Gains from child-centred Early Childhood Education: evidence from a Dutch pilot programme

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Robert Bauchmüller

Maastricht Economic and social Research institute on Innovation and Technology (UNU-MERIT)
email: info@merit.unu.edu | website: http://www.merit.unu.edu

Maastricht Graduate School of Governance (MGSoG)
email: info-governance@maastrichtuniversity.nl | website: http://mgsog.merit.unu.edu

Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands
Tel: (31) (43) 388 4400, Fax: (31) (43) 388 4499

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Gains from child-centred Early Childhood Education: Evidence from a Dutch pilot programme[1]

Robert Bauchmüller
Maastricht University, Graduate School of Governance

Abstract

Early Childhood Education (ECE) programmes are presumed to have positive effects in particular for children who are at risk of failing during their school careers. However, there is disagreement on whether such programmes should be more teacher and curriculum based or rather centred on the individual child. In this paper I study child-centred ECE programmes that are used at preschools in the Dutch province of Limburg, which is in fact mainly a study of '*Speelplezier*', a new child-centred programme which has recently been certified as being 'in theory' effective in raising children's school readiness, but which has not yet been evaluated.

I use a rich dataset covering the first three grades at elementary schools in the Southern part of Limburg for the year 2008/09 to evaluate the impact of child-centred ECE versus alternative preschool options. I estimate ordinary least squares effects of attending a preschool applying child-centred ECE onto test scores from the beginning of elementary schooling, under the control of alternative childcare experiences and various child and family related characteristics and re-weighing observations of the studied sample to represent population averages. I argue that access to a preschool kindergarten applying child-centred ECE is to some degree exogenously determined. In a further effort to identify causal effects, I also use propensity score matching and instrumental variable estimation techniques.

I find no evidence of the expected short-term effects on language or on cognitive development who attended a child-centred ECE preschool as compared to preschools applying other or no early education programmes. In order to reach measurable benefits, the child-centred methods and their applications need to be intensified and extended to all disadvantaged groups of children. Yet I find some evidence that children of low educated parents who have been placed in a child-centred ECE preschool tend to have higher language and cognitive outcomes.

Keywords: early childhood education (ECE), child-centred programme, cognitive and language development, school readiness, distance to preschool

(JEL: I21, J13, J24)

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1. Introduction

"*Investing in disadvantaged young children is a rare public policy with no equity-efficiency trade-off. It reduces the inequality associated with the accident of birth and at the same time raises the productivity of society at large*." This argument of Heckman and Masterov (2007) summarizes the economic rationale of investing in early childhood education so as to improve the starting position of children with underprivileged family backgrounds. Early childhood care provisions are extended in many countries, predominantly to facilitate maternal employment; their coverage which grew from 60.4 per cent in 2000 to 62.8 per cent in 2008 (OECD, 2011).

Introducing elements of early childhood education (*henceforth abbreviated as ECE*), in addition to mere child-care services, receives growing political currency. Policymakers in the OECD countries see in extensions of ECE programmes a strategy to deal with over-aging and shrinking populations through supporting more children in achieving their full skill potential. Similarly, policymakers in less developed countries consider ECE programmes as tools to empower more children to contribute to the growth of their knowledge-based economies and prepare them for the growing demand in the labour market for higher skills. However, when the state takes over part of the job to prepare children for their later lives, it is essential that sufficient quality of its child-care services can be provided.

The market for early childhood education programmes is growing in most countries. UNICEF (2008) reports that 15 of 25 studied OECD countries already provide subsidized and accredited early education services for at least 80 per cent of 4 year-olds. The Netherlands, at which this paper focuses, is not yet among them. Despite extending early childhood care and education provisions, policymakers are still insufficiently informed about the effectiveness of particular ECE approaches; the empirical evidence is rather limited. Particularly little is known yet about whether ECE programmes should stimulate child development and school readiness through providing a structured, curriculum and teacher based care approach with direct instruction or rather a more flexible, child-centred approach where the 'teacher' guides the child based on individual needs, usually along a specific theme.

Both types of programmes are frequently applied; however, most of the OECD countries, including the Netherlands, apply more ECE programmes with a teacher-based approach; Nordic and some central European countries as well as New Zealand follow more child-centred approaches (Nap-Kolhoff, Schilt-Mol et al., 2008; OECD, 2007). Parental preferences for a specific type of ECE provision are determined by their socio-economic but also cultural background. For example, Asian parents generally tend to prefer more teacher-based ECE programmes; Western parents show more preference for child-centred provisions (see, e.g. Tobin, Wu, & Davidson, 1991).

Constructivist theories of early child development, which go back to theorist like Piaget, Montessori and Vygotsky, stress the need for children to construct their own learning process and to build their own relationships with peers and teachers; whereas teacher-based preschool programmes, based on environmental theorist such as Skinner, Watson and Bandura, emphasize the importance of curriculum-based knowledge transmission (see, for example, Hohmann, Banet, & Weikart, 1979). The discussion about types of ECE is not always fully exclusive in terms of which approach to prefer. Copple and Bredekamp (1997; chapters 4 and 5) stress that teachers' training and behaviour should accommodate a *Developmentally Appropriate Practice* via a wide range of teaching strategies, including well-adjusted curriculum-based guidance as well as individualized development stimulation. Evaluating the attendance of Chicago Child-Parent Centres in the mid-1980s, Graue et al. (2004) highlight the importance of an appropriate balance between teacher-direct instructional approaches, child-initiated activities and parental involvement to generate any long-term effects.

ECE programmes combine a set of didactical principles, learning approaches, educational materials and staff training that shall assure sufficient quality of centre-based care. Nonetheless, there is surprisingly scarce empirical evidence for the many questions that can be raised regarding the

appropriate quality of child-care. A crucial question in this debate is whether children actually benefit from an educational stimulus already in their early childhood and if they do so whether an ECE programme is more stimulating if it is directing the child in its development according to a programme-directed or rather child-centred approach.

The share of child-centred ECE applications in OECD countries is increasing; a well-known example of such child-centred approaches is the Italian *Reggio Emilia* method. The Netherlands has recently accredited *Speelplezier*, a newly developed child-centred ECE programme, as being 'in theory' effective in raising the readiness for elementary schooling of children (see Pennings, 2009).[2] Accreditation of an ECE programme allows preschools to receive public funding for employing specially trained staff.

Before receiving official accreditation, the ECE programme *Speelplezier* has already been used since the school-year 2000/01 in some of the preschools and schools located in a few bigger municipalities in the South of the Dutch province of Limburg. Rich data has been collected at the initial stage of all elementary schools in this region, allowing new effect evaluations of preschool kindergarten experiences. The theoretically proven effectiveness of child-centred approaches can thus be tested by a comparison of *Speelplezier*, and the few other child-centred ECE applications, with other alternative preschool approaches. Child-centred ECE approaches are ideally compared versus its two alternatives, preschooling with a teacher-based approach or preschooling without any early education at all. Such comparisons contribute valuable empirical evidence to the scarce Dutch and international literature and go beyond the theoretical argumentation about effectiveness that is still predominant in the policy arena.

The introduction of the novel Dutch ECE programme *Speelplezier* and the few alternative child-centred ECE approaches used in the Southern municipalities of the Dutch province of Limburg is a unique opportunity to provide new empirical evidence. Despite annual aggregate monitoring reports of municipalities using child-centred ECE approaches, there is no empirical evidence on the effectiveness of those approaches yet. For that reason I address the following question in this paper: *Do pupils perform better at the beginning of elementary education if they had attended a preschool using a child-centred ECE programme rather than any alternative preschool which applies a teacher-based or no ECE approach at all?*[3] *And does child-centred ECE benefit disadvantaged children over-proportionally?*

The presented empirical results are the first pupil-level evaluation of the ECE programme *Speelplezier* and its potential to reduce inequalities in educational attainments. *Speelplezier* is the predominant child-centred ECE approach used in the studied region of South Limburg; more than 90 per cent of children with child-centred ECE experiences attended a *Speelplezier* preschool.[4]

Several municipalities in South Limburg are currently expanding their public ECE investments, piloting a future development in the rest of the country. Such expansions should be guided by evidence on the effectiveness of ECE approaches, in the studied case of South Limburg primarily *Speelplezier*. The assessment of the application of child-centred ECE in South Limburg provides evidence on whether governmental investments for scaling up early childhood education investments are likely to deliver the expected positive results, in particular for the targeted children with disadvantaged backgrounds.

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[2] Its name '*Speelplezier*' means '*fun in playing*', which reflects the programme's uniqueness in trying to reach the desired development gains through its extensive attention to playing activities that are to large extent freely determined by the children themselves and in part guided by child-care and teaching staff. At least one staff members for each 25 children receives training over two to three years in using the education materials with themes to play and interact with the children and within the four different programme modules (see Wouterse-Schmitz, 2006).

[3] I compare child-centered ECE to the joined pool of alternative of preschool experiences, i.e. those with teacher-based and those with no ECE applications, the sub-sample of teacher-based applications is too small for a direct comparison.

[4] Other child-centered ECE approaches used in the studied region are, for example, *Startblokken* and *Basisontwikkeling*, but *Speelplezier* is applied by the far majority of preschools using child-centered ECE.

A description of ECE policies in the Netherlands (Section ECE policies in the Netherlands) precedes a review of the international and Dutch evaluation literature on early childhood education (Section Literature discussion). Then a description of the data (Section Data description) and the empirical strategy (Section Methodology) paves the way for the presentation and discussion of the estimation results (Section Discussion of the estimation results). And finally the paper concludes with policy recommendations (Section Conclusions).

2. ECE policies in the Netherlands

In the Netherlands, a growing share of women is active in the labour market - 65.5 per cent in 2000 and 73.5 per cent in 2008, many of them in part-time contracts – 59.8 per cent in 2008; more than double the OECD average of 25.3 per cent (OECD, 2011). Whereas daycare centres or nursery ('*kinderdagverblijven*') are the most extensive provisions of centre-based childcare, preschool kindergartens ('*peuterspeelzalen*') cover a universal group of children with different backgrounds for a few half-day sessions (mornings or afternoons) each week.

Predominant centre-based childcare arrangements are daycare centres, which provide care for children as of a few months after birth and include later on out-of-school arrangements. Daycare provisions are largely organised by (semi) private organisations and have on average a lower quality standard than preschool kindergarten, largely due to having started earlier with focusing on child development aspects and promoting professionalism.[5] In the Netherlands, ECE programmes are applied in preschool kindergartens that provide care for children aged 2-4 years and at the initial stage of elementary schools, which are attended by children aged 4-6 years. Daycare centres are only starting to invest into ECE approaches.

Dutch ECE programmes are meant to stimulate linguistic, cognitive and social development. Policies to provide extra stimulation for those disadvantaged children were in the 1980s predominantly focused on parent-oriented investments. The growth in female employment was accompanied by increasing demand for non-parental care. Initially the state did not respond directly to this demand; instead, charity foundations started to fill the gap and founded numerous early childhood care and education arrangements (Pfau-Effinger, 1999). The first preschools were set up in the 1970s (Nap-Kolhoff & Schilt-Mol, 2008). Since the 1990s centre-based child-care investments combined with parent-oriented programme elements have become a preferred public policy strategy.

In order to provide extra stimulus for disadvantaged children, the Dutch government started providing subsidies and regulating the quality of the child-care sector. Nowadays, the government wants to advance the development of early childhood education programmes by making them more professional in accordance with what (international) research identifies as best practices and most effective. And the Dutch government has announced that programmes will be extended to reach more disadvantaged children in need of such development stimulus (see, for example, OCW, 2008).

