wave when $T_t = 1 T_t \in 0, 1$, daycares are affected by the subsidies. Treatment is indicated by the variable $I_i = D_i * T_i$. The observed outcome for treatment outcomes Y^N and control group outcomes Y^I can be written as follows:

$$Y_i = Y^N(1 - I_i) + I_i Y^I \tag{1}$$

Using a difference-in-difference model, the treatment effect can be estimated using OLS:

$$y_i = a + b_t + c_j + X_{it}\gamma + \beta_1 D_i + \beta_2 T_t + \rho I_i + e_i \tag{2}$$

In equation 2, the parameter of interest is ρ which is the treatment effect. In addition to the time effect T_t, center type effect D_i and and the treatment effect I_i, three sets of controls are added, X_{it} are classroom controls, b_t are the time fixed effects and c_j are the center fixed effects. Not all classrooms were observed in the same month in either wave. Fixed effects are thus added for each month and year combination in which the quality observation was made. Since child care markets tend to be local, market heterogeneity is controlled for by adding center fixed effects. While child to staff ratio in the Netherlands is regulated in both playgroups and daycare centers, the numbers could vary during the observations. We thus add controls for the numbers of children and adults in the classroom during the observation. Finally, the classroom could be engaged in various activities ranging from rest to free play during the observation. In order to control for these effects, a set of 12 dummies indicating what activity the class was engaged in during the observation is also added. In most estimations, we use clustered standard errors in the OLS estimates which allow for the error terms from classroom observations of the same center to be correlated (Bertrand et al., 2004) .

The secondary linear estimator used is the synthetic control method developed and discussed by Abadie et al. (2010). The synthetic control model explicitly takes into account the uncertainty about the validity of the control group and estimates the treatment effect ρ using equation 3. Since all daycare center observations are assumed to be affected by the same subsidy cut, quality observations from all daycare centers are first aggregated to construct an average daycare center where $i = 1$. Each of the n playgroups is then weighed using the vector $W = (w_{i+1}, ..., w_{1+n})$ where $(w_2 + ... + w_i + n = 1)$ to generate a counterfactual control group, synthetic control, that most resembles the daycare centers if a subsidy cut had not occurred.

$$\rho_1 = Y_1 - \sum_{i=2}^{i+n} w^N Y^N \tag{3}$$

The weights are assigned using a set of covariates Z including quality before the subsidy cut to minimize the difference in observable characteristics between the average daycare center and the synthetic control. More technically, the vector W minimizes $(Z^I - Z^N W)' V (Z^I - Z^N W)$, where matrix V indicates the relative importance of Z in predicting outcomes Y. Abadie et al. (2010) show that a synthetic control that minimizes the differences in Z and pre-intervention outcomes at least approximates differences in unobserved characteristics as well, and provides a more general estimator than the DD model, which is a specific case of the synthetic model where all weights are equal $(w_2 =, ..., = w_i + n)$. While the synthetic

control method is not ideal for our particular application due to the limited number of time periods we have, it provides an alternative identification method to test the robustness of the DD results.

5.2. Results

We estimated 5 alternative DD specifications to measure the impact of the subsidy reduction on daycare centers' quality. The results for the estimations can be seen in table 2. In the first model, we included only child care center type, the wave the observation is from, the treatment variable, activity fixed effects and the time fixed effects. The second model adds classroom characteristics to the list of independent variables by controlling for child to staff ratios in classrooms during the observation. The third model adds 39 municipality fixed effects, in an attempt to control for unobserved market heterogeneity. The final two models control for center heterogeneity by introducing center fixed effects. All models' standard errors are clustered at the center level with the exception of model 4. The treatment effect is negative in all models and is significant while the wave variable is insignificant throughout. The size of the treatment effect varies little when fixed effects are added at the municipality or center level and the significance level remains at around the 10% level. If clustered standard errors were not used, model 4 shows that the effects would appear to be far more significant than they really are.

The results in table 2 show a generally negative effect from the subsidy reduction on daycare centers' quality. Previous literature has shown that instructional support measures in particular are important indicators of school-readiness in terms of academic development (Mashburn et al., 2008). Especially in the Netherlands where quality scores were already average for emotional support and below average for instruction support, further decreases may have negative consequences on long term outcomes. When the models are fitted for instructional and emotional support separately, the effects on the two domains do not seem to differ significantly. The negative effects we find might be transitory since we are only looking at the year immediately after the subsidy reduction. In the case of child care however, short or long-term effects may be equally significant. Low quality care for even a few years may have long lasting effects on the current generation.

