Centre-based versus home-based childcare

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Centre-based versus home-based childcare[1]

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Abstract

Centre-based childcare is seen as a public investment to facilitate maternal employment. Recent theoretical research proposes that such investments potentially lead to substantial gains in child development and thus to high returns for society as a whole. However, the empirical evidence is still scarce and often contradictory. This study is based on rich survey data of a large-scale cohort study of children living in the Netherlands at the beginning of the new millennium. The Netherlands has made substantial investments in the last two decades to make the market of centre-based provisions more professional and far-reaching and to improve children's school readiness. I study the impact of experiencing centre- rather than home-based childcare on language, cognitive and non-cognitive development, assessed at the age of 6. To assess whether very long or intensive childcare spells can be harmful, I account for possible non-linearity in the correlation between the centre-based childcare experience and the child outcomes. As sensitivity analyses, I also apply instrumental variable and structural equation modelling approaches to try to correct for potential biases in my estimates that would result, for example, from unobserved heterogeneity of parents and children. For both ordinary least square estimates as well as the sensitivity analyses the results do not support the significant short-term effects of centre-based childcare stated in the literature.

Keywords: centre-based childcare, non/cognitive and language development, school readiness, non-linear effects, parental choice (JEL: I21, J13, J24)

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[1] I would like to thank the Data Archiving and Networking Services' Electronic Archiving System (DANS-EASY) for granting me access to the PRIMA dataset *P1701*. In this regard, I also acknowledge the excellent data collection implemented by ITS in Nijmegen and the SCO-Kohnstamm Institute in Amsterdam and the data documentation written by Driessen et al. (2006).

1. Introduction

Centre-based childcare provisions are extended in most countries. The primary objective of this extension is to increase female labour market participation. However, in doing so policymakers are often beset by worries about potential harm for their children if they attend such centre-based childcare arrangements, at a very early age or at institutions of insufficient quality. Concerns include a lack of sufficient evidence whether centre-based childcare provisions provide an environment that sufficiently stimulates child development by replacing the time spent with the child at home and whether they can provide an extraordinary chance for disadvantaged children to develop better than by being cared for 'only' at home.

The Netherlands is an example of a country with a long history of improving and extending childcare provisions. The number of centre-based childcare places increased between 1989 and 2004 from 20,000 to 200,000. The main providers are daycare centres and preschool kindergartens.[2] Early childhood care is provided by daycare centres (or nurseries) that serve children from the age of about 6-8 weeks up to the end of elementary schooling, which includes out-of-school care provisions.[3] Preschool kindergartens cater to the age group of 2-4 years and follow the same basic childcare quality standards. However, there is substantial variation in quality levels across those two types of provisions as well as within them.

Preschool kindergartens are regarded as having a higher average quality as they have focused earlier on professionalization of staff and strongly on stimulating child development; many of these use an early childhood education approach. The child population at preschools tends to come from more disadvantaged backgrounds. Subsidies targeted at those disadvantaged children are used to provide them with an additional education stimulus in preschools. In most cases municipalities subsidize, for example, an additional third and fourth half-day of weekly preschool attendance to children attending preschools that run a certified early childhood education programme. Such programmes have been introduced to a growing number of preschools – first only to urban areas, but increasingly also to rural areas. The mean quality of preschool kindergartens thus tends to be more professionalised, e.g. in terms of the training level of staff. Thus a preschool experience is likely to have a bigger impact on child outcomes than an ordinary

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[2] The Dutch names are '*kinderdagverblijven*' and respectively '*peuterspeelzalen*'.

[3] Dutch elementary schools are called '*basisscholen'* and cover the grades 1-8 (ages 4-12).

daycare experience. Yet, recent reforms and investments in the daycare sector address the quality differences between both types of childcare providers.[4]

Early childhood care and education investments are placed by Cunha and Heckman (2007, 2008) in a dynamic model, in which skills form in multiple stages throughout childhood. Acknowledging also the multiple dimensions of child development and the malleability of abilities at early ages, they argue that earlier investments produce multiplicative skill effects throughout later stages. They argue that non-cognitive skills are most elastic to parental inputs and stronger initial non-cognitive skills promote cognitive development at later stages. Yet, it is important to know which childcare investments have the potential to produce multiplier effects, which implies looking first at the direct outcomes at school enrolment to understand the initial gains.

However, there is still little evidence available on the effects of either source of childcare – be it home- or centre-based – for children from well-off backgrounds as well as for those disadvantaged children who are expected to benefit above average from good quality centre-based care arrangements. Despite a growth of the international evaluation literature on non-parental childcare provisions, a majority of studies focuses on small-scale and targeted childcare programmes rather than on large-scale provisions, such as those that can be found, for example, in the Netherlands. Evidence is often limited in its validity to specific groups of children or country settings.

This chapter assesses whether attending centre-based childcare is related to any significant development gains by the time children start elementary school as compared to home-based care provisions, and whether disadvantaged children benefit above average. It considers daycare and preschool kindergarten jointly as centre-based childcare (*treatment group*) while home-based care refers to any alternative care provisions (*control group*), including primarily parental care but also home-based care for small groups of children by a child-minder. In 2004/05, newly enrolled children at elementary schools had attended on average about 98 half-day sessions at preschool kindergartens and 84 half-day sessions at daycare centres, which aggregates to about 182 half-day sessions in any centre-based childcare arrangement.

I use data from the national cohort study PRIMA and follow up on an earlier, related study by Driessen (2004). New additions as compared to Driessen's paper are the application of a different estimation strategy as well as the use of a more

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[4] The law '*Wet Kinderopvang*' of January 1, 2005, included, next to the reorganization of financing procedures, a new regulation for quality standards, and has the intention to extend and improve the childcare sector so as to allow more mothers to work.

recent wave of the PRIMA data collection. Using a pseudo-experiment and a care selection model, I attempt to identify causal effects of attending daycare centres and preschool kindergartens, as compared to any alternative care arrangements that are home-based. Child outcomes are assessed at the age of six (middle of 2nd grade) and measure cognitive, non-cognitive and language development. To address the question of how much childcare is beneficial and when it turns out to be harmful, I account for non-linearity in the relationship between the duration of care attendance and child outcomes – accounting for attendance information on both types of centre-based childcare separately.

A review of international and Dutch childcare evaluation literature (Section 2) is followed by a description of the analysed dataset (Section 3) and the applied empirical strategy (Section 4). Thereafter, the estimation results are presented and discussed (Section 5), and the chapter is rounded off with final conclusions and policy recommendations (Section 6).

2. Literature discussion

A number of studies provide a comprehensive overview of evaluations of childcare investments that shall compensate in particular for parental childcare time or disadvantaged family backgrounds (see, for example, Camilli, Vargas, Ryan, & Barnett, 2010; Cunha, Heckman, Lochner, & Masterov, 2006; Heckman, 2008; Karoly, Kilburn, & Cannon, 2005; Nores & Barnett, 2009; Waldfogel, Han, & Brooks-Gunn, 2002). The evidence in those studies suggests positive effects in particular when children with disadvantaged backgrounds benefit from more extensive, targeted, high-quality interventions (see, for example, Esping-Andersen, 2004).

Estimated effects of childcare investments are particularly strong for cognitive development domains; even so, other domains such as non-cognitive skills are indicated to be equally relevant for long-term success in life (see, e.g. Borghans, Duckworth, Heckman, & Weel, 2008; Fletcher, 2012; Heckman, 2008; Heckman, 2011; Heckman & Masterov, 2007). Effect measures are lower when large-scaled childcare provisions are evaluated, and often positive effects are shown to be non-lasting.

Magnuson, Ruhm and Waldfogel (2007) estimate the impact of prekindergarten attendance on children's school readiness in the U.S. They find that prekindergarten attendance is positively associated with cognitive and language but negatively with non-cognitive outcomes. Effects on non-cognitive outcomes are more persistent at the beginning of the school trajectory, whereas the cognitive gains are more persistent for disadvantaged children. In a later study on U.S. data, Magnuson and Waldfogel (2005) study the heterogeneity of effects of early childhood care and education attendance on school readiness across different

ethnic, racial and economic backgrounds. They find that childcare attendance is associated with better school readiness and recommend that a substantial increase in enrolment of Hispanic, Black and poor children, as well as in the quality of the childcare that those children attend could potentially improve school readiness.