Evidence suggests that poverty, low social class, low educational attainment levels, to some extent traditional child-rearing beliefs and cultural backgrounds factors, foreign mother-tongues and low literacy can have pervasive influences on informal education at home and hence are likely to cause insufficient preparation for school (see, e.g. Leseman, 2002). If, for instance, neither of the parents is using Dutch in conversations with their child, the child is more likely to face difficulties when entering the school. Since the 1990s, language stimulation has been the prior target of such ECE programmes, acknowledging particularly the problems of integrating children with migrant backgrounds into the Dutch elementary schools. Cognitive development has been a wider goal with respect to generally targeting ECE programmes towards children of low educated parents; since 2006, programme targeting related to migrant backgrounds is phased out. Targeting at the age group of 2.5-

[5] Recently, the Dutch government promotes access to daycare centres and quality of such daycare provisions; however, for the studied children, provisions have been in general of lower quality than preschool kindergarten provisions.

6 years acknowledges that this age period is deemed sensitive for children's cognitive development and for its language advancements (Cunha, Heckman, Lochner, & Masterov, 2005; Heckman, 2008).

Starting in the year 2000, the first investments in ECE programmes were made in the four largest Dutch municipalities as they have bigger migrant communities. Since August 2002, ECE regulations became part of the '*Municipal Compensatory Education Policy*' (see GOA § 6.2.3., OCW, 2001). At that time 27 middle-sized municipalities also received public investments for ECE programmes - in the studied region of Southern Limburg these were Heerlen, Sittard-Geleen and Maastricht.

At the moment, there are efforts made to extend ECE programmes in particular to smaller municipalities in the countryside as the focus of targeting is widened to all children whose parents are low educated. A significant number of those children are disadvantaged native children who live in rural areas. Major examples of these extension policies are governmental pilot projects carried out in the rural regions of South Limburg and East Groningen. Both pilot schemes extended early education programmes to cover all disadvantaged children in those regions by 2009/11. Because of this pilot, a majority of preschools in South Limburg newly introduced or intensified child-centred ECE approaches, in particular the method *Speelplezier*, while preschools in East Groningen introduce mostly a teacher-based ECE programme.

The target group has not yet been fully reached by ECE programmes. The original goal was to reach 50 per cent of the target group within the period 2001/05 (OCW, 2001); the goal has then been raised to 70 per cent for the period 2006/10 (OCW, 2006) – the pilot areas accomplished to reach close to 100 per cent, already by the year 2010. In a national survey among municipalities, Jepma et al. (2007) have found that at the age group 2.5-4 years about 49-59 per cent of the target group have been covered by ECE programmes; at the ages 5-6 years the coverage has been about 54-85 per cent. Given the earlier focus on urban areas, the coverage is much higher in bigger cities than in smaller cities and on the countryside.

When a child turns four it can attend the first grade - nearly all children attend school in that grade, as of the age of 5 schooling is compulsory; often grade 1 and 2 form a combined group of pupils. During this initial stage of elementary schooling, children start to learn in a playful and simple manner to count, write and solve easy problems, and they advance their language and social skills in exchange with other pupils. Only from grade 3 onwards, when pupils are 6-7 years of age, subject-based teaching is introduced. Since 2000, municipalities are required to provide ECE to the majority of children who are at risk of falling behind in their school career programme, at least when they attend the initial stage of elementary schooling (Nap-Kolhoff & Schilt-Mol, 2008).

Yet, many municipalities introduced ECE programmes also before at preschool kindergartens and some even in daycare centres so as to stimulate children as early as possible. Those institutions are then supposed to apply the same ECE methodology as the elementary schools that most of their children attend afterwards. In such coupled partnerships, preschools and elementary schools communicate about the development progress of children who proceed from preschools to elementary schools and discuss joint extracurricular activities. These programmes hence are deemed to offer a continuous approach with professional ECE staff at both institutions. Such an integrated approach is regarded in the literature as the most promising intervention to reach sustainable development gains (V. E. Lee & Loeb, 1995).

The Netherlands devotes about 0.4 per cent of its GDP to pre-primary educational services, which matches the lower midfield of OECD countries, but remains below the EU target of 1 per cent; Scandinavian countries devote with 1.5-2 per cent of their GDP the biggest shares to pre-primary education (OECD, 2006). In the past – including most of the studied period, national funds addressing socially disadvantaged children were predominantly transferred to municipalities. Until the school year 2006/07, such targeting focused on the migration and educational background of parents, since then targeting focuses only on educational backgrounds.

Municipalities assigned part of these funds to investments in ECE programmes at selected institutions which covered areas where comparatively more children were at the risk of delayed Dutch language development as their parents spoke insufficiently Dutch with them. Since 2006/07, elementary schools receive their funds for ECE investments directly from the national government. Assignment of those funds to elementary schools depends on the pooled risk of enrolled children to endure educational delays because of any social disadvantages. For preschool kindergartens (and daycare centres) the amount of funding depends on how many groups and half-days the municipality deems necessary when putting special attention to disadvantaged children and can afford to subsidize.

ECE funds are used to subsidize parental contribution fees, to equip centres with ECE education materials as well as to train staff in applying ECE didactics. Fees are usually lower (or even non-existent) for children with disadvantaged backgrounds. Elementary schools invest their ECE funds to employ additional staff - to reduce the child-staff ratios, buy ECE education materials and to pay for ECE trainings for their staff. There are no tuition fees for elementary schooling in the Netherlands, except for private schools. Only preschools using an officially recognised ECE methodology can receive public funding.

A number of didactic approaches have been certified by the Dutch government as effective ECE programmes. A number of conditions for accreditation have been established that are based on what is in theory stimulating child development at preschool age (Inspectie van het Onderwijs, 2006; Nap-Kolhoff & Schilt-Mol, 2008; OCW, 2000, 2006). The conditions are:

- A satisfactory intensity: covering the age group of 2.5-6 year-olds for ≥ 3 half days per week[6];
- An appropriate and effective content: theory-based and well-structured didactic-pedagogical approach with evident positive effects on various development domains;
- Cooperation of preschools (and daycare centres) with elementary schools: continuation of the same approach throughout different ages;
- Child development is observed and registered;
- Enough qualified staff members per group: preschools and daycare centres with ECE programmes should not have more than 15 children per two professional staff members;
- Involvement of parents.

There are additional relevant factors contributing to the success of ECE programmes but they are not all included in the official conditions; these are, for instance, measures taken to attract parents of the target population to send their children to a preschool that uses an ECE programme. It is unfortunate that most of the before-mentioned conditions are not very transparent in terms of measurable standards. Conditions are not fully met in all cases because of constrained resources, for instance, expenditures permit only three subsidized half day sessions per week instead of four. Often the administrative capacity to control appropriately for the proper application of early childhood education at all locations is limited.

First assessments of *Speelplezier* by Bolt and Schonewille (2006) indicated that it has the potential to fulfil most conditions, suggesting improvements with respect to the involvement of parents, though. In January 2009, the National Youth Institute (NJI) has assessed *Speelplezier* with respect to fulfilling the necessary conditions and granted an official ECE accreditation to the programme (Pennings, 2009).

Dekker, De Fijter & Veen (2000) provided a policy guide which gave municipalities an overview of the conditions as regulated in 2000. A recent update of this policy guide sub-classifies integral ECE

[6] Municipalities reported that they provide on average about 2.8 half days per week (Jepma et al., 2007; Middleton, 2009). Though, ≥ 4 half days per week are regarded as the didactically necessary intensity to reach significant gains in development (Van der Vegt, Studulski, & Kloprogge, 2007).

programmes, into programme-directed and development-oriented approaches, and keeps an inventory of which early childhood education and parent-child programmes received certification (Nap-Kolhoff, Van Schilt-Mol, & Vallen, 2008). However, both inventories indicate that the empirical evidence on effects of the ECE programmes has been rather incomplete, besides assessments of compliance with the conditions of accredited programmes. The classification of Dutch ECE programmes into programme-directed and development-oriented approaches goes back to Leseman, Otter, Blok and Deckers (1998). They argue that all programmes are in part development-centred as they all use some form of observation and assessment follow-up system to better address the needs of the individual child.

According to Nap-Kolhoff et al. (2008), the most commonly used ECE programmes in the Netherlands are *Piramide* (50 per cent of ECE preschools) and *Ko-Taal* (15 per cent), which are examples of programme-directed approaches; *Startblokken van Basisontwikkeling* (14 per cent) and *Kaleidoscoop* (7 per cent) are examples of development-centred approaches. Despite the fact that these programmes differ substantially, for instance, in the amount of development domains that are addressed, the involvement of parents, the quality assurance and the scientifically expected effectiveness, programmes taken as a whole are somewhat similar once they qualify for official accreditation (Nap-Kolhoff, Schilt-Mol et al., 2008).

Speelplezier resembles to some extent the ECE approach *Kaleidoscoop*, which is based on the American *High-Scope* programme. It has a strong focus on the individual child, an inclination to play activities and uses an observational record to keep track of the child rather than using a set of development tests. Children are clustered in smaller sub-groups and receive special attention of the teaching staff according to their level of development each day in child-care. Teaching focuses on personifying, intervening and inspiring activities. Similar to the structured, teacher-based *Piramide* approach is the fact that it uses topic folders to guide the daily activities done with the children (Pennings, 2009). *Speelplezier* also puts a focal point on language development in its activities.

Institutions that do not use a distinctive professional ECE programme (yet) are typically referred to as '*regular*' institutions. Henceforth, I refer to a *child-centred ECE preschool* as a preschool that has arranged at any time until the school year 2007/08 training for (part of) its staff to implement, for example, *Speelplezier* as child-centred ECE method. Despite weak evidence on effects of Dutch early childhood care and education provisions in general, my hypothesis is that child-centred ECE institutions which are reaching out to the target group of disadvantaged children lead to significantly better outcomes for children than any alternative teacher-based ECE or regular preschool provisions.

3. Literature discussion

There is still little evidence available about the effectiveness of early childhood care and education provisions, in particular with respect to differentiating effects by the quality of such provisions. Quality evaluations of early childhood care and education investments can be classified into two types, those studying the processes and those studying structural quality aspects (see, e.g., Marshall, 2004). In this regard, effect studies of ECE programmes assess mainly the quality with respect to the processes.

The international evaluation literature on early childhood education is dominated by a few U.S. American (quasi)experimental long-term studies, for example, of the child-centred High-Scope Perry Preschool, the curriculum- plus teacher-based Abecedarian programme and the teacher- plus parent-based Chicago Child-Parent Centres (for a review see e.g. Barnett, 2008). Studies of these programmes provided convincing evidence that early childhood investments lead in fact to positive effects in the long-run, such as a reduction in grade retention, drop out, crime and delinquency rates, as well as in the length of stay in special education, and increases in achievement scores and high school graduation rates. These programme examples imply for the society a ratio of investment costs to benefits between 1:6 and 1:13 (Nores, Belfield, Barnett, & Schweinhart, 2005). A critical review of this

evaluation literature, envisaging the compromises that occurred in the randomisation protocol, identified lower but still significant social rates of return – well above the historical rate of return on equity (Heckman, Moon, Pinto, Savelyev, & Yaditz, 2009).

However, despite providing convincing evidence of the positive effects of early childhood education, the studied ECE programmes are of rather small scales and study experimental, high-quality and strongly targeted programmes. Policymakers cannot rely fully on those studies when deciding about larger scale programmes for other contexts. Scaling programmes up, as is currently done in the Netherlands, usually demands to reduce quality somewhat to an affordable and feasible level and it becomes more difficult to monitor and enforce sufficient quality in the ECE provisions.

In the U.S. American context, Head Start is an example of a much larger scaled ECE programme, it is sponsored by the U.S. federal government. Its effect evidence has been more ambiguous. Earlier studies showed that Head Start improves the test scores of children at the age of 5 (Magnuson, Lahaie, & Waldfogel, 2006) while positive effects fade away over time, in particular, for black disadvantaged children (Barnett, 1992; Currie & Thomas, 1995; V. E. Lee & Loeb, 1995). More recent studies, however, identify also longer term gains of Head Start. Garces, Thomas and Currie (2002) identify long-term gains for Head Start participants by their early twenties, in high-school completion, college attendance and earnings outcomes, and for African-American participants delinquency rates are lowered.