The main theoretical arguments as to why a subsidy reduction can lead to lower quality relies on a negative demand shock coupled with adverse market conditions. Child care centers that operate in thick markets where parents' demand or income is high would not be heavily affected by the subsidy cut because they do not need to cut prices and lower costs in the face of decreasing demand. An indication of market conditions is the hourly price that child care centers charge. Since any price increases above the subsidy

Table 2: Effects of the 2012 subsidy reduction on average quality

Model	1	2	3	4	5
# of children		-0.030***	-0.032***	-0.030***	-0.030***
		(0.01)	(0.01)	(0.01)	(0.01)
# of adults		0.044	0.051	0.074***	0.074*
		(0.04)	(0.04)	(0.03)	(0.04)
Daycare	0.016	0.043	0.187	-0.168	-0.168
	(0.24)	(0.24)	(0.26)	(0.37)	(0.27)
Wave	0.299	0.097	0.226	0.042	0.042
	(0.31)	(0.32)	(0.32)	(0.42)	(0.36)
Daycare*wave	-0.218*	-0.226*	-0.258*	-0.237***	-0.237*
	(0.13)	(0.13)	(0.13)	(0.07)	(0.14)
Constant	4.577***	5.184***	4.941***	5.812***	5.812***
	(0.58)	(0.59)	(0.64)	(0.87)	(0.73)
Standard errors	Clustered	Clustered	Clustered	Robust	Clustered
Activity fixed effects	Yes	Yes	Yes	Yes	Yes
Year-month fixed effects	Yes	Yes	Yes	Yes	Yes
Municipality fixed effects	No	No	Yes	No	No
Center fixed effects	No	No	No	Yes	Yes
Observations	1,564	1,564	1,564	1,564	1,564
R-squared	0.138	0.19	0.281	0.438	0.438
# of clusters	124	124	124	-	124
# of daycare centers	51	51	51	51	51
# of playgroups	73	73	73	73	73

Standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1

cap result in large net price changes for the parents, child care centers that set prices above the cap most likely operate in markets where demand elasticity with respect to price is relatively low. The effects of a subsidy cut should be more pronounced for or even exclusive to centers with prices below the subsidy cap, which are more likely to be facing a high demand elasticity.

In table 3's first column, we test this hypothesis by introducing an interaction effect in the DD model for daycare centers that have prices below the subsidy cap. The number of observations is lower since price information was unavailable for some daycare centers. In the second column, we estimate a difference-in-difference model that uses child care centers with prices above the subsidy cap as the control group and those with prices below the subsidy cap as the treatment group. In both models, the results show that the effects are only significant for centers with prices below the subsidy cap. The coefficient of -0.2 found in the main model with center fixed effects rises to -0.6 for daycare centers below the subsidy cap. Considering the average daycare center quality in wave 1, that is equal to a drop of about 14% in quality.

Table 3: Effects on the quality of daycare centers below the subsidy cap

Control groups	Playgroups	Above cap daycare
Wave	-0.191	-0.137
	(0.39)	(0.26)
Daycare	-0.370	
	(0.28)	
Below cap daycare	1.671***	0.992***
	(0.306)	(0.379)
Daycare*wave	-0.133	
	(0.144)	
Daycare*wave*below cap	-0.596***	
	(0.17)	
Below cap*wave		-0.501**
		(0.22)
Observations	1,549	679
R-squared	0.466	0.480

Controls for the number of children and adults as well as fixed effects for centers, year-month combinations and activities are included. Clustered standard errors are used in both regressions.
*** p<0.01, ** p<0.05, * p<0.1

To test the robustness of the DD estimates, we implement the synthetic control model introduced by Abadie et al. (2010) as an alternative estimator. As covariates in constructing the weighing vector w that is used to calculate the synthetic control group, we introduce new variables at area and center levels. Both of the fitted models presented in table 4 use the first wave values and the average numbers of staff and children as controls. To control for area level differences, we use municipality level information on income

and neighborhood level information on the number of births. The results using only the area level controls are presented on left side of table 4. We also have data on center characteristics from a managerial survey that was done as a part of the Pre-Cool study. On the right side, center level controls on center age, the size of the parent firm as measured by the number of the other centers owned and the average number of hours the center is open for are introduced. The center age and firm size variables are both linear in categories[1]. Center level controls lead to a loss of observations since the managers' surveys these variables are based on are incomplete. In both cases, the estimated effects appear to be around -0.30, which is larger than the full sample results from the linear DD model with center fixed effects presented in table 2.