Gregg et al. (2005) study effects of the large increase in maternal employment in the UK in the last 20 years. Besides studying adverse family background factors that could have negative implications on child cognitive outcomes, they look at the effects of the use of non-maternal childcare on cognitive school readiness. They find that such care can replace the lack of maternal care if the quality is sufficient and recommend that affordable childcare should be available, particularly for very young children. Brilli, Del Boca & Pronzato (2011) confirm such findings by studying the case of Italy. They find positive effects of public childcare, in particular on children's language development and for children with low educated mothers in poor regions. In contrast, Bernal (2008) finds in a comparable analysis with U.S. data that very early maternal employment and use of childcare can have sizable negative effects, in particular for children with higher ability endowments. This reflects that the literature is still inconsistent in the effect estimation of childcare attendance.

The large majority of evaluations of home-based versus out-of-home childcare solutions do not differentiate by the type or quality of non-parental childcare solution. An important contribution has been a study by Datta Gupta and Simonsen (2010) in which they used rich Danish administrative and survey data to assess the effects of home-based care versus preschool and family daycare on a non-cognitive child outcome at age seven. While they find no significant overall differences, they find negative effects of family daycare attendance for boys whose mothers achieved only lower education. In a follow-up study, they assess a non-cognitive child outcome at the age 11 and find no significant differences between types of daycare (Datta Gupta & Simonsen, 2011). Using the same data, Esping-Andersen et al. (2011) compare high-quality centre-based care versus lower-quality child-minding versus family care in Denmark and the U.S. They find a significant and positive effect of high-quality care on reading skills at the age of 11 in Denmark, especially for disadvantaged children. For the U.S. they show that formal school- or centre-based care relates to significant cognitive development gains at school entry. However, they show that these effects are not lasting, in particular for disadvantaged children, e.g. because they may find themselves later on in low-quality schools that undo the initial stimulus effects.

Notwithstanding the growing international research on the effects of childcare, Dutch research on such investments is still limited. Studies have usually been small-scale. The development of pedagogically more structured programmes at preschools has predominantly been accompanied by studies on how much the programmes fulfil official quality standards rather than on how they actually affect

the individual child. There is no evidence of daycare centres having significant effects, but there are some indications that preschool attendance may have some positive effects on language and cognitive skills (Van der Vegt, Studulski, & Kloprogge, 2007).

There are two extensive national empirical studies on the effects of attending early childhood care and education. Driessen (2004; see also Driessen & Doesborgh, 2003) use several earlier waves of the Dutch large-scale PRIMA cohort study (1996-2000) to analyse the (co)variances between different early childhood interventions and child language, cognitive as well as non-cognitive outcomes. The analysis controls for various child and family characteristics and cannot confirm any effects of Dutch early childhood care and education investments on the tested child outcomes, either in the short term (test scores at age 6) or in the medium term (test scores at ages 8, 10 or 12). As soon as child and family background characteristics are controlled for, the weak relationships between early childhood care and/or education participation and test outcomes turn out to be insignificant.

Driessen suggests that insufficient quality of interventions, low intensities and short durations of participation as well as early fading out due to discontinuities of stimulus may be reasons why no significant effects are found. He also quotes Blok & Leseman (1996) in noting that early interventions may not be sufficient to overcome deficiencies in the home environment. However, he points out that additional public investments in early childhood care and education, which have taken place since the year 2000, may eventually lead to significant effects.

The second major evaluation study of Dutch childcare investments was done by Nap-Kolhoff et al. (2008). They use later waves of the PRIMA study (2002-2004) and supplement it with qualitative information on childcare from a web survey of schools and preschools on their use of early childhood education programmes and a number of supportive case studies. Even though Nap-Kolhoff et al. have much more detailed quality information about childcare characteristics available than Driessen and look at early childhood interventions that have progressed in quality since Driessen's study, they also find no significant mean effects, once background characteristics of the child and school fixed-effects are accounted for.

Nap-Kolhoff et al. also look at interaction effects. They find that attendance at a preschool that uses such an early childhood education programme leads to less negative outcomes for several groups: children who are of foreign background (but neither Turkish nor Moroccan), children of native origin, children who have low educated parents, and children who have parents with a middle level of education attainments. While this indicates that the desired stimulus on the target group may have been reached to some degree, the picture is not fully coherent. There is no difference for children of higher educated parents or for Turkish and Moroccan children of low educated parents. Nap-Kolhoff et al. contemplate that conclusions

on mid- and long-term childcare effects cannot be made yet. They also indicate that childcare quality has been lower at locations where such programmes have been implemented more recently. They suggest that more detailed quality information needs to be collected and linked to databases to be able to produce evidence that can properly inform childcare policymaking.

A number of international studies evaluate the importance of childcare duration (years) and intensity (hours per week) in generating an impact on child outcomes. The studies indicate that longer, more intensive childcare experiences are more likely to cause significant development gains, up to a certain amount.

Gorey (2001) finds in a meta-analysis evidence a strengthening of effects with more intense and longer programmes. Another meta-analysis of 117 childcare evaluations by Leak et al. (2010) assesses the importance of the starting age and duration of childcare spells. Their results indicate that a starting age below 3 is associated with higher development outcomes, whereas the duration is not significantly related to child development. Barnett & Lamy (2006) show that childcare as of the age of 3 instead of 4 might increase development gains, e.g. in vocabulary development. Leuven et al. (2010) use the same Dutch PRIMA data and school readiness indicators as used in this chapter; they look at the age variation of elementary school enrolment which usually takes place around age 4 and resembles preschooling in the Netherlands, and show that earlier schooling leads to development gains. A cross-country study using PISA data of Braga, Checchi & Meschi (2011) support these findings. They show that reforms expanding the access to pre-primary education are associated with an increase in average educational attainments.

The intensity and duration of a child's childcare attendance and the socio-economic and ethno-cultural background are determinants of childcare's effectiveness. Landvoigt, Mühler & Pfeiffer (2007) look at two aspects of the length of kindergarten attendance in Germany, duration in terms of years of enrolment and intensity in terms of daily hours. They find that both - non-attendance and full-day attendance - are associated with a significantly lower probability to reach the highest secondary school track. However, they also show that those two groups of children have weaker family backgrounds than children who attend half-days. Also, they indicate that intensity may matter more than duration. Barnett and Lamy (2006) show that longer preschool attendance is associated with higher cognitive and language outcomes. Schütz, Ursprung and Wößmann (2008) show in a comparative study of 54 countries that longer pre-primary education in terms of duration and enrolment is positively associated with cognitive development at mid-level schooling age; systems with longer pre-primary education spells show more equality of opportunity.

Yet, some studies argue that too intensive and very early attendance at childcare institutions could be harmful for children, in particular if these are of insufficient quality. Evidence shows, for example, that within the first year of life centre-based care can be harmful if its quality cannot compensate for the temporary detachment of new-born children from their parents (see, for example, Belsky & Rovine, 1988). However, they indicate that the potential harm relates to attendance at a very early age rather than very intensive attendance; the harmful effect should diminish with increasing ages. Loeb et al. (2005) find that intensive centre-based care at very early ages has positive effects on cognitive and language outcomes, whereas harmful effects on socio-behavioural outcomes are amplified. Results vary by income level and race - poor and Hispanic children benefit above average in their cognitive and language development. Waldfogel (2004) suggests that early intensive interventions might have a positive effect in particular on the socio-emotional development of disadvantaged children.

The possible harm of very early childcare due to the child's detachment from the parents may be caused rather by parental employment, i.e. maternal employment, than by exposure to institutional childcare itself. In a comparative study using longitudinal data from five OECD countries, Huerta et al. (2011) find evidence that, in some of the countries, maternal employment within the first six months after childbirth may have negative but small effects on child outcomes, in particular cognitive development. Yet, they suggest that institutional arrangements such as daycare might have a significant positive and persistent compensation effect on child development, in particular if it is of sufficient quality. And, despite the fact that maternal employment is growing, both parents tend to spend nowadays more developmentally relevant time with their children (see e.g. Bianchi, 2000).

3. Data description

The PRIMA cohort studies have been collected by ITS Nijmegen together with SCO-KO Amsterdam with a biannual frequency between 1994/95 and 2004/05 and studied by many social scientists, in particular to evaluate elementary school investments. The studies follow children at a large, nationally representative sample of elementary schools in the grades 2, 4, 6 and 8. About 30 children were randomly selected at each school for each of the studied grades. The nationally representative sample for the second grade of the PRIMA wave 2004/05 covers a total of 10,751 observations at 309 elementary schools (Driessen et al., 2006). Those children were born in 1998/99 and thus about six years old at the time of data collection. Of the nationally representative sample I use a sub-sample that covers full information in the set of variables that are relevant for my analysis, N=4616.