Studying a summary index of young adult outcomes, Deming (2009) finds that the disappearance of long-term effects may be caused by the fact that test scores are not covering the full scale of skills. He identifies that socio-emotional development gains can be found in particular at later outcomes. A growing body of evaluation research on the state sponsored universal Pre-K programmes confirms short-term gains of larger scale ECE programmes, in particular for disadvantaged groups (see, for example, Fitzpatrick, 2008; Gormley & Gayer, 2005; Huang, Invernizzi, & Drake, 2012). Esping-Andersen et al. (2011) argue that early development gains that may results from the experience of higher childcare quality such as early childhood education, as found for example for disadvantaged children in the U.S., may not last because the higher quality of attended childcare may subsequently not be matched by sufficient quality of schools to sustain those gains.

Evidence on the particular type of ECE programmes remains limited. That early non-parental language interventions at preschools, as in the case of the studied Dutch ECE programmes, can have a positive effect on the language skills of ethnic minority children has been shown in studies, as discussed, for example, by Monte, Xian and Schweihart (2006). Their international comparison of preschool experiences of 10 countries that shows that child-initiated, small group activities, which are consistent with developmentally appropriate practices, as applied in the *Speelplezier* programme, can promote active learning and school performance by the age of seven. This is in line with earlier studies, which compare the effectiveness of alternative ECE approaches, e.g. by Marcon (1992) and Stipek et al. (1998; 1995). They find that child-centred approaches over-proportionally benefit children as compared to mixed or teacher-directed approaches.

Barnett (2011) argues that large gains in other domains than cognitive development would likely require a balance of teacher-directed and child-initiated activities, including elements of dramatic play. Camilli et al. (2010) find in a meta-analysis of 123 studies of early childhood interventions that direct teacher instruction correlates strongly with cognitive child outcomes, more than child-oriented instruction. However, they stress that in the past many initial studied ECE interventions have been stronger characterised by direct teaching, while child-oriented practices have been less advanced.

Haskins (1985) stresses temporary intellectual gains from cognitively oriented ECE provisions could come at the cost of social behaviour deficits. Schweinhart et al. (1986) indicate that child-centred approaches can have longer lasting effects than those with direct-instruction and show substantially better effects on non-cognitive outcomes, positive effects would even increase over time, in particular in the socio-emotional non-cognitive domain. However, these results are based only on a limited

sample. Huffman & Speer (2000) point out in this regard that more appropriate classrooms are related to better language and cognitive outcomes at the 3rd school grade for Hispanic and Afro-American children when they attend a preschool that participates in the '*Head Start - Public School Transition Project'*. However, they cannot identify whether these effects are linked to the appropriateness of the classrooms or rather the absence of overly regimented or highly disordered classrooms; they observed classrooms in which stronger emphasis has been put on basic skills and highly structured, direct teaching approaches.

Findings by Peisner-Feinberg et al. (2001) as well as Burchinal et al. (2010) suggest that high-quality classrooms and instructions are necessary to improve social and academic outcomes such as language, math and reading skills in pre-kindergarten ECE programmes, in particular for disadvantaged children such as children from low-income households. Heckman (2008) argues that in particular early childhood intervention programmes that put their attention to stimulating character development and motivation rather than focusing exclusively on the stimulation of cognitive development appear to be most effective.

Despite the limitation of the given literature on quality of ECE programmes, some studies attempt to shed some more light on the processes. Applications of environmental rating scales to assess a variety of such process quality factors by using composite indicators have become popular[7]. The Dutch catalogues of conditions for ECE accreditation resemble simpler proxies of such quality assessments.

What evidence is available about Dutch ECE programmes? A review of the Dutch evaluation literature on ECE programmes by Nap-Kolhoff et al. (2008) has shown that effect studies on the major, maturing programmes is becoming out-dated while studies on the newer programmes such as *Speelplezier* is still incomplete.

The most relevant evaluation study of ECE programmes[8] has been done by Veen, Roeleveld and Leseman (2000), assessing the effectiveness of *Kaleidoscoop* and *Piramide*, two intensive ECE interventions (4 half-days per week), between 1995 and 1997, using a quasi-experimental research setup with two control groups and two experimental groups, one for each programme. Each group had a sample size of about 100 children; however, attrition has been high, reducing the power of the statistical results. Simple correlations, controlling for earlier development outcomes and various background factors, show that children who attended an institution which applies one of the two ECE programmes show no significant difference in language and cognitive test scores as compared to the control groups. Litjens (2011) studies the impact of the 2000 policy impulse to extend ECE policies, matching children who entered elementary schooling before and after the impulse. She finds no significant effects of early childhood education, but some indication that ECE could lead to cognitive gains for native Dutch children with low educated parents.

Various reasons are put forward in the literature about what may have caused the lack of evidence on the effects of Dutch ECE programmes and thus of confirmations of the apparent theoretical support. Leseman (2002) argues that the intensity of early childhood care and education experiences, often not reaching the recommended four half-days per week, has been insufficient. Driessen (2004) suggests that the professionalization of early education services has still not progressed sufficiently as to reach

[7] See, for example, the environmental rating scales of the UNC / FPG Child Development Institute (2005): *ITERS* for infants and toddlers, *ECERS* for early childhood (e.g. Mashburn et al., 2008), as well as *FCCERS* for family daycare, and *SACERS* for children of school age. Applications of such scales can be found in the British EPPE study or the U.S. American NICHD study. Duncan (2003) provides an example of using the Observational Record of the Care-giving Environment *ORCE* as recorded in the NICHD Study of Early Child Care.

[8] For an extensive discussion of characteristics of the programmes and their evaluation literature see Nap-Kolhoff, Schilt-Mol et al. (2008), as well as the meta-studies on effects of ECE attendance by Leseman et al. (1998) and the inventory of Van der Vegt et al. (2007).

significant improvements.[9] Nap-Kolhoff et al. (2008) argue that the quality of services is still insufficiently documented so as to distinguish beneficial high-quality investments from non-beneficial low-quality investments.

To sum up, the evaluation literature on early childhood education programmes is still limited, e.g. to very specialised cases, and is dominated by U.S. American studies. The increasing use of ECE programmes, e.g. in the Netherlands, is not backed up by sufficient research on their effectiveness. Neither does the scarce literature disproof the theoretical effectiveness.

4. Data description

To evaluate the impact of child-centred ECE programmes, I use a unique dataset (henceforth referred to as *Moelejaan* data) collected in the 19 municipalities of the Southern part of the Dutch province of Limburg, covering the first three grades of all publicly financed elementary schools in 2008/09 (Jungbluth, Rodigas, & Bauchmüller, 2009).[10] This data thus covers three consecutive child cohorts born between the years 2001 and 2004, whose preschooling period was 2003-2006. This aggregates to a total of 16,679 child observations[11]. Those observations cover almost the entire child population at the ages 4-6 years in South Limburg in 2008/09.[12]

The *Moelejaan* data provides rich information about these children from school registries and test administrations as well as a survey that has been conducted among parents. School registry information is available for (nearly) the whole population of children; next to birthdates and gender of every child it includes identification information of the child, including home addresses, parental education levels and country of origin. Furthermore, in the autumn of 2008 all children took a questionnaire home to their parents; 11,088 children (~66 per cent) returned a (partially) completed questionnaire to their teacher. The survey collected further information on the family backgrounds as well as information on the child's history of early childhood care and education.

I study short-term effects of child-centred ECE on school readiness at the beginning of elementary schooling. Most children who attend a preschool kindergarten with child-centred ECE subsequently attend a partnered elementary school applying such an approach, too. Even though ECE programmes are continued during the initial stage of elementary school, the lack of later outcome measures in the studied *Moelejaan* dataset restrains me to study the impact of the application of ECE programmes in the preschool kindergartens only.[13] If I find short-term effects of preschool investments, they would prospectively be stronger when studying later child outcomes. Duncan et al. (2007) show in a meta-analysis that such earlier cognitive measures of school readiness can be strong predictors for later school performance.

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[9] Professionalization refers to continuous integration between different levels of early childhood education and schooling (Driessen, 2004; Driessen & Doesborgh, 2003).

[10] 207 of 210 elementary school locations have provided at least parts of the requested information (for a description of the fieldwork, please refer to Rodigas, 2009). Children in private schools (less than 0.3 per cent), special schools (about 1.5 per cent; CBS Statline, 2010) and children who attend primary schools across the border in Belgium or Germany are not included in this study. Own estimates based on newspaper articles (e.g. Mariën, 2007) indicate that in 2006 about 5-10 per cent of Dutch children living in the 19 municipalities of the South of Limburg attended an elementary school abroad. Belgian and German pupils who came to Limburg for the elementary schooling have been included in the data collection, but are not part of this analysis as they spent their preschool period abroad.

[11] Observations where parents did indicate that they want their children to be excluded from research have been dropped (~0.5 per cent of all registered children).

[12] The official number of children living in the South of Limburg in that age group was 16,616 children according to the public administrations in 2009 (CBS Statline, 2009). No data is available on the small fraction of children participating in private and other specialised care.

[13] The gathering of test outcomes for all children at grade 3 and above, and the inventory of ECE applications at the initial stage of elementary schooling are not yet completed; they are element of future waves of the Moelejaan data collection; a longitudinal set of observation of the studied children will then be available.

To assess children's cognitive and language development, Dutch schools use nationally standardized tests of arithmetic understanding and Dutch skills at half-yearly intervals. I use raw test scores of those cognitive and language tests taken in the middle of the second school year (January to February). Those M2 tests scores are nationally comparable, e.g. to studies based on PRIMA data from the Dutch national cohort study, and are available for more children than any other collected tests; data for both tests is available for 7,862 children.14 To facilitate comparability of test scores with other studies, I have standardized scores for each test to means of 100 and standardized deviations of 15. Scores are normally distributed; see Figure A-1 for frequency distributions of the test scores and Table A-1 for a direct comparison of the original and standardized scores.

There has been no central register or inventory of ECE applications in South Limburg at the time of the *Moelejaan* data collection. I enriched the *Moelejaan* data with ECE information on preschools from a survey among all 19 municipalities in South Limburg that I collected in early 2009. In this survey I investigated which preschools use an early education programme and when those programmes have been introduced. I cross-validated this information by doing an inventory of municipal documents and reports stating any information about preschool provisions and linked it to the preschool attendance details as stated in the initial survey among the parents whose children are covered in the *Moelejaan* data.

The studied child cohorts attended preschools by and large in the period 2003 to 2009. During that period six of the nineteen municipalities in which data has been collected had at least one preschool kindergarten applying *Speelplezier*; whereas nearly 90 per cent of the *Speelplezier* applications occurred in two municipalities. In eight of the nineteen municipalities occurred investments into other ECE programmes, however, at a much smaller scale.

Preschool kindergartens often apply ECE programmes only in part of their child groups. As I cannot identify which specific group a child attended, I measure average effects across ECE and '*regular*' groups of an entire kindergarten. I assume that there are positive spill-over effects from applying ECE in some groups to children in other regular groups as teachers of a location exchange their experiences. Moreover, I measure average ECE effects across all attended preschool days as I cannot identify at how many of the days that a child attended an ECE group it was exposed to ECE programme elements. ECE programmes are usually not applied during all provided days. I assume that even if some of children's preschool days consist of '*regular*' child-care supervision, there are still spill-over effects from early education activities on to other days. Averaging across groups and days may imply that I underestimate the true effect of ECE programmes by diluting ECE effects when attributing them to children who did not benefit of it. Yet, the expansion child-centred ECE may introduce variability that is attributable to other unobserved quality factors such as, for example, the quality of the local preschool head. Such added variability may help to identify an effect that otherwise could be absent. Hence, the direction of any conceivable bias resulting from averaging across groups is not apparent upfront.