Table 4: Synthetic control estimates of the 2012 subsidy reduction effects on average quality

	Area controls			**Area and center controls**		
	Wave 1	Wave 2	Diff	Wave 1	Wave 2	Diff
Daycare centers	4.07	3.54	0.53	4.02	3.56	0.46
Synthetic control	4.06	3.87	0.19	4.02	3.83	0.19
Treatment effect		-0.34			-0.27	
# number of playgroups		63			31	

6. Analysis using non-linear DD models

6.1. Empirical methodology

The linear DD model provides only the treatment effect for daycare centers' average quality. To estimate a non-linear model that takes into account the shift in the full distribution of quality values from 2011 to 2012, we implement the changes-in-changes (CIC) model of Athey and Imbens (2006). The non-parametric changes-in-changes (CIC) model relaxes the additivity assumption in the DD model and compares the changes in distributions rather than the means. The CIC model has two advantages over the linear DD model in our case. First is the significant shift in the distributions of both playgroups and daycare centers' quality values from wave 1 to wave 2. Second, the implication in the DD model that the effects are homogenous for all daycare centers is difficult to justify given that child care markets tend to be localized. Heterogenous effects at different quality levels is to be expected if each quality observation is the result of a unique local market equilibrium.

[1]Center age categories: <1 year, 1-2 years, 3-4 years, 5-10 years, >10 years. Firm size categories (# of centers): 1, 2-5, 6-10, >10.

Within the CIC model, changes in the variance of outcomes over time within treatment and control groups are explained through changes in the production function defined by $Y = h^I(u,t)$ where u are unobserved characteristics at time t. The restriction of the function $h(.)$ is that it is monotonic and increasing in u. In contrast to the DD model which ignores changes in the distribution of outcomes and provides identification through the change in conditional means, identification in the CIC model is based on the full distribution of control and treatment groups before and after the treatment. Given an outcome value in the treatment group in the first wave Y_{10} and its associated quantile q, we first find the matching value in the first wave control group $Y_{00} = Y_{10}$ with its associated quantile q'. Taking into account the change in the cumulative distribution function of the control group in the second wave, we can find the second wave value Y_{01} at quantile q'. The difference between the first and second wave values of the control group at quantile q' equal to the counterfactual change in quantile q of the treatment group in the absence of treatment. Athey and Imbens (2006) show that the complete counterfactual distribution of the treatment group F_{Y^N} can be obtained using equation 4. Once the complete counterfactual distribution is constructed, the average treatment effect can be calculated by taking the difference between the realized distribution of the treatment group and the counterfactual distribution.

$$F_{Y_N}(y) = F_{Y_{10}}(F^{-1}_{Y_{00}}(F_{Y_{01}}(y))) \tag{4}$$

6.2. Results

Similar to the synthetic control model, rather than controlling for classroom characteristics such as the staff to child ratios or the activities at the time of the observation, we use average quality levels from each center to estimate the CIC model. Furthermore, since the full counterfactual distribution has to be estimated, it is possible to calculate the effects at different quantiles. All standard errors are calculated by bootstrapping with 200 repetitions. The analytical standard errors that Athey and Imbens (2006) provide do not differ significantly from bootstrapped standard errors. Additionally, 8 centers that were excluded in the linear DD model due to missing value issues for activity controls and exact dates were reintroduced.

Table 5 shows the average treatment effect along with the estimated effects at 25%, 50% and 75% quantiles. The average treatment effect is similar in size to the estimates from the linear DD models, although it is more significant. The main additional insight of the CIC model are the quantile effect estimates. It is clear from the coefficients from different quantiles that the effects are larger for centers that offered high quality child care in the first period. A possible explanation for the heterogenous effects may be that the low quality child care centers simply do not have any more room to cut costs and lower quality. The het-

erogeneous effects confirm the heterogeneity of the child care markets within the Netherlands. The larger negative effects for higher quality centers suggest a regression to the minimum in terms of quality in the child care sector, where the minimum is defined either by the regulations in place (or parental concerns).