The PRIMA data originates from four sources: 1) teacher assessments of children's non-cognitive skills; 2) parental survey responses on family background and children's early childhood care and education; 3) schools registry information, e.g.

on general parental and child characteristics; and 4) language and cognitive test scores from the school administrations for the testing period in the middle of the second school grades (March 2005).

I use three indicators of school readiness at the age of 6 for evaluating the effects of childcare attendance. Cognitive and Dutch language test scores come from the nationally comparable 'Cito' tests called *Ordenen* (= arithmetic test) and *Taal voor kleuters* (= Dutch language test for toddlers). Those tests are regularly taken at nearly all Dutch elementary schools. As a third indicator I aggregate teachers' assessments of children's non-cognitive performance in class in terms of work attitude, social behaviour, self-confidence and well-being to a single principal-component factor. For easier comparison I have standardized all three scores of school readiness to a mean of 100 and a standard deviation of 15 (see Appendix Figure 2.a, b and c).

Table 1 gives an overview of the standardized test outcomes across groups of children with different childcare experiences, as described in the survey among parents.

Table 1: Summary statistics on child outcomes by childcare arrangement

	Obs.	Mean	Std. Dev.	Min	Max
Dutch language test at middle of 2nd grade					
Only *home-based care* experienced	424	98.58	14.76	36.93	121.47
Some *centre-based care* attended	4192	102.29	13.58	34.89	123.44
Cognitive test at middle of 2nd grade					
Only *home-based care* experienced	424	99.94	14.23	52.06	125.26
Some *centre-based care* attended	4192	102.05	14.07	39.86	127.70
Non-cognitive assessment by teacher during 2nd grade					
Only *home-based care* experienced	424	100.57	14.31	46.41	135.79
Some *centre-based care* attended	4192	100.67	14.71	31.77	135.79

The sub-sample for which parents provided childcare information shows that about 91 per cent of children experienced centre-based childcare. The survey provides sufficient information to identify which type of centre-based childcare, i.e. preschool kindergarten or daycare centre, the child attended as well as the duration of those childcare experiences. Three quarters of children attended a preschool kindergarten for some time, and nearly every second child attended a daycare centre. Despite the fact that only about one in ten children did not attend any childcare institution before going to school, the spells of centre-based childcare are rather short compared to the possible time children spend at home.

The centre-based childcare attendance can be described not only in terms of type of provision but also in terms of the attendance duration. Parents were asked whether their children attended a daycare centre or a preschool kindergarten and, if they

did so, for how many years and half-days per week. I calculate the doses of half-days of childcare experiences by multiplying the reported years with the reported half-days per week,[5] assuming that there are 40 weeks per year in which a centre is open. However, information about childcare attendance is not available for all children as not all parents have provided information on at least some of the underlying questions. For those who attended centre-based childcare, the average attendance spell was 206 half-day sessions in daycare centres and 129 half-day sessions in preschool kindergartens; a large share of children has attended both types of childcare.

4. Methodology

To estimate the effects of experiencing centre-based versus home-based childcare, I use a linear regression model estimated by Ordinary Least Squares (OLS) in which I correlate standardized outcomes of child i (CO_i) with an attendance dummy of centred-based childcare as treatment variable ($I_{1,i}$) and as conditioning set the duration and type of childcare ($I_{2,i}$), plus the usual control set of child (X_i) and family characteristics (F_i) that are used in such cross-sectional studies to evaluate effects of human capital investments on child outcomes and assumed to be exogenous. The family background factors presumably account for part of the child's development predispositions, to the extent that they are linked to inherited abilities. As there is no further information available on the quality of the provided intervention in the PRIMA dataset, the childcare evaluation is limited to the estimation of mean effects of centre-based childcare provisions. To get consistent standard error estimates, errors are clustered at the individual elementary school group to account for potential nesting of child outcomes ($N_{cluster}$=654).

$$CO_i = \beta_0 + \beta_1 X_i + \beta_2 F_i + \beta_3 I_{1,i} + \beta_4 I_{2,i} + \varepsilon_i \qquad (1)$$

I control for the child's gender, age in months when taking the test[6], and for belonging to an ethnic minority in terms of having at least one parent who was born abroad, and as family background factors I include a dummy variable for living in a single-parent household, the number of children in the household, and whether the mother has been employed for more than 12 hours per week, as well as a categorical indicator for the highest education level that the parents attained. The PRIMA dataset does not include information about household incomes;

[5] A half-day session in the Netherlands, morning or afternoon, lasts on average about 5 hours at a daycare centre and 2.5-3 hours at a preschool kindergarten (see Eurydice, 2007; OECD Review Team, 1999; Van der Vegt et al., 2007).

[6] At that time children have attended elementary school on average for about 23 months when being tested. The enrolment age is not available for about a third of observations; missing values are replaced by average values to keep the sample size up.

instead it provides a proxy indicator for the social milieu of the child's family background, which is a factor score. Moreover, I include the father's Dutch language skills and parental weekly reading of books, newspapers and magazines as proxy variables for the parents' cultural capital with respect to learning.[7]

The ultimate policy goal is to see not only whether any child-centred care experience is beneficial in addition to any home-based care, but also to see whether the type of childcare makes a difference and especially whether children from disadvantaged backgrounds benefit more than others. Therefore, I account for the duration of the childcare spell at daycare centres and preschool kindergartens separately, and I study moderation effects of childcare experiences on the equality of test outcomes across different groups of children. I am particularly interested in whether the impact of childcare experiences varies by gender as well as family background factors such as ethnic origin, parental education and single-parenthood.[8] Those factors are frequently regarded as influencing the chances to do well in life and respectively with the risks of falling behind (see, e.g. Björklund & Salvanes, 2011; Bowles, Gintis, & Osborne Groves, 2005; Jencks, 1979; Leseman, 2002; Plug & Vijverberg, 2001; Wößmann, 2004). To test the heterogeneity of effects, I use estimation models with interaction terms.

4.1. Non-linear link between childcare spell and child outcomes

Despite the given evidence on the variation of childcare effects by duration and intensity (see section 2), most studies evaluating childcare investments use linear specifications for the relationship between childcare attendance and the measured child outcomes. However, effects may eventually be averaged out when using linear specifications. To address this issue with the correct functional form, I explore the relationship in the given data by using local regression smoothing (LOWESS) to trace out whether the relationship between the outcome variables and the amount of childcare attendance has a non-linear pattern.[9] Yet, it is important to note that the unconditional LOWESS graphs do not prove the

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[7] The Dutch language skills of mothers and fathers are highly correlated; I therefore include only the indicator for fathers' language skills. Other indicators of the parents' cultural capital such as the frequency of theatre and museum visits are not used as they are strongly correlated with parental reading.

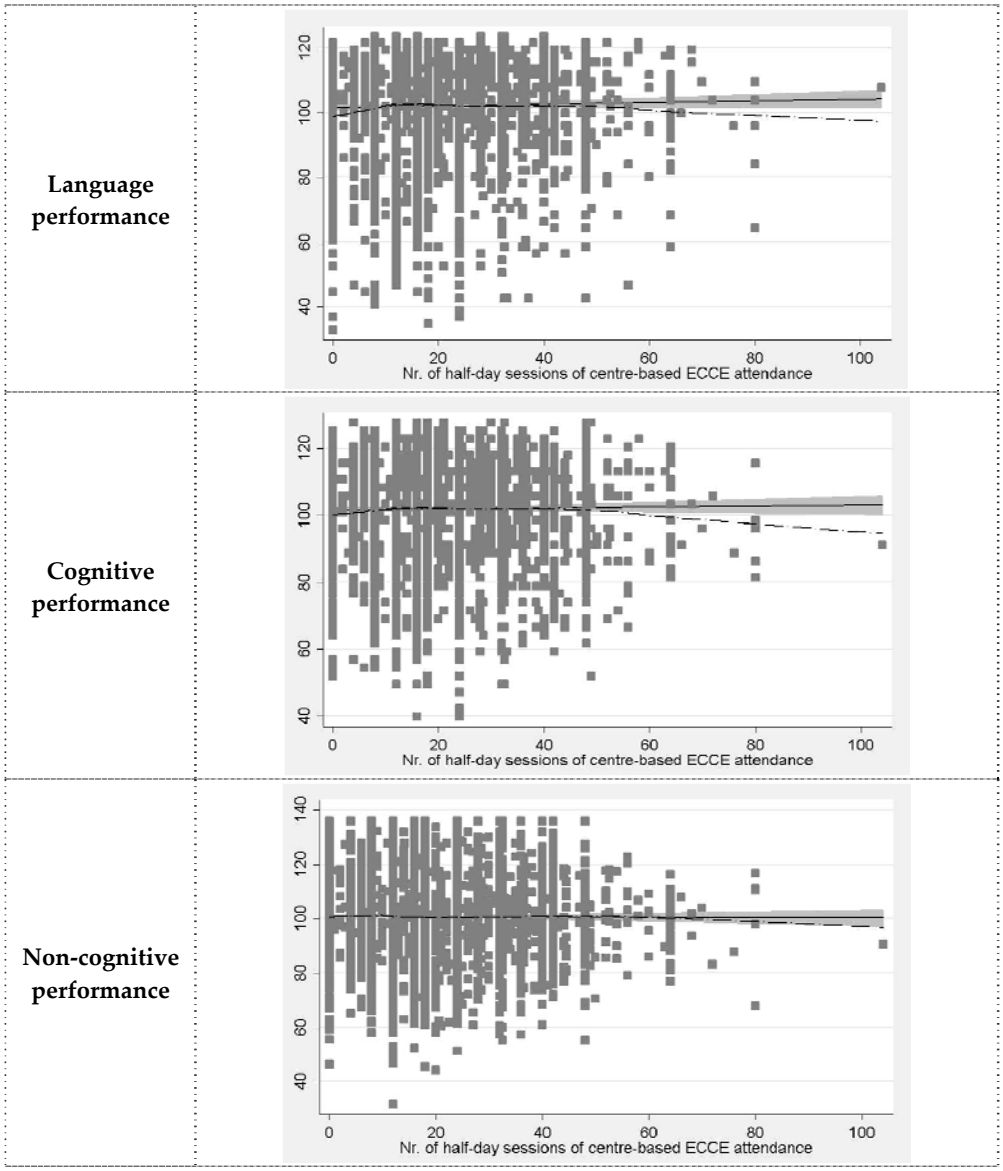
[8] To keep the paper compact, I present only estimation output when I find significance heterogeneity in the treatment effects.