According to the survey among parents, about 78 per cent of children attended a preschool kindergarten in South-Limburg. They spent on average a term of 153 half-day sessions in preschool kindergartens[15]. The survey provides for 61 per cent of all children information on the length of their preschool kindergarten attendance (for an overview of early childhood care and education attendance statistics for the studied sample, see Table A-3).

[14] The M2 tests are available for children who have been in the second and third elementary school year at the moment of the data collection while children who attended the first school year were not tested yet at that moment. Test data is available only for a maximum of two thirds of the children.

[15] This is roughly in line with figures from the nationally representative cohort study PRIMA for 2004/05 that showed a preschool attendance rate of 75 per cent with an average length of 131 half-days; the attendance rate for the unweighted PRIMA sub-sample for Limburg was 83 per cent with an average of 146 half-days of preschooling (own calculations, see Driessen, Van Langen, & Vierke, 2006, for more information about PRIMA).

I reduce the studied child population to a sub-sample for which parents have responded to the survey and where I can link the provided preschool information to a particular preschool kindergarten, for which I could find and cross-validate sufficient ECE information in my survey among municipalities. For about 44 per cent of the children who attended a preschool, I could identify whether their preschool kindergarten has used any or no ECE programme at the time when the child attended the specific preschool; hence ECE information is available for 27 per cent of all studied children in South Limburg. Within this sub-sample for which information is available, 78 per cent attended a regular preschool without any ECE application, 11 per cent of children attended a preschool kindergarten that runs a child-centred ECE programme (incl. *Speelplezier*), 7 per cent attended a preschool with a teacher-based ECE programme, and another 3 per cent attended any unspecified ECE programme.

5. Methodology

I want to measure the effect of child-centred ECE on child outcomes at the beginning of elementary schooling relative to any alternative preschool option. More precisely, I consider the effects on the child outcomes of language and cognitive development at age six of having participated at age two to four in some form of publicly provided preschool. I am not taking into account whether a child also experienced ECE at the beginning of the elementary school, up to the moment they took the test, but presume that they do, as preschools that apply an ECE programme are usually linked to elementary schools that also run such a programme. I cannot exactly measure the children's development before or at the change from preschool to elementary school – early test outcomes are incomplete and less reliable child development indicators. The studied test outcomes thus reflect the full effect of early education at the preschool, including any indirect effect of preschooling that comes from the first months of a well-chosen, better quality elementary school trajectory that may be the result of improved preschool outcomes in the first place.

I test the impact of attending a preschool that used a child-centred ECE programme such as *Speelplezier* (*treatment group*) versus a group of children who attended either a preschool with alternative teacher-based ECE programmes or a regular preschool (*control group*). By looking only at children who attended any preschool of any type and by having faith in the circumstance that parents are little informed about the particular types of applied ECE programs, I can disregard such unobserved selection biases that are due to parental choices for preschooling at the outset. This strategy helps reducing potentially large biases on pre-treatment observables and thus in making stronger causal claims about the effects of child-centred ECE versus any other preschool investment.

I first compare the simple mean differences of the two assessed test outcomes; then I assess the problem of missing data bias and suggest the creation of a non-response weight to counteract such bias. Thereafter, I provide an ordinary least squares (OLS) estimation of differences between the before mentioned treatment and control groups under the control of various background factors. In this OLS estimation the child i's outcome (CO_i) is linearly determined by an average baseline score β_0 and varies according to the child's preschool history (I_i) and individual characteristics (X_i), as well as to family background factors accounting for part of the child's initial development (F_i), plus a general error term, as shown in equation (1), X_i and F_i are assumed to be exogenous.[16] For an overview of descriptive statistics on the used variables please refer to Table A-2.

$$CO_i = \beta_0 + \beta_1 I_i + \beta_2 X_i + \beta_3 F_i + \varepsilon_i \quad (1)$$

Despite relating the child outcome to the type of experienced preschool care, I account for other care provisions. The collected data allows me to also cover part of the variation in initial investments at the period prior to children's preschool attendance. I therefore also include an indicator for the length of

[16] The exogeneity assumption implies that there is no unobserved ability, which is intergenerationally correlated. Any such correlation, e.g. with respect to parental affinity towards investing in early childhood that could reflect also parental skills to address the child's needs, would lead to biased OLS results.

any centre-based daycare experience (that usually starts much earlier than preschooling) and for the estimated time a child was cared for at home by parents, other family members or a nanny. The duration of all three childcare arrangements is measured by the total number of half-day sessions.[17]

As child characteristics, I control for gender, the child's age when taking the test in the middle of the second grade and for belonging to an ethnic minority in terms of having at least one parent who was born abroad. The family background factors account for single-parent households, the number of children per household, mothers' employment status at the time of the survey - children's initial stage at elementary schools, the educational level of the parent who was educated the most, as well as income per household. Additionally, I exploit information collected in the survey about the cultural capital in the household with respect to language development. Therefore I use information on the father's Dutch language skills and the amount of books for children available in the household.[18]

Errors are clustered at the elementary school group level to account for potential nesting of types of children per group or systematic variation in the way children have been tested (=365 clusters); as a result I get more consistent standard errors. Potential biases caused by non-responses and missing information are accounted for by using weights for each observation in the regression.

5.1. Accounting for missing treatment information

Information about ECE attendance is not available for all children as not all parents have responded to the survey that I use to identify preschool attendance and not all individual ECE histories could be reconstructed using additional survey information on municipal preschool provisions. I would need to assume that this information is missing at random to prevent any bias in my results. Many cross-sectional studies using survey data tend to neglect such issue of item non-responses as they either assume that it occurred randomly or because the issue of missing data occurs only in some explanatory factors.

But if, for instance, those who do not respond to the survey are overrepresented among those who did not attend any ECE preschools, my results could turn out to be underestimating the true returns to ECE attendance (see e.g. Rässler & Riphahn, 2006). I cannot neglect such potential non-response and missing variable bias as there is higher non-response for disadvantaged children (see Table A-5). ECE programmes are targeted at disadvantaged children and shall benefit them over-proportionally. Hence, I may underestimate the true effect of ECE preschools if I do not control for this lower representation of disadvantaged children in the studied sub-sample.[19]

There are systematic differences between the full and the studied sub-sample in a number of descriptive statistics for the control variables on the individual child and family background as used in the linear regression. T-tests for the sample averages (see Table A-5) show that the studied sub-sample has a significantly lower share of boys, older children and ethnic minorities, of children with single parents and of unemployed mothers, of children with lower educated parents and with fewer books at home, as well as of those whose fathers have lower Dutch skills and who live in poorer households. Children of such advantaged backgrounds allegedly benefit below-average from child-centred ECE experiences. I may underestimate the true treatment effects if disadvantaged children are underrepresented in the studied sub-sample (see e.g. Rässler & Riphahn, 2006).

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[17] A typical preschool kindergarten session in the Netherlands lasts about 2-3 hours for any visited half-day (see OECD Review Team, 1999).

[18] The Dutch language skills of mothers and fathers are highly correlated. I therefore include only the indicator for fathers' language skills which varies more than mothers' language skills.

[19] As I estimate the effects of child-centred ECE over any alternative preschool option, including teacher-based ECE preschools, this under-estimation may only be partial, though.

To account for any potential bias that is due to item nonresponse, I create a sampling weight that outweighs such bias which could results from using the sub-sample. The Moelejaan dataset has rich information available for a large share of the population. Weights are created in two steps, following the procedure as suggested by Little (1986).[20] First I generate propensity scores with the help of a logit model, the dependent variable being a response dummy to differentiate the two samples, Figure A-2 and Distribution of calculated non-response weight (in the appendix) stress that the calculated propensity scores have a large common support and accordingly provide a good balance between the full sample and the studied sub-sample. In the second step, I use inverse values of the calculated propensity scores as weights for individual respondents.[21]

5.2. Group differences

Table 1 shows summary statistics of the standardized test outcomes across two groups of children: 1) children who attended a regular preschool without any ECE or with a teacher-based ECE application, and 2) children who experienced a child-centred ECE preschool, e.g. one applying the *Speelplezier* approach.

Table 1: Summary statistics on child outcomes

	Obs.	Mean	Std. Dev.	Min	Max
Dutch language test at the mid of 2nd grade's testing moment					
Alternative preschool attended *(teacher-based or no ECE method)*	1199	102.63	12.99	37.82	123.51
Preschool with child-centred ECE attended	122	102.21	13.32	64.75	123.51
Cognitive test at the mid of 2nd grade's testing moment					
Alternative preschool attended *(teacher-based or no ECE method)*	1199	102.61	13.29	43.92	127.06
Preschool with child-centred ECE attended	122	100.01	17.04	37.99	124.09

Note: re-weighted to account for non-responses or missing data in studied sub-sample, see section Accounting for missing treatment information.

In particular for the Cognitive test, child-centred ECE experiences are associated with somewhat lower average child outcomes. Only for this test the difference is marginally significant (t-test, p=0.07). The fact that child-centred ECE is associated with lower average test outcomes could be a result of its targeting to disadvantaged children who tend to lower the average score. That the difference is larger for cognitive test scores could be due to the fact that child-centred ECE such as the *Speelplezier* approach explicitly focus on stimulating the linguistic development rather than cognitive development.

5.3. Linear Regression

I first study the effects of child-centred ECE with an OLS multiple regression model. I assume that the relationships between explanatory factors and outcomes as well as a number of control factors are linear, which is in line with the majority of papers evaluating educational investments with cross-sectional data. For the treatment period, I include a simple plus a quadratic term to adjust for potential non-linearity in the relationship between preschool duration and child outcomes (see, for

[20] For a related discussions on the application of propensity scores as sampling weights in case of potential nonresponse biases, see also Yansaneh (2003), Wun et al. (2004), Harrod & Lesser (2006) as well as Potter et al. (2006).

[21] To prevent that respondents with very low propensity scores receive excessively large weights that could inflate the variance of the survey, I exclude outliers using a 0.01 cut-off level; 1 out of 1322 observations is dropped.

example, Landvoigt, Mühler, & Pfeiffer, 2007). And I control for various child and family related characteristics that are also deemed important for determining child outcomes.

Interaction effects between the treatment variable and the family background characteristics can indicate whether the programme is more beneficial to children who have disadvantaged backgrounds. I am interested in whether effects are heterogeneous, e.g. by gender, parental educational attainment, by single-parenthood and the child's origin.

I provide eight different OLS estimation models: a basic model per test child outcome (models 1 and 4) that includes only the attendance spells of different early childhood care experiences as well as other child characteristics and family background factors; the basic models extended by the treatment dummy for attending a child-centred ECE preschool (models 2 and 5); and the extended basic models including the treatment dummy as well as its significant interactions with any subgroup dummies (models 3 and 6).

To make any causal claims about the tested relationship I need to assume an exogenous treatment allocation process that is unrelated to the child outcome. If I_i is determined exogenously determined, i.e. the choice of preschool institution is at random, the OLS estimates are inconsistent and efficient (see Duncan, Magnuson, & Ludwig, 2004). OLS may overstate the effect if high-quality children are selected into high-quality preschools (Angrist & Krueger, 2001).

The studied ECE approaches have been mainly introduced as a result of the year 2000 policy to target disadvantaged children in larger cities. The new ECE regulation ('*Regeleing VVE*') of the Ministry of Education, Culture and Science (OCW, 2000) gave a financial impulse to extend ECE application to some preschools, in particular in bigger municipalities to help better integrating its larger populations of ethnic minority children into the elementary schooling. Notwithstanding a general tendency to improve the quality and to extend the availability of preschool places, the studied period has seen no major policy changes affecting preschool kindergartens.