Table 5: Changes-in-changes estimates of the 2012 subsidy reduction effects on average quality

		Quantile effects		
	Average treatment effect	25%	50%	75%
Treatment effect	-0.279**	-0.135	-0.354*	-0.391**
	(0.128)	(0.143)	(0.198)	(0.16)
# of playgroups	78	78	78	78
# of daycare centers	54	54	54	54

Bootstrapped standard errors (200 repetitions) reported.
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

7. Conclusions

This study examined the impact of a subsidy reduction in the Netherlands on child care centers' quality. Exploiting the two-tiered child care system in the Netherlands, we were able to estimate the effect using a natural experiment based on a 2012 subsidy reduction. The results indicate that process quality in Dutch daycare centers declined as a result of the subsidy cut. Moreover, the effects appear limited to child care centers that set prices below the subsidy price cap, which may indicate that centers that face a more sensitive demand curve with respect to prices are more likely to lower quality in order to maintain low prices. The baseline negative treatment effects estimated using linear DD models are robust to the synthetic control and changes-in-changes models. The CIC estimates show that the effects are concentrated on high quality child care centers, that may have had more room to cut costs without losing customers. A more rigorous examination of how the child care market works is needed to make definitive conclusions with regards to the mechanisms involved. However, the conclusion remains that the reduction in subsidies have lowered ECEC quality in the Netherlands.

Currently there appear to be two policy trends pulling in opposite directions when it comes to child care subsidies and ECEC in general. On the one hand, research showing significant positive gains in future outcomes of children attending high quality care has led to discussions on extending the coverage of ECEC services. On the other hand, fiscal crises in many European countries, combined with the already high female participation rates, is leading to cuts in ECEC spending. The results found in this study suggests that

cuts in child care subsidies may have unintended consequences on child care quality and that a singular focus on labor supply effects will underestimate the total costs of a subsidy reduction.

An interesting question to consider is how increases in subsidies would influence child care quality. A straightforward interpretation of the Dutch experience would be that an increase in subsidies would raise both quality and coverage. However, there is no evidence to suggest that the effects of child care subsidies are symmetric. Higher demand as a result of child care subsidies can lead to higher prices if supply does not adjust accordingly and parents' choices are limited. The effects of subsidy increases would need to be considered within the specific market in which they are implemented. Easy entry into the market to allow for more parental choice and regulations on prices may be required to realize concurrent increases in ECEC coverage and quality.

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Appendix A

We calculated the net income and net child care costs of various household types to see what the net increase in monthly child care costs are. To calculate net family incomes, the MICROTAX programme of the Dutch Central Planning Bureau (CPB) is used. To disentangle the effects of the subsidy cut from changes in the tax code, all net incomes are calculated using the tax code applied in 2012. We assume in all cases that the total monthly hours of child care used is 120. In table 1, net costs are calculated for a single parent family, a family with one parent working full time and the other part-time and a dual income family. All calculations are performed for the case with one child in formal child care. In table 2, the net costs for the same household types are shown, but income is raised to twice the median. In table 3, using incomes twice the median, net costs are presented for families with two children in child care.

Table .1: Child care costs of median income households with one child

	Single parent		**1.5 income**		**Dual income**	
Family income	33150		49725		66300	
Net family income	24467		38006		47877	
	2011	*2012*	*2011*	*2012*	*2011*	*2012*
Child care cost	758.4	774	758.4	774	758.4	774
Net cost	90	109	141	175	183	225
% change	21.10%		24.10%		23%	

Table .2: Child care costs of median(x2) income households with one child

	Single parent		**1.5 earners**		**Dual earners**	
Family income	66300		99450		132600	
Net family income	40693		64372		80895	
	2011	*2012*	*2011*	*2012*	*2011*	*2012*
Child care cost	758.4	774	758.4	774	758.4	774
Net cost	152	189	278	336	377	452
% change	24.30%		20.90%		19.90%	

Table .3: Child care costs of median(x2) income households with two children

	Single parent		**1.5 earners**		**Dual earners**	
Family income	66300		99450		132600	
Net family income	40693		64372		80895	
	2011	*2012*	*2011*	*2012*	*2011*	*2012*
Child care cost	758.4	774	758.4	774	758.4	774
Net cost	192	278	332	442	440	603
% change	44.80%		33%		37%	