[9] Note that daycare centres are attended much earlier than preschool kindergartens. A too long daycare spell is likely to reflect a too early or too intensive enrolment of the child at the centre-based care. For preschool spells, non-linearity might reflect that too high intensity could be harmful.

existence of nonlinearity in the impact, since they may hide a potential compositional effect or sample sorting. If, for instance, parents were aware of a potential harm of too high intensity of preschool attendance it would be crucial whether they would have any choices with respect to using longer hours; i.e. the poor might more likely choose longer hours because they have to work, the rich might choose the optimal amount.

[For Figure 1, please turn the page.]

Figure 1: Link between child outcomes and centre-based childcare experience



Note: LOWESS smoothing (*dotted line*) of relationship between child outcomes (*vertical axis*) and childcare attendance (*horizontal axis*) and 95 per cent confidence intervals (*shaded area*) around the fitted values (*solid line*).

These figures indicate non-linearity in the relationship between test scores and centre-based childcare attendance, in particular for language and cognitive skills. What could be the reason for such non-linear patterns? The most plausible argument for a levelling off in the relationship between childcare experience and test outcomes would be diminishing returns. This would imply that the marginal returns from additional days of centre-based childcare experiences decrease. In the framework of a human capital production function, this means that the inputs from preschool experience are not causing any additional learning effect for the child anymore, even if the child had stayed for a longer time in the preschool. The pattern indicates not only a levelling off but even negative marginal rates. A possible explanation for this may be that too intensive preschool attendance turns out to be harmful for the child.

Separate LOWESS estimates by different type of centre-based childcare indicate a stronger curvature for preschool kindergarten spells than daycare centre spells. Since the invention of the kindergarten by Friedrich Fröbel in the 19th century, the value and potential harm of early education has been discussed. In comparing the more structured, education-oriented approaches of preschools to daycare centres, critics regarded preschools as having too severe interference with children's needs for playful and unconstrained time to develop themselves in such institutions, causing in particular negative implications for children's non-cognitive development. Proponents have argued that more structured and targeted activities, as for instance to stimulate early math and reading preparedness, are beneficial for a child's development. If there are no hidden compositional effects, a non-linear relationship could reflect that both arguments may be valid.

Such two-dimensional response plots may provide a relatively easy first look at higher dimensions, outliers and other influential observations. Yet, the interpretation of individual frames in a scatterplot matrix is relatively easy only in isolation as a simple regression problem with a 1-to-1 relationship. But the interpretation of a scatterplot matrix can be less straightforward when viewed in the context of a full, multiple regression on a bigger conditioning set that may complicate matters (see Cook, 1998; chapter II). Hence, to interpret the pattern as a nonlinear relationship, I need to make some a priori assumptions regarding what I expect, namely that the function is likely to be smooth and single-peaked (see Leamer, 1983).

Schütz, Ursprung & Wößmann (2008) provide an alternative explanation: they suggest that if human capital accumulation at home is linear in time and if preschooling operates with decreasing returns, it could be possible that children acquire less human capital if they are sent to preschool for a too long time, as children may benefit too little from human capital accumulation at home. This argument may be linked to the fact that parents who send their child for more hours per day to preschool also send the child more years to daycare centres. In

this case children would spend insufficient time with their parents, which would manifest weaker test performance if parental influence has no diminishing returns. The data does not provide information on the ages when children attended either of the institutions, but there is some evidence that among children who have attended both types of childcare institutions (about 28 per cent) the years spent in preschool are positively correlated to the years spent in daycare centres, while the enrolment age at elementary school is about the same for any subgroup of children.

To account for possible non-linearity in the relationship between childcare attendance and the child outcomes, I add a quadratic term of the approximated number of hours of childcare attendance in line with other researchers such as, for example, Landvoigt, Mühler & Pfeiffer (2007). Such quadratic terms have not been used in any of the major studies on Dutch early childhood education yet. As centre-based childcare spells can potentially be longer when a child enrols in elementary school at a later age, I also control for the enrolment age (in months).

4.2. Instrumental variable (IV) application

When testing the cross-sectional regression models I cannot ignore possible joint determination of the dependent variable and the treatment variable, e.g. because important explanatory variables such as the unobserved initial ability endowment of the child before daycare attendance might be insufficiently accounted for by the included child and family background factors. This could cause the variation in childcare attendance to have unobserved (endogenous) heterogeneity and result in biased and inconsistent OLS estimates. This reflects a typical problem in evaluating the effects of human capital investments such as childcare and education when no controlled experiment is available or feasible. An alternative approach is to use an instrumental variable that does not determine the studied child outcome but provides information on exogenous variation on the potentially endogenous treatment allocation, which can be used for a two-stage least squares (2SLS) estimation (see, for example, Angrist, Imbens, & Rubin, 1996; Imbens & Angrist, 1994).

As potential sources of exogenous variation I use the aggregate daycare and preschool attendance at the larger geographic level of provinces; I find significant variation across the twelve provinces in preschool and daycare attendance, which reflects different progress between more urban and rural regions in extending centre-based childcare provisions (see Table 7). A similar application of geographic aggregates as source of instrumental information on the treatment variable has been done by Dustmann & Preston (2001); they evaluated the impact of ethnic minority group concentration in the UK on the attitude towards those ethnic groups. Heckman, Layne-Farra & Todd (1995) as well as Card & Krueger (1996) use aggregate statistics to evaluate the effect of school quality on earnings. They

indicate the importance of non-random sorting of residence to identify consistent effect estimates. For that reason, I need to assume that parents do not choose their residence according to the available childcare provisions. Parents' influence on the overall preschool quality in the province is marginal, and it is unlikely that parents move across provinces due to daycare and preschool availability. Parental sorting within the province does not affect the overall composition in the province, and within-province sorting should therefore not affect validity of the IV estimation.

While the presence of such exogenous variation can only be argued theoretically, the strength of the correlation between the IV and the treatment variable can be confirmed by first-stage estimation results conditional on all the other explanatory variables. To assess the power of the IV application, a Wooldridge test (1995) can show whether the instrumented variables are exogenously determined and a Hausman test (1978) can assesses whether there are systematic differences between coefficients of IV and OLS estimates.

4.3. Structural equations modelling (SEM)

Instrumental variable applications formulate straightforward moment conditions without any explicit assumptions about a specific structural model on the selection into treatment. However, the chosen instrumental variable could turn out to be a weak predictor of the treatment variable. This can be tested, by looking at the first-stage correlation between the instrument and the studied treatment. Yet, the instrumental variable might provide only a local average treatment effect (LATE) estimate if the endogenous treatment effect is heterogeneous (Imbens & Wooldridge, 2007). In that case, approaching the issue of causality from a theoretical point of view by modelling the choice into treatment participation is an alternative strategy to get closer to unbiased effect inferences in a structural way.