In the Netherlands many parents choose a childcare arrangement according to availability and to some degree according to the prices. Often they have been less aware of whether any preschool applied a child-centred ECE approach or not. There is some evidence from fieldwork and survey data that there is only little awareness of the existence of particular ECE approaches such as *Speelplezier*. Of those parents who mentioned in the survey that their child attended a *Speelplezier* preschool and whose children can be matched via the provided preschool name to the truly applied ECE approach at the preschool, only 33 per cent have actually experienced *Speelplezier*. Quoting of other ECE methods has a similarly low appropriateness and there is no significant variation of those levels across background factors such as, for example, parental education level (see Table A-3 in the appendix).

The presence of such strong measurement errors in ECE variables from surveys might induce attenuation bias if not accounted for (see, e.g. Frost & Thompson, 2000), which might be a reason why some comparable studies have not found ECE effects yet. By using only a sub-sample of children for which I match children exactly to their preschool and its ECE history, I prevent dilution of my OLS regression.

Awareness of ECE applications may be somewhat higher among parents of a stronger socio-economic background, but this difference can be accounted for by including parental factors in the analysis. Parents differentiate little between the quality of a childcare arrangement according to whether an ECE method is used or not. Those who send their child to a preschool kindergarten that uses an ECE method do not value the preschool quality higher than parents whose children attend a regular preschool.[22]

[22] The international literature confirms that preschool quality seems of lower importance in parental childcare choices than, for example, the price of childcare (see e.g. Blau, 1991; Blau & Hagy, 1998).

Given that there is some exogeneity in the allocation of children into preschools applying different ECE approaches, I argue that parents do not care much about what occurs to their children in such preschools. Nonetheless, I will apply alternative estimation techniques, i.e. Propensity Score Matching and IV, in order to deal with possible endogeneity.

5.4. Propensity Score Matching

As the assumptions about a linear parametric model specification and the random character of the allocation process might be too strong to withhold against any doubt, I also use two alternative strategies: Propensity Score Matching (PSM) and an instrumental variable approach.

The application of the propensity score matching technique is another way to construct a counterfactual and thus to determine the average outcome the child-centred ECE attendees would have experienced had they attended an alternative preschool, which gives us the Average Treatment Effects for the Treated (ATT) (see Caliendo & Kopeinig, 2005, for a step-wise description of applying PSM). The advantage of PSM over a linear regression is that parametric assumptions of linearity can be relaxed; it allows for more robust predictions within the area of common support as it does not make any extrapolations outside of that area (see e.g. Cochran, 1963). Moreover, PSM focuses the researcher's attention on the direct comparability of treatment and control groups.

Propensity scores are balancing scores based on a number of observed characteristics from the overall population whose conditional distributions are independent of the assignment into treatment, as described by Rubin & Rosenbaum (1984) as well as Imbens & Rubin (2008). I reduce the whole *Moelejaan* data sample to a sub-sample of observations for which sufficient information about individual ECE experiences is available. I then match people who are on average alike in terms of their observable pre-treatment characteristics, including their attendance of a preschool kindergarten of any kind.[23] The only difference that is allowed is that the *treatment group* has attended a child-centred ECE preschool while the *control group* did not, i.e. those who have experienced any other ECE programme or regular preschooling.

To generate the propensity scores, I use the same child and family background factors that I use as controls in the linear regression model. I have cross-sectional data and thus no baseline information about the initial development of the studied children and their parental background. I hence assume that the indicators, which I use for my propensity scoring, are stable over the preschooling period, only the treatment is supposed to differ.

PSM applications make the strong assumption that selection into treatment is solely based on observable characteristics, implying that all variables that significantly influence the assignment of child-centred ECE preschooling and the studied child outcomes simultaneously are observed (Conditional Independence Assumption or CIA). I have a rich dataset of individual and family characteristics at hand to predict selection as good as possible. As discussed for the case of the linear regression, I argue that the treated cases were treated to a large degree at random. While the programme has been targeted towards preschools in areas where a potentially 'weaker' child population lives, the targeting has been far from perfect – so it is likely to find children with similar characteristics among those who have been treated and those who have not been treated.

The area of common support assures that that children with the same propensity score have a positive probability of having both experienced a child-centred ECE preschool or any preschool alternative (Heckman, Lalonde, & Smith, 1999). Treated observations which lie outside the common support are not matched and are excluded. While a match of control and treatment group is better if more information is used to calculate the propensity score, each additional variable exponentially increases the multivariate dimensions necessary to find a common support area.

[23] I use the Stata command PSMATCH2 to implement full Mahalanobis matching and different direct and closest neighbour PSM methods (see Leuven & Sianesi, 2003).

Propensity scores ought to be based on a number of variables that credibly influence the participation in a child-centred ECE preschool as well as the test outcomes (Grilli & Rampichini, 2011; Smith & Todd, 2005). Extraneous variables that influence only participation could be included to increase the fit of the estimated model. However, an over-parameterised model can reduce the area of common support and thus reduce the number of successful matches; it can also increase the variance of the estimates.

Balancing tests, before and after matching, are used to check whether the propensity score optimally balances the treatment groups with the matched control group. Covariates are well balanced when the percentage bias after matching is less than 5 per cent and the t-tests are non-significant (Grilli & Rampichini, 2011; W.-S. Lee, 2006). The '*bias*' is defined as the difference of the mean values of matching variables of the treatment group and the treatment group (before and after matching), divided by the square root of the average sample variance of the original full sample.

A too small common support can give some indication of selection bias due to excluded factors which are non-overlapping (Bryson, Dorsett, & Purdon, 2002). If the overlap is too small, then PSM may not be the most accurate method to apply; the external validity of estimation results from the overlapping sub-sample might be limited. Next to matching to the nearest as well as five nearest neighbours (1-to-1 and 1-to-5 matching), I also apply Kernel matching, which potentially produces a bigger common support area. For the Kernel procedure I make use of the whole common support and matches weighted by the distance between the propensity scores of the matched treatment and control group units (Bryson et al., 2002).

Despite correcting for biases caused by observables, propensity score matching cannot overcome potentially significant biases based on unobservables; omitting important variables could eventually even increase the resulting bias in estimated treatment effects (Heckman, Ichimura, & Todd, 1997). The CIA is in principle an untestable assumption that we cannot fully proof or disproof.

If I_i is endogenous, both OLS and PSM estimates are inconsistent. Endogeneity may occur if the choice of preschool institution is not completely random, e.g. if parents influence the choice of preschool institution in an unobserved way. If high-ability children are more likely to be sorted into such child-centred preschool institutions while we cannot identify their initial ability, OLS or PSM estimations might overstate the effects of such preschools. In that case, estimation by OLS and PSM will produce an upward-biased estimate of β_3 and will therefore not identify true causal effects of the daycare institution on children's outcomes.

5.5. Instrumental variable application

If preschool quality is endogenous, I expect β_3 in the estimated equation (III.1) to be smaller when applying the IV method rather than when estimating by OLS or PSM. If parents cannot truly influence the choice of preschool institution, the estimated OLS/PSM and IV coefficients are both consistent, but estimation by OLS/PSM is more efficient.

As an attempt to overcome potential biases that are due to unobserved factors, I introduce IVs that are correlated with the provision of child-centred ECE at preschools, but are unrelated to the child outcomes. All applied instrumental variables use exogenous sources of information that presumably provide an element of randomness in the preschool allocation process (Angrist & Krueger, 2001).

I use the following four instruments: 1) municipality dummies that indicate whether a municipality has already invested into child-centred ECE, 2) dummies for the management boards of the preschool kindergartens to control for a variation in ECE policies, 3) the distance between homes and the nearest child-centred ECE preschool, 4) the distance towards the nearest child-centred ECE preschool over the distance to any nearest alternative.

The validity of those four instruments as effective exclusion restriction cannot be tested directly (Angrist, Imbens, & Rubin, 1996), they need to be confirmed by theory. I argue in the following why I

perceive those instrumental variables valid in providing exogenous treatment information. The strength of those IVs is later on assessed in terms of first-stage t-statistics.

The first source of instrumental variable information is related to the *municipality in which preschool kindergartens are located*. Only a small share of the nineteen municipalities has made investments in *Speelplezier* or other child-centred ECE methods during the studied period. And as parents cannot easily register their child at a subsidized preschool kindergarten in another municipality, choices with respect to ECE availability at preschool kindergartens are thus limited to some parents. As instrumental variables I thus include a dummy for whether municipalities use *Speelplezier* or not. The instrument might be questioned on the argument that parents who care about their children's education tend to elect politicians who adopt similar policies. However, given that ECE programs are targeted to disadvantaged children, corresponding parents would care less about electing this type of politicians.

A similar source of instrumental information relates to the *management board of preschool kindergartens*. Management boards tend to promote a common approach across preschools towards using ECE. Some have invested strongly into ECE, e.g. *Speelplezier*, while others have not made any ECE investments at all yet - 3 of 10 boards have invested in child-centred ECE, covering preschools with about half of studied children. Many preschools are independent from a higher level management board and some management boards cover preschools in different municipalities. Parents seem to have not only little awareness of the variation in ECE applications but also of the ECE policy variation across management boards. They have little preferences for sending their child to a preschool of a specific management board over another.

The third and fourth sources of exogenous information on treatment allocation are based on the geographic availability of child-centred ECE applications. According to the survey among parents, 78.3 per cent of parents favour a short distance from home. The *Moelejaan* data and the inventory of the preschool kindergartens include information about the postcodes of the child's household and the preschool's location. After having matched those postcodes to GPS coordinates, I calculated distances between individual households and preschool locations.[24] I create the following two instrumental variables: the *distance to the nearest preschool kindergarten which uses child-centred ECE* as well as the *ratio of this distance over the distances to the five closest alternative preschool locations*. Both geographic sources of exogeneity build on the assumption that parents do not move to a housing location to be closer to their preferred preschool location.

However, it is not clear how parents would choose - the preference to access a preschool with presumably higher quality that is due to an ECE application is likely to be outweighed by an aversion of the weaker peer group in that area; ECE investments are targeted towards areas with more disadvantaged children - ethnic minorities and children of lower educated parents.

As a result of such targeting, parents may consider the ECE applications not only as a sign of higher childcare quality but also as a label that indicates a more problematic peer group. Hence, targeting may provide signals that can lead to segregation. Due to 'stigmatization' of ECE preschools parents may be inclined to choose a regular preschool even if the quality of the provided childcare at such a preschool would be lower. On the other hand, if disadvantaged parents are on average less informed and knowledgeable of the existence of ECE applications, they may not stigmatize ECE preschools by its weaker peer group, or they may not have the resources to send their child to another preschool.

Moelejaan data indicates that preschools with larger distances from home are much less often chosen. The data also shows that lower educated parents are more likely to choose a destination that uses an

[24] Dutch Postcodes include a 4-digit number, referring to small sub-areas of municipalities, and a 2-letter combination that usually varies within the same street. Own calculations for 2009 show, there are on average 17 private households per 6-position postcode. Postcodes have been matched to GPS coordinates that were tracked from free online maps. Distances are based on a simple Pythagorean formula and recalibrated into kilometre units.

early education programme than middle and higher educated parents. Over all parents, the presence of an early education programme makes parents choose less likely for a preschool destination.

The *Moelejaan* survey reveals reasons why parents chose a specific ECCE investment for their child. It shows that the preschool peer group is a less important argument when choosing an ECCE investment than the quality of the childcare staff and the institution as well as the used study materials. A cross-check across different socio-economic groups of parents shows that stigmatization happens to some degree; parents with more advantaged backgrounds tend to choose more in terms of peers at an institution. Still, across all groups the importance of ECE quality is ranking higher than the social composition at an institution.

A look at the social compositions of preschools with and without child-centred ECE applications shows that, on average, children at child-centred ECE locations stem from households with lower incomes, fewer books and with fathers that have weaker Dutch skills (see Table A-6). Yet, the differences for the two targeting factors - ethnic minority and lower parental education, are not or only marginally significant.

6. Discussion of the estimation results

In the following I discuss the output of the OLS estimation (see Table 2) for the explanatory factors on the child's characteristics and the family background, for the variation according to different childcare provisions and finally the variation according to the child-centred ECE method and its subgroup interactions.