Structural equations modelling (SEM) provides more flexibility than instrumental variable approaches by allowing correlated error terms and modifications to look at heterogeneous treatment effects, without additional assumptions, e.g. about linearity, as in IV applications (Bernal & Keane, 2010). It also allows a combination of various decisions in a structured way (see, e.g. Keane & Wolpin, 1997). And SEM provides more efficient parameter estimates than IV estimates as it considers all information simultaneously. However, SEM becomes unbiased only with large samples and possibly turns out to be more sensitive to violations of assumptions than IV estimates; errors in one strand of the system of relations that SEM estimates may have unknown effects throughout the system.

SEM is often used in the economic literature to guide empirical work or to make predictions as they explicitly allow for the construction of counterfactual results that are often lacking when evaluating treatment effects without having experimental data with a random treatment allocation at hand (Angrist & Krueger,

1999; Heckman & Macurdy, 1986). Despite this advantage, SEM examples are still rare in the childcare evaluation literature. As an exception, Arnold et al. (1998) apply 2SLS and SEM to evaluate the impact of teachers' laxness or over-reactive discipline in daycare on child behavioural outcomes. And in a more recent study Bernal and Keane (2010) use SEM to model maternal employment and childcare choices to 'quasi-structurally' evaluate the effect of non-maternal childcare for children of single mothers. They use variation in welfare rules across states as a plausible exclusion restriction, finding evidence for biases that are due to unobserved heterogeneity.

The system of equations of the SEM is assessed by a two-step estimation procedure, controlling directly for the correlation between the error term in the outcome equation with the treatment variable (Heckman, 1976). The binary treatment choice that is modelled in the first stage estimates at which threshold of explanatory variables the choice switches from mere early childhood care at home, i.e. by parents, relatives or nannies, to attending any centre-based childcare institution (see e.g. Heckman, 1978). The generated inverse Mills ratio augments the second stage estimation for the outcome equation to control for potential selection biases that are a result of omitted variables.

I model the choice into any childcare centre, under control for the child's background and the type and duration of childcare attendance. The choice for centre-based childcare is driven by a number of demand and supply factors. On the demand side, maternal employment is anticipated to be the most relevant factor, in particular among poorer or single parents. Since the late 1980s, the Dutch government has been promoting maternal employment through gradual extension of centre-based childcare provisions. Parents with more children are expected to choose centre-based childcare arrangements less often. Parental preferences as approximated by parental education, cultural capital and language skills are additional factors determining the demand for centre-based childcare. Parents with higher endowments of such factors are more likely to choose centre-based provisions, i.e. because they are better informed about how to access them. Choices are also determined by supply factors such as availability, user fees and quality attributes. Despite discounts in such fees for poorer parents, parents with higher incomes are more likely to be able to afford centre-based childcare (see e.g. Gathmann & Sass, 2012).

When assessing parental childcare choices, it is essential to understand whether parents perceive the quality of a specific centre-based childcare provision as being higher or lower than home-based alternatives. Hence, in the selection equation, I also account for the type of centre-based care, a commonly used quality indicator. There might be trade-offs between different determinants of the decision for a specific childcare provision. Parents might prefer, for example, high-quality childcare arrangements if they choose to have fewer children (for a discussion of

the quality-quantify trade-off, see e.g. Blau & Hagy, 1998; Ermisch, 1989). An extensive set of background factors is included in the choice models to account for them.

As an exclusion restriction, I use variation across provinces, degree of urbanization at the parent's home, and whether parents adhere to a religious belief. These factors enter only the choice equation but not the outcome equation (see, e.g. Heckman, Lalonde, & Smith, 1999; Verbeek, 2000).[10] Those three exclusion restrictions prove to be irrelevant in predicting the child outcomes but very important in predicting variation in centre-based childcare attendance.

In the first stage, I estimate a *probit* function of the treatment dummy for centred-based childcare attendance ($I_{1,i}$), on child characteristics (Xi), family background factors (F_i), the duration and type of childcare ($I_{2,i}$) and the restriction variables: indicators for each province (P_i), for the degree of urbanization (U_i) and for having a religious faith. The estimated choice equation (2) is hence:

$$\Pr(I_{1,i}) = \gamma_0 + \gamma_1 X_i + \gamma_2 F_i + \gamma_3 I_{2,i} + \gamma_4 P_i + \gamma_5 U_i + \gamma_6 R_i + \delta_i \qquad (2)$$

From these estimates, I obtain the inverse Mills ratio, which is the ratio of the probability density function of the predicted values to the cumulative distribution function of the predicted values. The inverse Mills ratio enters then in the second stage, the outcome equation (1).

5. Estimation results

I first assess the impact of centre-based childcare with OLS estimations and then turn to instrumental variable and structural equations model applications to address possible biases.

5.1. OLS estimates

I run a number of OLS estimation models for the three school readiness indicators, including a number of interactions with subgroup indicators – gender, parental education, single parenthood, social milieu of the household and ethnic origin. For

[10] The Netherlands has 12 provinces. PRIMA sub-samples per province are not representative, yet there is no indication of any systematic sampling interference that could bias the relationship between childcare attendance and the province indicators. The urbanization degree ranges from 0 = "completely rural" to 5 = "completely urban". The indicator for religion reflects maternal religious beliefs, which are strongly correlated with paternal religious beliefs, 0.76. Among the mothers covered by the sample, about 35 per cent do not adhere to any belief, 28 per cent adhere to the roman-catholic church, 20 per cent to reformed beliefs, 4 per cent to other Christian confessions, 9 per cent to the Islam, and less than 3 per cent to other beliefs.

convenience only estimation output of significant interactions is presented. To test the validity of non-linearity in the relationship of the treatment to the outcomes, I run the full estimation model with and without squared terms. I include both attendance spells together as they describe separate influences in early childhood.

[For Table 2 please turn the page.]

Table 2: OLS regression output

	Dutch language skills			Cognitive skills			Non-cognitive skills	
Estimated OLS Model	**1**	**2**	**3**	**5**	**6**	**7**	**8**	**9**
Childcare indicators								
Centred-based childcare	-0.92		-1.14	-1.26		-0.3	0.25	
(attendance dummy)	[-0.88]		[-1.10]	[-1.23]		[-0.26]	[0.22]	
Daycare attendance	0.05	0.02	0.05	0.07*	0	0.07*	-0.02	-0.01
(in units of 10 half-day sessions)	[1.42]	[1.16]	[1.40]	[1.67]	[0.19]	[1.69]	[-0.49]	[-0.82]
Length of daycare attendance,	0		0	0		0	0	
squared term	[-0.14]		[-0.13]	[-1.02]		[-1.05]	[0.31]	
Preschool attendance	0.24***	-0.01	0.24***	0.19**	-0.05	0.19**	-0.04	-0.09**
(in units of 10 half-day sessions)	[2.79]	[-0.34]	[2.79]	[2.09]	[-1.50]	[2.07]	[-0.41]	[-2.56]
Length of preschool attendance,	-0.01***		-0.01***	-0.01***		-0.01***	0	
squared term	[-3.29]		[-3.30]	[-2.90]		[-2.85]	[-0.77]	
Subgroup interaction effects								
Centre-based childcare X						-3.12*		
low educated parents						[-1.92]		
Centre-based childcare X			9.49*					
single parent			[1.68]					
Child characteristics								
Gender	-2.40***	-2.40***	-2.40***	-1.76***	-1.75***	-1.75***	-5.76***	-5.76***
(boy=1)	[-6.52]	[-6.46]	[-6.52]	[-4.53]	[-4.49]	[-4.49]	[-14.24]	[-14.28]
Age at time of testing	8.36***	8.34***	8.43***	8.46***	8.43***	8.44***	1.63***	1.64***
(in years, middle of 2nd grade)	[14.99]	[14.98]	[15.07]	[14.22]	[14.17]	[14.19]	[2.59]	[2.59]
Ethnic minority	-9.42***	-9.86***	-9.39***	-4.25***	-4.58***	-4.35***	5.22***	5.06***
(min. one parent born abroad = 1)	[-7.76]	[-8.14]	[-7.78]	[-4.19]	[-4.52]	[-4.29]	[5.28]	[5.20]

(continued on next page)