6.1. OLS estimation results

Table 2: OLS regression output

Dependent variable	Dutch skills			Cognitive skills		
Estimated OLS Model	1	2	3	4	5	6
ECE treatment indicator						
Child-centred ECE		0.76	-0.87		-2.08	-3.69*
(attendance dummy)		[1.42]	[1.49]		[2.04]	[2.01]
Child-centred ECE *interacted with*			13.43***			13.21***
Highest par. education: level 1			[3.90]			[3.05]
Other ECCE indicators						
Total length of preschool attendance	-0.22*	-0.22*	-0.20*	-0.10	-0.09	-0.08
(in units of 10 half-day sessions)	[0.12]	[0.12]	[0.12]	[0.10]	[0.10]	[0.10]
Total length of preschool attendance	0.00	0.00	0.00	0.00	0.00	0.00
(squared term)	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Total length of daycare attendance	-0.03	-0.03	-0.02	0.00	0.00	0.00
(in units of 10 half-day sessions)	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]
Total length of childcare at home	-0.01	-0.01	-0.01	0.00	0.00	0.00
(in units of 10 half-day sessions)	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Child characteristics						
Gender	-3.39***	-3.41***	-3.61***	-1.88***	-1.82**	-2.02***
(boy = 1)	[0.76]	[0.76]	[0.75]	[0.71]	[0.71]	[0.70]
Age at moment of testing	5.24***	5.23***	5.16***	6.46***	6.50***	6.44***
(in years, middle of 2nd grade)	[1.03]	[1.03]	[1.02]	[0.98]	[0.98]	[0.98]
Ethnic minority	0.35	0.39	0.59	0.27	0.14	0.34
(at least one parent born abroad = 1)	[1.34]	[1.33]	[1.32]	[1.36]	[1.34]	[1.33]
Family background factors						
Parenthood	-0.28	-0.30	-0.49	-1.82	-1.76	-1.95
(single parents = 1)	[1.84]	[1.84]	[1.77]	[1.98]	[1.96]	[1.98]
Number of children in household	-1.27**	-1.26**	-1.17**	-1.05*	-1.08*	-1.00*
	[0.50]	[0.50]	[0.50]	[0.56]	[0.55]	[0.55]
Mother's unemployment	-1.16	-1.22	-1.33	-4.37	-4.21	-4.33*
	[3.67]	[3.68]	[3.58]	[2.75]	[2.70]	[2.52]
Highest par. education: level 2	3.79***	3.79***	4.99***	2.54**	2.56**	3.74***
(middle / professional educ.)	[1.43]	[1.42]	[1.45]	[1.29]	[1.29]	[1.29]
Highest par. education: level 3	4.82***	4.78***	6.03***	2.42*	2.52*	3.74***
(higher professional / acad. educ.)	[1.48]	[1.48]	[1.50]	[1.36]	[1.37]	[1.37]
Number of child books at home	1.16**	1.16**	1.20***	0.99**	1.00**	1.04**
(1 unit = 5 books)	[0.45]	[0.45]	[0.45]	[0.48]	[0.48]	[0.47]
Father's Dutch language skills	1.69***	1.71***	1.70***	1.70***	1.64***	1.63***
(5 point Likert scale)	[0.60]	[0.61]	[0.60]	[0.56]	[0.57]	[0.57]
Net monthly hh-income	0.78	0.79	0.62	2.82**	2.78**	2.61**
(logarithmic scale)	[1.13]	[1.12]	[1.12]	[1.20]	[1.19]	[1.18]
Constant	62.02***	61.96***	61.16***	49.93***	50.10***	49.31***
	[7.16]	[7.14]	[7.04]	[7.03]	[7.04]	[7.02]
Observations	1321	1321	1321	1321	1321	1321
Adjusted R^2	0.08	0.08	0.09	0.07	0.08	0.08

Note: Cito Dutch and Cognitive tests are taken in the middle of the 2nd grade, standardized scores (mean 100, std.dev. 15) – see Figure A-1 and Table A-1; * significant at 10 per cent level, ** at 5 per cent level; *** at 1 per cent level; clustered at individual elementary school group level (robust standard errors in parentheses); analysed sub-sample re-weighted to covariate distribution of whole child population in Southern Limburg.

Even though the estimated models use a common set of factors about child characteristics and on the family background, they can explain only about 8 per cent of the variation in the data (see Adjusted R^2). Despite having a rather big sample size, a number of explanatory factors show no significant correlation to the two assessed child outcomes. In particular single-parenthood and belonging to an ethnic minority shows no significance for any of the estimated regression models. More children living in a household has adverse effects on child outcomes. Girls strongly outperform boys, as do older children.

The other explanatory factors that are significantly correlated with the child outcomes and show the expected signs - for an extensive review on the link between child outcomes and various background factors see, for example, Björklund & Salvanes (2010). The estimated negative effects of mother's unemployment and positive effects of household income are only significant for cognitive test scores, which could indicate that language development is insensitive to household investment – an interesting finding that needs further research attention.

Factors of the household's cultural capital show the expected signs. Parental education has a significant positive relationship with both development indicators; effects are particularly large for Dutch skills. The amount of child-books in the household (grouped in categories of 5 books), a proxy for literacy environment and learning culture in the household, has a positive and significant relationship with both test outcomes. The same is the case for fathers' Dutch language skills (that are strongly related to the mother's language skills in the first place).

When looking at the care arrangements that a child has experienced before elementary schooling there are only few significant associations found. Attendance at preschool kindergartens has the most sizable effects, but the negative association is still negligibly small – substantial changes in the experienced preschool term would be needed to get any sizable effects. Childcare at home shows some negative association with Dutch skills and centre-based daycare is showing a negative association with Cognitive skills, but these effects are even smaller. Overall, the negative signs of those associations are unexpected.

Many estimates for the spells of care attendances are insignificant and those who are significant are rather small, which may be because formal childcare arrangements at home or centres constitute still a rather small share of children's experiences and home-based care may be underreported. Likewise, a lack of significant estimates could (in part) be due to bigger measurement errors in those indicators.

Turning to the crucial effect estimates of the ECE programmes, I find that child-centred ECE experiences show no significant main effects for both Dutch language and cognitive test scores, compared to children who attended any other preschool with a teacher-based or no ECE approach. However, when looking at the effects of child-centred ECE across a range of sub-groups of children I find that such an experience has a powerful positive effect on both child outcomes for those children who have low educated parents.[25] At the studied period, low parental education has been one of the risk factors that ECE targets to compensate, next to belonging to an ethnic minority. With the interaction term included, the main ECE effect turns negative for the cognitive outcomes, which might point towards child-centred ECE not being able to address the needs of children with better educated parents, e.g. due to insufficient staff qualifications.

I also check whether the estimated effects are affected by any outliers, so I run those models again as quantile regressions (excluding the clustering option). Quantile regressions are estimates of central tendency where median values are resistant measures that are not as greatly affected by outliers as are the means. The sensitivity check shows similar levels for significant estimates as in the OLS regression. The zero mean effect does not hide any impact in some point of the distribution. Yet, the

[25] Only significant effect differences between those sub-groups and the main-group are presented; the whole set of effect estimations is available upon request.

quantile regression indicates that outliers might influence the effect estimate for the subgroup of children with low educated parents. The interaction effect for language outcome is somewhat lower (9.58) and thus a still remarkably high but more reasonable level; the main effect for the language outcome stays the same. For the cognitive outcome, the interaction effect does not change, whereas the main effect loses its significance (it is significantly negative in the OLS regression).

When rerunning the OLD regression without applying weights as described in section Accounting for missing treatment information, the main effect for child-centred ECE turns out small but significantly negative for the language outcome, all other estimates do not change much. This backs up my presumption that estimation without controlling for item non-response in the treatment variable could lead to a downward bias in the estimated treatment effects.

6.2. PSM estimation results

Are those results confirmed when applying propensity score matching? Table 3 provides an overview of average treatment effects on the treated (ATT) for three matching techniques: 1) nearest neighbour matching, 2) 5-nearest neighbours matching, and 3) Kernel matching. The significances of the differences between the group of treated and the group of matched controls are tested applying bootstrapping method.

Table 3: Propensity Score Matching

	Treated		Controls		Bootstrapping		
	Mean	N	Mean	N	Average treatment effect on treated (ATT)	Std. Error	P>|z|
Nearest Neighbour matching							
Dutch test (M2)	102.500	122	103.062	1199	-0.562	2.167	0.80
Cognitive test (M2)	99.998	122	104.184	1199	-4.186	2.270	0.07
5-Nearest Neighbours matching							
Dutch test (M2)	102.500	122	103.379	1199	-0.879	1.606	0.58
Cognitive test (M2)	99.998	122	102.972	1199	-2.974	1.889	0.12
Kernel matching							
Dutch test (M2)	102.500	122	102.160	1199	0.341	1.358	0.80
Cognitive test (M2)	99.998	122	102.325	1199	-2.327	1.565	0.14

Note: Cito Dutch and Cognitive tests are taken in the middle of the 2nd grade, standardized scores (mean 100, std.dev. 15) – see Figure A-1 and Table A-1; average Treatment Effects for Treated (preschool attendees); treated and control group within common support; bootstrapping on ATT with 100 replications.

Standard errors need to be corrected as PSM brings along additional variation beyond the usual sampling variation (Heckman, Ichimura, Smith, & Todd, 1998). Bootstrapping accounts for this problem, which is valid as long as the sample size is sufficiently large. When applying this method, random draws from the given sample are taken, with a large number of repetitions as to create a large number of randomly reordered datasets. In this regard, bootstrapping relies on the statistical distribution as it is in the data, it does not have to make any parametric assumptions.

All three matching methods achieve substantial percentage reductions in the absolute standardized bias of the vast majority of explanatory variables before and after matching; after matching there are no significant differences between the treated and non-treated group in any variable anymore.[26] The matched sample is sufficiently large to have statistical power; the treatment group size is above 100.

[26] Detailed results of balancing tests based on Stata's pstest-command are available from the author upon request.

Each of the three matching methods results in insignificant differences between treatment and control group, which is in line with Smith and Todd (2005) who stress that, in practice, the choice of matching method often turns out to make little difference. Still, the joint consideration of several approaches offers a way to check the robustness of the treatment estimates. The PSM results confirm the results from the linear OLS regression, which also show no significant main effects of child-centred ECE.[27]

6.3. 2SLS estimation results

In the following, I use different sources of exogenous information on the allocation process of child-centred ECE in an attempt to correct for potential unobserved biases. I present the results of two stage least squares (2SLS) estimations using the before-mentioned instrumental variables. First-stage results allow an assessment of the strength and validity of my chosen IVs in determining the allocation of child-centred ECE. A whole range of IV combinations is tested for best fit.

All four indicators are shown to be valid instruments when used separately[28]; however, a combination of all four of them leads to over-identification problems and the geographic indicators on distances between homes and preschools do not predict significantly the treatment variable when combined them with the other two IVs, which are the indicators that show whether the municipality and the management board of a preschool invest in child-centred ECE. Therefore, I present only the output for the investment indicators, see Table 4.

[27] As the areas of common support for the different child outcomes are already small, in particular for the second testing moment, I cannot study sub-groups in more detail with sufficient statistical power.

[28] A sensitivity test on whether the full set of IVs is jointly strong enough to predict each of the two potentially endogenous repressors – child-centred ECE attendance and its interaction with the group of children with low-educated parents, shows that the joint set of IVs can significantly predict each of the two regressors (following the procedure described by Angrist & Pischke, 2008, p. 218).

Table 4: 2SLS regression output, applying all 4 Instrumental Variables

a) 1st stage results

Dependent variable	Dutch test (M2)	Cognitive test (M2)
Estimated IV Model	2SLS (2)	2SLS (5)
Instrumental variables used for child-centred ECE attendance dummy		
Municipality invests in child-centred ECE	0.347***	0.347***
	[12.67]	[12.67]
Management board of Preschool board invests in child-centred ECE	0.019***	0.019***
	[2.72]	[2.72]
1. Joint significance of the instrument(s) in the first stage; critical values F>10	F=19.76 / p=0.00 IVs strong	F=19.76 / p=0.00 IVs strong
2. Over-identifying restrictions for 2nd stage regression: Sargan (1958)	χ^2=0.67 / p=0.41 IVs valid, No over-identification	χ^2=1.01 / p=0.31 IVs valid, no over-identification

Note: Robust standard errors in parentheses; * significant at 10 per cent level, ** at 5 per cent level; *** at 1 per cent level. A critical F value for the test on joint significance of the IVs (see test Joint significance of the instrument(s) in the first stage; critical values F>10) is 10 (as stated, for example, in Baum, Schaffer, & Stillman, 2003); the test for the over-identification is based on an estimation without robust standard errors and weights are forced.

b) 2nd stage results

Dependent variable	Dutch test (M2)		Cognitive test (M2)	
Estimated IV Model	OLS (2)	2SLS (2)	OLS (5)	2SLS (5)
Child-centred ECE *(attendance dummy)*	0.76	0.10	-2.08	-2.75
	[1.42]	[2.98]	[2.04]	[3.36]
Other ECCE indicators	YES	YES	YES	YES
Child characteristics	YES	YES	YES	YES
Family background factors	YES	YES	YES	YES
Constant	61.96***	62.01***	50.10***	50.16***
	[7.14]	[7.11]	[7.04]	[6.98]
Observations	1321	1321	1321	1321

Note: Cito Dutch and Cognitive tests are taken in the middle of the 2nd grade, (standardized at mean 100 and std.dev. 15) – see Figure A-1 and Table A-1; Robust standard errors in parentheses, clustered at individual elementary school group level; * significant at 10 per cent level, ** at 5 per cent level; *** at 1 per cent level.

c) Post-estimation Model tests

Dependent variable	Dutch test (M2)	Cognitive test (M2)
Estimated IV Model	2SLS (2)	2SLS (5)
3. Wooldridge's test of exogeneity of instrumented treatment variable(s)	F=0.07 / p=0.80 Exogenous	F=0.06 / p=0.80 Exogenous
4. Hausman test for systematic differences between 2SLS and OLS estimation model	χ^2=0.01 / p=1.00 no difference	χ^2=0.04 / p=1.00 no difference
Interpretation of IV results	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; for this option I force weights. 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.

2SLS estimations reproduce the results of the OLS and PSM in terms of finding no significant effects of child-centred ECE over alternative preschool options. Whichever 2SLS specification I use, Wooldridge's tests of the exogeneity of the IVs show that I do not need to worry about endogeneity in the treatment-variable. And Hausman's tests for systematic differences between the OLS and 2SLS show that none of the tested 2SLS models is systematically more efficient than an OLS model. However, the chosen IVs might be valid but not strong enough to produce systematically more efficient 2SLS estimates, i.e. due to too high standard errors for the 2SLS estimates.

Unfortunately, the four IVs do not have sufficient strength to predict a second treatment factor, i.e. interaction terms of the child-centred ECE with any sub-group.[29] In some cases two (or more) of the IVs show a significant relationship in the first-stage results (even though the F-statistics for the join significance is below 10) and Wooldridge's endogeneity test confirms that the treatment variables are endogenous.

The positive direction of the effects of child-centred ECE on language development of children with low educated parents, as found in the OLS estimation, are significant at a 10 per cent significant when using all four IVs jointly or when combining only the first IV (municipal investment in child-centred ECE) and the third IV (ratio of distance to nearest child-centred ECE over alternative preschools). However, for those models the size of effects is far beyond any reasonable level, which could be a result of the lack of strengths of the IVs to determine both treatments.

7. Conclusions

While there is mounting evidence that enriched early childhood investments can stimulate in particular disadvantaged children, little is known yet how such investments should look like. There is a growing debate about what a good early childhood education programme should be like: structured, curriculum- and teacher-based, or rather holistic and individual child-centred. In this paper, I investigate whether children who attended a preschool with a child-centred ECE programme show more development gains than those who attended alternative preschool options. And I study whether such a programme can level the playing field for children who are at risk of not being ready for school when enrolling in elementary schooling.

The estimates show that child-centred ECE programmes, such as the newly certified early childhood education programme *Speelplezier,* have not yet led to significant positive (nor negative) effects on language and cognitive development. These results are in line with the given literature that finds little evidence for the effectiveness of Dutch early childhood education and thus challenges again the positive effects on cognitive and school outcomes found in international studies on individualised ECE approaches, as reviewed, for example, by Camilli et al. (2010).

The evident lack of overall main effects of child-centred ECE experiences cannot be easily generalised to other settings. As a matter of fact, I have used a restricted sample of children to estimate the model. In particular, I have used data for the specific case of the Southern half of the Dutch province of Limburg. This region faces fewer problems with integrating ethnic minority children within early childhood education institutions than the rest of the Netherlands. It rather observes disadvantages for native children caused by low parental education. However, with its pilot investments in targeting at this subgroup of native children, it pioneers a development in the Netherlands.

There are some indications, though, that child-centred ECE approaches produce quite substantial positive effects for children from low educated parents, which are a prior target group of such early compensation investments. These results give a first indicative support to policymakers' plans to extend ECE programmes in South Limburg to children of low educated, native parents in more rural

[29] 2SLS Estimation output for those interaction models is available from the author upon request.

areas across the Netherlands. However, the results also raise questions about why no significant effects are reached yet.

The lack of evident effects could be due to measurement errors, in particular in the child outcome and in the studied indicator for child-centred ECE experiences. Even though, the studied child outcomes from Cito, an independent test provider, are less likely to contain measurement errors; they are applied regularly at most Dutch elementary schools and have been used in a large number of studies. Besides, the Dutch language test should be especially well fit for assessing the linguistic stimulation that child-centred ECE programmes shall provide. With respect to the studied ECE indicator, there are no obvious indication for measurement errors: I have cross-validated the information about ECE provision with an additional survey and secondary information, and excluded observations for which I cannot identify with full certainty whether it attended a preschool that applied child-centred ECE or not. A quantile regression shows that the zero mean effect does not hide any impact in some point of the distribution.

There may be a number of other reasons why I cannot detect statistically significant effects on most of the estimated treatments. The used *Moelejaan* data confirms Leseman's (2002) argument that the intensity of early childhood care and education experiences tends to be insufficient to lead to sizable effects. And ECE programmes at preschool kindergartens and elementary schools in South Limburg are at an early implementation state at the time of data collection, which is in line with Driessen (2004); he suspects that too little professionalization of ECE provisions causes a lack of significant development gains.

Effects might be measurable in future when more experience with child-centred ECE methods has been acquired by the preschool staff and more children of the target group experience such ECE. A large share of the children who shall benefit from child-centred ECE preschool has not yet attended such preschools in the studied time period. Also, I assess test observations of children rather soon after their ECE experience at a preschool kindergarten. ECE programmes are usually continued in elementary schools and thus some effects may show up only later on during the schooling career.

Finally, Nap-Kolhoff et al. (2008) stress the lack of sufficient data about the quality of the child's early childhood care and education experience to provide informed evidence. The study at hand has still insufficient quality information, effects estimates have to be averaged, e.g. across preschool groups and days, and child-centred ECE can only be compared to the joined alternative of teacher-based ECE and regular preschooling. Whereas this study uses new information about the type of ECE programme, it builds on the assumption that the application of an ECE programme reflects the full application of the quality conditions considered to be, in theory, a prerequisite for being effective. Even so there is evidence, that a majority of ECE providers does not yet fulfil all those conditions in practice.

Further research on the quality of preschooling and its extension to bigger groups of disadvantaged groups is needed, which implies that municipalities introducing child-centred ECE programmes such as *Speelplezier* should consider devoting sufficient money to the collection of appropriate data to evaluate the effectiveness of the programme. The research centre '*Kaans*' at the University of Maastricht is working on such an extended research agenda and data collection for South Limburg. This research will also look more into the impact of child-centred ECE on children's socio-emotional and behavioural development. The strong interactive character of such child-centred ECE approaches suggests that positive effects may be found in those domains.

I conclude in line with the literature, that various sample distortions impede finding significant and robust effects of investing additional funding into child-centred early childhood education programmes.

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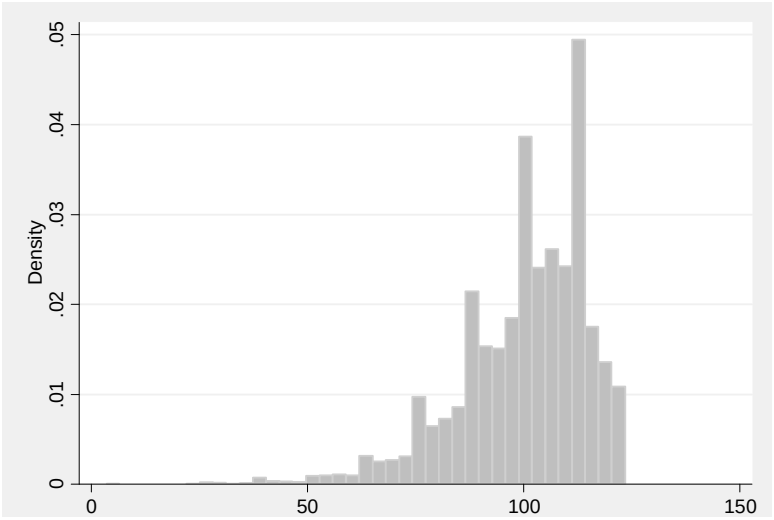
Appendix

Figure A-1: Distribution of standardized Cito Test scores (mean 100, std.dev. 15)

a. Dutch language test, M2



b. Cognitive test, M2

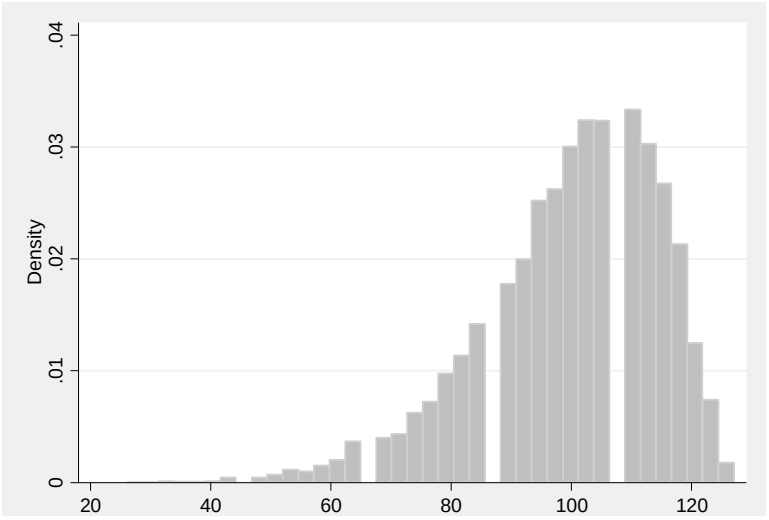
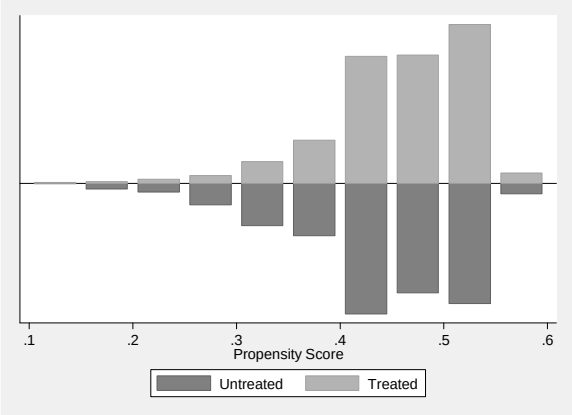