Table 2 *(continued)*

(continued)	Dutch language skills			Cognitive skills			Non-cognitive skills	
Estimated OLS Model	**1**	**2**	**3**	**5**	**6**	**7**	**8**	**9**
Family background factors								
Parenthood *(single-parents = 1)*	-1.56 [-1.39]	-1.52 [-1.35]	-10.52* [-1.90]	-1.98* [-1.68]	-1.95* [-1.65]	-1.91 [-1.62]	-1.19 [-1.08]	-1.18 [-1.07]
Number of children in household	-0.23 [-0.98]	-0.27 [-1.18]	-0.25 [-1.07]	-0.04 [-0.14]	-0.05 [-0.18]	-0.03 [-0.10]	0.83*** [3.33]	0.79*** [3.16]
Mother's employment *(>12hrs / week = 1)*	-0.25 [-0.60]	-0.26 [-0.61]	-0.23 [-0.56]	-0.01 [-0.01]	-0.03 [-0.07]	-0.02 [-0.05]	0.6 [1.34]	0.61 [1.37]
Highest parental education: level 2 *(Middle / professional educ.)*	3.83*** [5.51]	3.83*** [5.51]	3.86*** [5.56]	3.11*** [4.42]	3.08*** [4.38]	0.42 [0.27]	-1.28* [-1.78]	-1.26* [-1.77]
Highest parental education: level 3 *(Higher / professional / acad. educ.)*	4.89*** [6.80]	4.85*** [6.79]	4.94*** [6.88]	5.06*** [6.85]	5.00*** [6.76]	2.35 [1.46]	-0.4 [-0.52]	-0.38 [-0.50]
Parental reading *(hours per week)*	-0.05 [-1.46]	-0.05 [-1.45]	-0.05 [-1.48]	-0.03 [-1.02]	-0.03 [-1.03]	-0.03 [-0.97]	-0.07** [-1.97]	-0.07** [-1.98]
Father's Dutch language skills	1.78*** [4.39]	1.80*** [4.44]	1.77*** [4.36]	0.62 [1.54]	0.64 [1.58]	0.62 [1.53]	-0.04 [-0.09]	-0.03 [-0.08]
Social milieu *(PRIMA VI factor score)*	4.33*** [12.87]	4.32*** [12.87]	4.32*** [12.83]	4.76*** [13.64]	4.74*** [13.68]	4.77*** [13.66]	7.68*** [20.86]	7.69*** [20.91]
Constant	26.21*** [6.52]	26.86*** [6.69]	26.15*** [6.52]	28.78*** [6.63]	29.18*** [6.65]	30.60*** [7.04]	63.75*** [13.35]	64.17*** [13.72]
Observations	4616	4616	4616	4616	4616	4616	4616	4616
Adjusted R^2	0.23	0.23	0.23	0.16	0.16	0.16	0.17	0.17

Note: Test scores are standardized to mean 100, standard deviation 15; * significant at 10 per cent level, ** at 5 per cent level, and *** at 1 per cent level; clustered at individual school group level (robust t-stat. in parentheses).

The included child and family background characteristics show the usually expected signs. Notwithstanding the rather large sample size, I do not find any significant correlation with the child outcomes for the indicators of maternal employment, and parental customary weekly reading is also only marginally significant.

Coefficients for daycare attendance are significant, which comes to a surprise given that the average daycare spells are longer than the average preschool spells. It may reflect that daycare attendance is neutral in comparison to parental childcare. As preschools have presumably been of higher quality than daycare centres in the early 2000s, I would expect to find some significant relationships, at least for the preschool attendance indicators. None of the centre-based childcare estimates are significant. There is only a significant mean effect of the preschool attendance for non-cognitive skills, but it points to a negative relationship. This may reconfirm the argument that overly structured childcare experiences could turn out to be harmful. However, if I account for possible non-linearity I find a significant positive main effect of preschool attendance on language and cognitive outcomes, with decreasing returns to more attended half-days, although the effects are very small in scale.

Frequently, focusing on the mean as a measure to identify effects (as done with OLS) results in a disregard of properties at the end of the tails of the distribution or of distorting impacts of outliers. The estimated effects of centre-based childcare might be sensitive to such distributional aspects – effects might be more significant at other quantiles than at the mean or even show opposite signs (see Koenker & Basset, 1978). Therefore, I estimate the impact of centre-based childcare attendance also on different quantiles of the conditional distribution of the error term (see Table 8 in the Appendix).

Quantile regressions reconfirm largely that centre-based childcare does not significantly predict child outcomes. However, effect estimates by decile indicate some evidence for negative effects of centre-based childcare at the lowest end of the distribution for language and cognitive development; this could suggest that centre-based childcare could be harmful for disadvantaged children. There is some evidence for positive effects of centre-based childcare on child language and non-cognitive outcomes closer to the median.

When looking at the variation of childcare attendance effects across various subgroups whose backgrounds are presumably disadvantageous, I cannot find any effect of heterogeneity for the majority of such subgroups. However, there are significant correlations for some of the interactions with the group of children with less educated parents and children of single parents; centre-based childcare shows a more positive effect for children of single parents, but a rather negative effect for children of less educated parents.

When running the regressions by potentially disadvantageous subgroup and by the main group separately, neither output shows any significant effects from centre-based childcare. There is one exception, though. For the sub-sample of children from ethnic minorities, centre-based childcare shows marginally significant effects on language development and strongly significant effects on cognitive development – both effects being negative.

5.2. IV estimates

In the following, I try to assess whether omitted variable bias may have influenced the OLS results. I use the aggregated mean of the child-centred childcare dummy at the province levels to instrument for the choice for centre-based childcare.

Table 3: 2SLS regression output, applying the instrumental variable

a. 1st stage results

Dependent variable	**Centred-based childcare** *(attendance dummy)*
Instrumental variable:	
Province aggregate of child-centred childcare	0.46***
	[9.44]
1. Joint significance of the instrument(s) in the first stage; critical values F>10	F= 41.13
	p=0.00
	IVs strong

Note: Robust t-statistics in parentheses; * significant at 10 per cent level (|t|>1.64), ** at 5 per cent level (|t|>1.96); *** at 1 per cent level (|t|>2.58). A critical F value for the test on joint significance of the IVs (see test 1) is 10 (as stated, for example, in Baum, Schaffer, & Stillman, 2003).

The first-stage output of the 2SLS-regressions shows that the province aggregates strongly predict the individual spells (see Table 3.a).

b. 2nd stage results

	Dutch test (M2)		Cognitive test (M2)		Non-cognitive assessment	
Estimated model	OLS (2)	2SLS (1)	OLS (6)	2SLS (2)	OLS (9)	2SLS (3)
Childcare indicator						
Centred-based childcare	-0.92	-10.04	-1.26	-18.66*	0.25	13.86
(attendance dummy)	[-0.88]	[-1.07]	[-1.23]	[-1.76]	[0.22]	[1.21]
Attendance variables	YES	YES	YES	YES	YES	YES
Child characteristics	YES	YES	YES	YES	YES	YES
Family background factors	YES	YES	YES	YES	YES	YES
Constant	26.21***	30.29***	28.78***	36.56***	63.75***	57.66***
	[6.52]	[5.20]	[6.63]	[6.16]	[13.35]	[8.55]
Observations	4616	4616	4616	4616	4616	4616
Adjusted R^2	0.23	0.21	0.16	0.10	0.17	0.14

Note: Robust z-statistics in parentheses, clustered at individual school group level (=654 clusters); * significant at 10 per cent level (|z|>1.64), ** at 5 per cent level (|z|>1.96); *** at 1 per cent level (|z|>2.58).

The 2nd stage output of the 2SLS regressions shows no significant effects for child-centred childcare attendance on language and non-cognitive outcomes. However, child-centred childcare attendance is marginally significant in determining cognitive outcomes.

c. Post-estimation model tests

Dependent variable	**Dutch test (M2)**	**Cognitive test (M2)**	**Non-cognitive assessment**
Estimated 2SLS model	**2SLS (1)**	**2SLS (2)**	**2SLS (3)**
2. Wooldridge's test of exogeneity of instrumented variables	F=1.00	F=3.16	F=1.44
	p=0.32	p=0.08	p=0.23
	endogenous	(marginally) endogenous	endogenous
3. Hausman test for systematic differences between 2SLS and OLS estimation model	χ^2=13.16	χ^2=13.06	χ^2=4.46
	P=0.44	P=0.44	P=0.99
	No diff.	No diff.	No diff.
Interpretation of IV results	Prefer OLS	Prefer OLS	Prefer OLS

Note: I test for each of the two stage least squares models whether it is better than an ordinary least squares specification, i.e. I use a Wooldridge test (1995) to see whether OLS are providing consistent estimates because the instrumented variables are actually exogenously determined. And finally I use a Hausman test (1978) to check for systematic differences in the consistency and efficiency in the specifications of each IV and OLS estimation model.

Post-estimation tests show that there is reason to worry about endogeneity (see Wooldridge's test of exogeneity) and thus to look for a better identification strategy than OLS estimates. However, the 2SLS estimates result in no systematic difference to the OLS estimates. This indicates that the chosen IV might be too weak or heterogeneous in predicting the treatment variable; an alternative estimation strategy may be needed.

5.3. SEM estimates

Structurally estimating the choice for the mode of childcare provides an alternative method to amend possible selection bias of effect estimates. The following table shows the *probit* estimates of the childcare choice model.

Table 4: SEM 1st Stage - *probit* centre- versus home-based childcare choice

Dependent variable	**Centred-based childcare** *(attendance dummy)*
Child characteristics	
Gender *(boy=1)*	0.09 [1.49]
Age at time of testing *(in years, middle of 2nd grade)*	0.00 [-0.00]
Ethnic minority *(min. one parent born abroad = 1)*	0.05 [0.39]
Family background factors	
Parenthood *(single-parents = 1)*	0.17 [0.93]
Number of children in household	-0.47*** [-15.42]
Mother's employment *(>12hrs / week = 1)*	0.22*** [2.76]
Highest parental education: level 2 *(Middle / professional educ.)*	0.34*** [4.07]
Highest parental education: level 3 *(Higher / professional / acad. educ.)*	0.47*** [4.99]
Parental reading of books, newspapers or magazines *(hours per week)*	-0.01*** [-3.12]
Father's Dutch language skills	0.02 [0.41]
Social milieu *(PRIMA VI factor score)*	0.17*** [3.62]

Exclusion restrictions	
Drenthe	0.08
	[0.39]
Flevoland	-0.43***
	[-2.68]
Friesland	0.00
	[0.01]
Gelderland	-0.17
	[-1.58]
Groningen	-0.62***
	[-3.84]
Limburg	0.17
	[1.18]
Noord-Brabant	0.51***
	[3.84]
Noord-Holland	0.25**
	[2.16]
Overijssel	0.54***
	[2.77]
Utrecht	-0.67***
	[-3.88]
Zeeland	-0.44***
	[-2.95]
Zuid-Holland	*dropped*
Degree of urbanization *(completely rural = 1 / completely urban = 5)*	0.08**
	[2.51]
Religion of the mother *(no religious affiliation = 1)*	0.53***
	[6.46]
Constant	1.26**
	[2.07]
Observations	4607
Adjusted R^2	0.26

Note: The sub-samples of schools are not representative for the provinces.

The probit estimates for the first step of the structural model show that child characteristics are not determining the choice for centre-based care, whereas family background factors show the expected significance and directions. Parents with more children tend to send their children less often to a centre-based care arrangement. Better educated parents, those from higher social milieus, and employed mothers tend to opt more often for centre-based childcare.

The chosen exclusion restrictions – province indicators, degree of urbanization and mothers' religiosity - are significant determinants of the choice for centre-based childcare. In some provinces, such as Noord-Brabant, Noord-Holland and Overijssel, parents are more likely to send their child to centre-based care arrangements; in other provinces, i.e. Flevoland, Groningen, Utrecht and Zeeland,

parents are less likely to do so. In more urban areas, it is more likely that parents will chose a centre-based care arrangement. More religious parents tend to keep their children at home.

Table 5: SEM 2nd Stage - OLS regression model including Mills ratio

Dependent variable	**Dutch language skills**	**Cognitive skills**	**Non-cognitive skills**
Estimated SEM Model (2nd stage)	**1**	**2**	**3**
Childcare indicators			
Centred-based childcare	-0.70	-0.60	-0.18
(attendance dummy)	[-0.73]	[-0.59]	[-0.17]
Daycare attendance	0.05	0.06	-0.02
(in units of 10 half-day sessions)	[1.33]	[1.56]	[-0.43]
Length of daycare attendance, squared term	0.00	0.00	0.00
	[-0.12]	[-0.95]	[0.24]
Preschool attendance	0.24***	0.19**	-0.04
(in units of 10 half-day sessions)	[2.77]	[2.04]	[-0.42]
Length of preschool attendance, squared term	-0.01***	-0.01***	0.00
	[-3.37]	[-2.87]	[-0.72]
Child characteristics			
Gender	-2.40***	-1.72***	-5.78***
(boy=1)	[-6.70]	[-4.49]	[-14.55]
Age at time of testing	8.34***	8.44***	1.59***
(in years, middle of 2nd grade)	[16.33]	[15.43]	[2.81]
Ethnic minority	-9.53***	-4.48***	5.42***
(min. one parent born abroad = 1)	[-12.58]	[-5.52]	[6.44]
Family background factors			
Parenthood	-1.56	-1.96*	-1.19
(single-parents = 1)	[-1.59]	[-1.86]	[-1.09]
Number of children in household	-0.39	-0.61*	1.21***
	[-1.24]	[-1.82]	[3.48]
Mother's employment	-0.20	0.16	0.47
(>12hrs / week = 1)	[-0.48]	[0.37]	[1.04]
Highest parental education: level 2	3.91***	3.43***	-1.42**
(Middle / professional educ.)	[7.04]	[5.76]	[-2.31]
Highest parental education: level 3	5.02***	5.51***	-0.64
(Higher / professional / acad. educ.)	[8.03]	[8.23]	[-0.92]
Parental reading of books, newspapers or	-0.05*	-0.05	-0.06*
magazines *(hours per week)*	[-1.76]	[-1.56]	[-1.73]
Father's Dutch language skills	1.81***	0.72*	-0.10
	[5.21]	[1.92]	[-0.25]
Social milieu	4.37***	4.89***	7.60***
(PRIMA VI factor score)	[15.37]	[16.06]	[24.12]

Control function	1.08	3.92**	-2.57
(Mills ratio)	[0.68]	[2.31]	[-1.46]
Constant	26.10***	27.94***	64.53***
	[7.03]	[7.03]	[15.68]
Observations	4607	4607	4607
Adjusted R^2	0.23	0.16	0.17

Note: Test scores are standardized to mean 100, standard deviation 15; * significant at 10 per cent level, ** at 5 per cent level, and *** at 1 per cent level; clustered at individual school group level (robust t-stat. in parentheses).

The control function estimates once again reconfirm that there is no significance of coefficients on centre-based childcare attendance. Given that the tested structural equations reflect the true character of selection into centre-based childcare, the partial insignificance of the coefficient on lambda (the inverse Mill's ratio) suggests that the selection bias is not very large in this model. And indeed, the coefficient estimate on the treatment variable changes little compared to the simple OLS model Table 2. For cognitive skills, the significance of lambda suggests that the control function works better, indicating some selection bias. Yet, the coefficient of the treatment variable is not significant, which is in line with the OLS estimates.

6. Conclusions

The last decades have seen a substantial increase in maternal employment in the first year after giving birth. When skill gains multiply over a lifetime (see, e.g., Heckman, 2008), small initial skill returns from centre-based early childhood care and education can turn out to produce larger long-term effects.

My analysis shows that previous studies may have prematurely concluded that there are indeed significant short-term effects of centre-based childcare attendance on child outcomes. Attempts to deal with potential omitted variable biases by applying instrumental variables and structural equation models reconfirm ordinary least square estimates.

The results are based on different types of tests to assess the impact of centre-based childcare. Ordinary least square estimates assess the average treatment effect of centre-based childcare on school readiness. Instrumental variable estimates provide local average treatment effects that are corrected for possible biases, local implying that the instrument may not be valid across the whole range of treatment. And finally, I use structural equations modelling to account for possible biases. All tests point in the same direction, namely an absence of significant results. The structural estimation seems to work better with cognitive skills; this indicates that, if at all, cognitive skills seem to be the most affected, which is entirely consistent with the role of childcare.

The absence of significant effect estimates contradicts the evidence provided by Van de Vegt, Studulski & Kloprogge (2007), who find some indication of positive effects of preschooling on language and cognitive outcomes, as well as by Magnuson, Ruhm & Waldfogel (2007), who find a negative main effect of pre-kindergarten attendance on non-cognitive short-term child outcomes. They reconfirm the findings of Driessen (2004; see also Driessen & Doesborgh, 2003), who studied the effectiveness of centre-based childcare for an earlier period using co-variation techniques and stressing that controlling for background factors leads to a disappearance of significant effect estimates.

When taking a closer look at how centre-based childcare experiences affect children who are at risk of falling behind in their later schooling, my results do not confirm the expected positive impacts or even point towards weaker cognitive outcomes for children of less educated parents. Only children of single parents are associated with higher language scores. Quantile regressions indicate that centre-based childcare may be harmful for disadvantaged children that are more likely to be represented in the lower end of the distribution for language and cognitive outcomes but beneficial for children with outcomes closer to the median with respect to language and non-cognitive development.