Table A-1: Test scores in five categories and averages of standardized scores

Dutch language test, M2	Average standardized scores	Frequency	Cognitive test, M2	Average standardized scores	Frequency
22-41	77.90	172	15-28	76.97	161
42-45	94.43	229	29-31	91.92	214
46-48	101.78	245	32-34	100.63	318
49-50	107.56	233	35-36	107.83	224
51-55	114.63	429	37-41	116.31	392

Figure A-2: Calculated weights

a. **Overlap between population (*untreated*) and matched sub-sample that is studied (*treated*)**



b. **Distribution of calculated non-response weight**

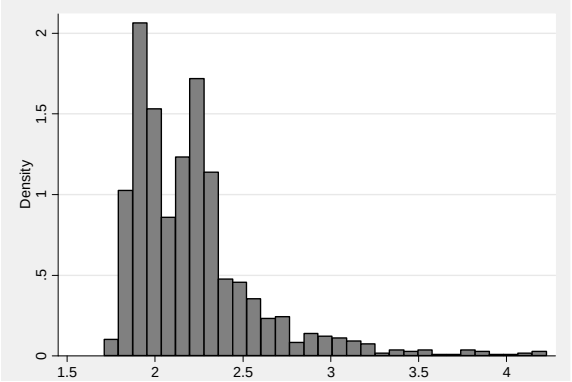


Table A-2: Descriptive statistics

Control variable	variable name	N	Mean	Std. Dev.	Min.	Max.
Child-centred ECE *(attendance dummy)*	ece_childcentred_all	1321	0.09	0.29	0.0	1.0
Total length of preschool attendance *(in units of 10 half-day sessions)*	preschool_total	1321	14.54	8.82	0.0	72.0
Total length of daycare attendance *(in units of 10 half-day sessions)*	daycare_total	1321	4.52	11.64	0.0	90.0
Total length of childcare at home *(in units of 10 half-day sessions)*	homecare_total	1321	73.36	33.00	0.0	180.0
Dutch test *('taal voor kleuters', M2-testing moment)*	std_rstvkm2	1321	102.37	13.14	37.8	123.5
Cognitive test *('ordenen', M2-testing moment)*	std_rsordm2	1321	102.07	13.74	38.0	127.1
Gender *(boy = 1)*	boy	1321	0.51	0.50	0.0	1.0
Age at moment of testing *(in years, middle of 2nd grade)*	age_m2	1321	5.77	0.38	3.7	7.3
Ethnic minority *(at least one parent born abroad = 1)*	ethnic_minority	1321	0.13	0.34	0.0	1.0
Parenthood *(single parents = 1)*	singleparent	1321	0.05	0.22	0.0	1.0
Number of children in household	child_nr	1321	2.12	0.71	1.0	7.0
Mother's unemployment	m_unemp	1321	0.02	0.15	0.0	1.0
Highest par. education: level 1 *(no / elem. /l ower educ.)*	educ_highest3_cat1	1321	0.13	0.34	0.0	1.0
Highest par. education: level 2 *(middle / professional educ.)*	educ_highest3_cat2	1321	0.52	0.50	0.0	1.0
Highest par. education: level 3 *(higher professional / acad. educ.)*	educ_highest3_cat3	1321	0.35	0.48	0.0	1.0
Number of child books at home *(1 unit = 5 books)*	books	1321	4.46	0.95	1.0	5.0
Father's Dutch language skills *(5 point Likert scale)*	dutchskills_dad	1321	4.50	0.69	2.0	5.0
Net monthly hh-income *(logarithmic scale)*	hh_inc_gross_log	1321	1.66	0.43	0.0	2.4

Note: These figures are based on the studied sub-sample of the Moelejaan data for Southern Limburg; non-response weights are applied (see section Accounting for missing treatment information).

Table A-3: Length of different childcare experiences

	Obs.	Mean	Std. Dev.	Parental care	Family care	Nanny care	Home care	Daycare	Preschool	Total reported childcare
Parental care (home-based)	1321	52.10	32.12	1.00						
Family care (home-based)	1321	18.04	19.85	-0.31	1.00					
Nanny care (home-based)	1321	3.72	12.06	-0.13	-0.04	1.00				
Overall home-based care	1321	73.87	32.56	0.75	0.29	0.22	1.00			
Daycare (centre-based)	1321	4.49	11.69	-0.15	-0.13	0.01	-0.23	1.00		
Preschool kindergarten (centre-based)	1321	14.46	8.73	-0.02	0.08	-0.01	0.02	-0.15	1.00	
Total childcare	1321	92.82	32.91	0.68	0.27	0.21	0.92	0.09	0.24	1.00

Note: These unweighted figures (in units of 10 half-day sessions) are based on the sub-sample Moelejaan survey data for Southern Limburg for which sufficient information has been available. In the *Moelejaan* survey, we have asked parents about the types of childcare used before enrolling their child at elementary school, including questions about the number of half-day sessions per week and years of total childcare attendance. Most children enrol at school when they are about four years old. Children can potentially experience a maximum of about 1400 half-days of childcare (= 3.5 'years before enrolment' x 2 'half-day sessions' x 5 'working days per week' x 40 'weeks per year excl. holidays'). Descriptive statistics of the collected data are approximately within that range. Still, the average total number of reported childcare half-days (=927) is smaller than this total possible number of half-days; some parents do not provide complete information on all possible answer options and other possible childcare alternatives have not be asked.

Table A-4: Appropriate parental quoting of ECE method Speelplezier

ECE method (Speelplezier) quoted by parents in the survey resembles the truly applied ECE method that has been linked via the preschool's name		
	Not appropriate	Appropriate
Highest par. education: level 1 *(no / basic / lower educ.)*	65.1 per cent	34.9 per cent
Highest par. education: level 2 *(middle / professional educ.)*	67.8 per cent	32.2 per cent
Highest par. education: level 3 *(higher professional / acad. educ.)*	65.0 per cent	35.0 per cent
Total	67.0 per cent	33.0 per cent
Observations *(within full sample)*	1173	578

Table A-5: T-tests of sample comparison - studied sub-sample with ECE information and without

variable name	N_1 (studied sub-sample)	N_2 (non-studied sample)	mean comparison	t-test at 5 per cent significance
boy	5693	10645	$mean_1 < mean_2$	(marginally) significant difference
age_m2	2634	4820	$mean_1 < mean_2$	significant difference
ethnic_minority	5692	5283	$mean_1 < mean_2$	significant difference
singleparent	5509	4897	$mean_1 < mean_2$	significant difference
child_nr	5684	5171	$mean_1 > mean_2$	no significant difference
m_unemp	5392	5051	$mean_1 < mean_2$	significant difference
educ_highest	4685	8806	$mean_1 > mean_2$	significant difference
books	5502	5003	$mean_1 > mean_2$	significant difference
dutchskill_dad	4850	5490	$mean_1 > mean_2$	significant difference
hh_income	4527	4232	$mean_1 > mean_2$	significant difference

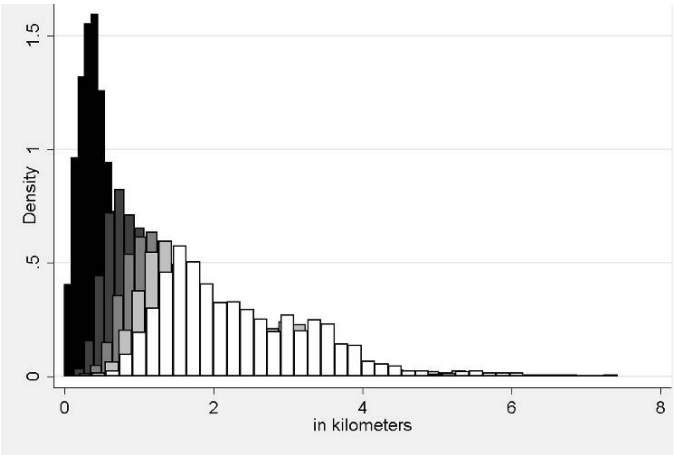
Table A-6: T-tests of sample comparison - preschools with and without child-centred ECE

variable name	N_1 (child-centred ECE)	N_2 (other ECE or regular)	mean comparison	t-test at 5 per cent significance
ethnic_minority	634	5058	$mean_1 < mean_2$	no significant difference
singleparent	609	4900	$mean_1 < mean_2$	no significant difference
child_nr	643	5041	$mean_1 > mean_2$	no significant difference
m_unemp	512	4880	$mean_1 > mean_2$	no significant difference
educ_highest	548	4137	$mean_1 > mean_2$	(Marginally) significant difference
books	571	4931	$mean_1 < mean_2$	significant difference
dutchskill_dad	620	4870	$mean_1 < mean_2$	significant difference
hh_income	494	4033	$mean_1 < mean_2$	significant difference

Table A-7: Distance information between homes and preschools

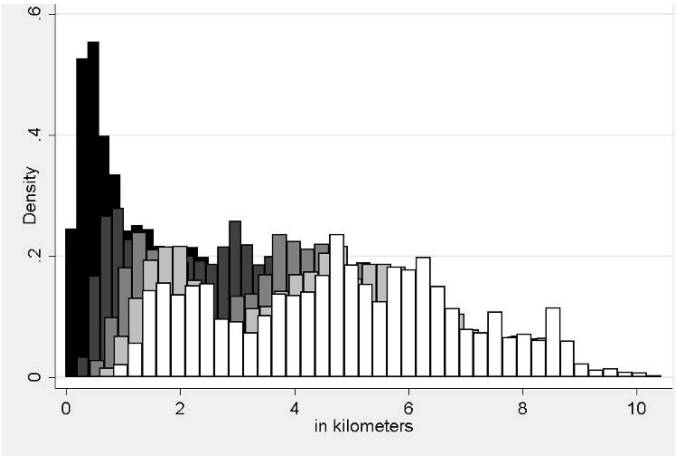
	Obs.	Mean	Std. Dev.
Distance to chosen preschool	1309	1.52	2.99
Distance to closest preschool	1309	0.59	0.42
Distance to closest child-centred ECE preschool	1309	1.90	1.58
Distance of chosen preschool compared to average 5 closest alternatives	1309	0.99	2.18
Distance of chosen preschool compared to average 5 closest alternative options of child-centred ECE preschools	1309	0.50	1.17
Distance of closest child-centred ECE preschool over closest alternative option	1309	218	3472

Figure A-3: Distances five closest available preschools that do not apply Speelplezier



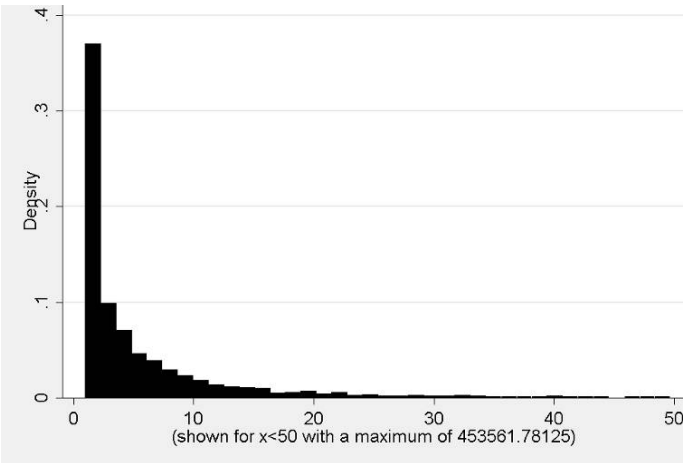
Note: Shading goes from 1st closest preschool in black bars to 5th closest in white bars.

Figure A-4: Distances to five closest available preschools that apply Speelplezier



Note: Shading goes from 1st closest preschool in black bars to 5th closest in white bars.

Figure A-5: Ratio of distance to closest child-centred ECE over closest alternative preschools



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