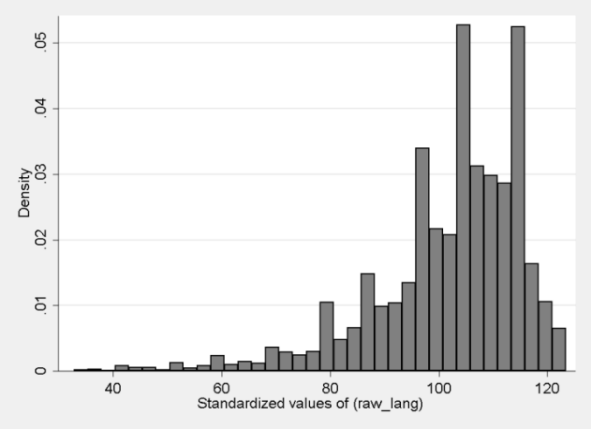
The lack of evidence on mean effects of centre-based childcare on all child development domains, combined with the indicated harmful effects for more disadvantaged children, raises questions about the quality and length of childcare spells that children of different background have actually experienced. Do disadvantaged children fare better if they attend higher quality centre-based childcare or attend shorter spells? I do find some evidence that there is a non-linear relationship between spells of centre-based childcare and child outcomes, in particular between preschool kindergarten attendance and language and cognitive development. By accounting for non-linearity in the spell of preschool kindergarten and centre-based daycare respectively, I partially control for potentially averaging out effects.

I conclude, in line with the literature, that the effects of centre-based childcare may be averaged across all qualities of daycare centres and preschools, preschooling being more likely to stimulate child development, and daycare attendance not being harmful. Further research is needed to identify whether there is stronger evidence for the effect of quality differences on childcare experiences.

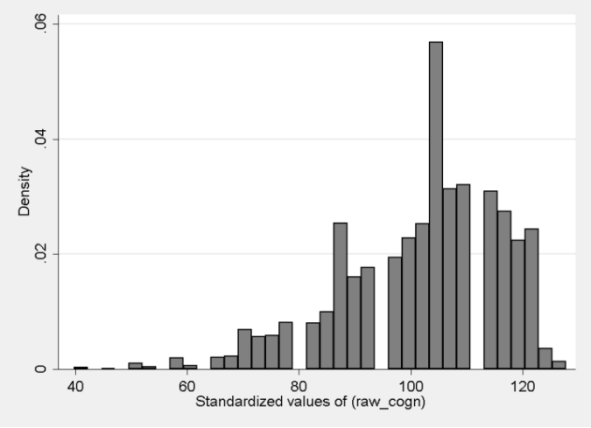
Appendix

Figure 2: Distribution of standardized child outcomes

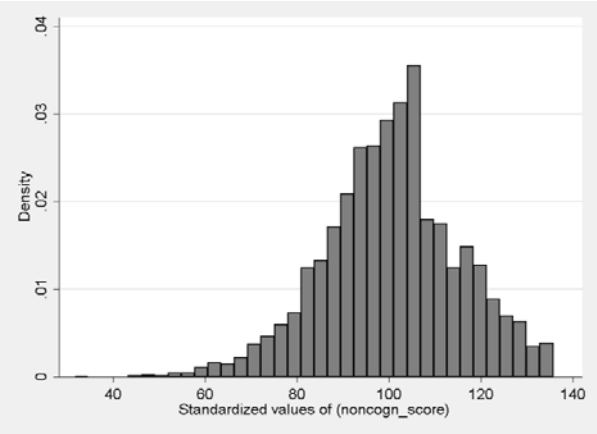
a. Dutch language test, M2



b. Cognitive test, M2



c. Non-cognitive assessment by teacher



Note: Cito test scores have been standardized to a mean of 100 and standard deviation of 15.

Table 6: Descriptive statistics

Control variable	N	Mean	Std. Dev.	Min.	Max.
Dutch test *(taal voor kleuters, M2-testing moment)*	4616	101.945	13.731	32.9	123.4
Cognitive test *(ordenen, M2-testing moment)*	4616	101.852	14.093	39.9	127.7
Non-cognitive assessment score *(teacher's assessment at moment of survey)*	4616	100.661	14.672	31.8	135.8
Daycare attendance *(in units of 10 half-day sessions)*	4616	8.395	13.309	0.0	80.0
Preschool attendance *(in units of 10 half-day sessions)*	4616	9.706	6.991	0.0	40.0
Gender *(boy=1)*	4616	0.511	0.500	0.0	1.0
Age at time of testing *(in years, middle of 2nd grade)*	4616	5.983	0.352	5.3	7.6
Ethnic minority *(min. one parent born abroad = 1)*	4616	0.084	0.277	0.0	1.0
Parenthood *(single-parents = 1)*	4616	0.035	0.183	0.0	1.0
Number of children in family	4616	2.476	0.915	1.0	5.0
Mother's employment *(>12hrs / week = 1)*	4616	0.303	0.459	0.0	1.0
Highest parental education: level 1 *(no / elem. / lower educ.)*	4616	0.175	0.380	0.0	1.0
Highest parental education: level 2 *(middle / professional educ.)*	4616	0.448	0.497	0.0	1.0
Highest parental education: level 3 *(higher / professional / acad. educ.)*	4616	0.377	0.485	0.0	1.0
Parental reading *(of books, newspapers or magazines)* *(hours per week)*	4616	11.164	6.339	0.0	36.0
Father's Dutch language skills	4616	4.579	0.602	1.0	5.0
Social milieu *(PRIMA VI factor score)*	4616	3.871	0.702	1.0	5.0
Degree of urbanization *(completely rural = 1 / completely urban = 5)*	4614	3.410	1.214	1.0	5.0
Religion of the mother *(no religious affiliation = 1)*	4614	0.356	0.479	0.0	1.0

Table 7: Variation of average childcare attendance at each province

Province	Children in elementary schools			Attended *preschool* half-days		Attended *daycare* half-days	
	total population 2004/05	PRIMA 2004/05 sample	Sample coverage	Mean	Std. Dev.	Mean	Std. Dev.
Drenthe	5,807	142	2.45%	9.577	4.950	3.039	8.180
Flevoland	5,342	126	2.36%	9.683	9.013	6.991	11.847
Friesland	7,768	310	3.99%	10.317	5.441	4.438	10.118
Gelderland	24,264	748	3.08%	9.040	6.639	7.565	12.499
Groningen	6,280	154	2.45%	9.377	6.688	3.952	10.346
Limburg	12,007	357	2.97%	10.793	8.099	10.930	13.656
Noord-Brabant	28,564	623	2.18%	11.148	6.749	8.790	12.311
Noord-Holland	29,834	890	2.98%	9.418	6.780	10.425	15.319
Overijssel	13,800	225	1.63%	10.133	5.616	5.868	11.091
Utrecht	14,323	104	0.73%	8.068	7.335	7.873	12.701
Zeeland	40,190	196	0.49%	9.398	7.200	7.702	11.101
Zuid-Holland	4,527	741	16.37%	9.011	7.784	10.109	14.966
Total	192,706	4,616	3.47%	9.706	6.991	8.395	13.309

Note: The sub-samples of schools are not representative for the provinces. Figures on the total number of children aged 6 in 2004/05 in elementary schools are taken from CBS-Statline.

Table 8: Simultaneous quantile regression

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Dutch skills	-3.91*	-0.63	-0.75	1.12*	0.32	-0.23	0.20	0.56	1.05	-5.01
	[-1.90]	[-0.49]	[-0.73]	[1.82]	[0.31]	[-0.23]	[0.22]	[0.59]	[1.48]	[-0.55]
Cogn. skills	-0.83	-3.25*	-1.78	-1.11	-1.20	-0.87	-0.85	0.33	-0.17	-7.61
	[-0.37]	[-1.79]	[-1.17]	[-0.97]	[-1.00]	[-0.61]	[-0.65]	[0.33]	[-0.15]	[-1.18]
Non-cogn. skills	-2.48	0.20	0.17	0.23	0.92	2.13*	1.29	0.64	0.15	-6.24
	[-1.44]	[0.14]	[0.12]	[0.17]	[0.60]	[1.76]	[0.75]	[0.38]	[0.07]	[-1.20]

Note: Effect estimates for centre-based childcare when running the OLS model (1) by decile, including childcare attendance indicators, child characteristics and family background factors. Test scores are standardized to mean 100, standard deviation 15; level t-statistics based on bootstrapped errors in brackets; * significant at 10 per cent level, ** at 5 per cent level, and *** at 1 per cent.

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