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Child Care and School Performance in Denmark and the United States

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Abstract

Child care and early education policies may not only raise average achievement but may also be of special benefit for less advantaged children, in particular if programs are high quality. We test whether high quality child care is equalizing using rich longitudinal data from two comparison countries, Denmark and the United States. In Denmark, we find that enrollment in high-quality formal care at age 3 is associated with higher cognitive scores at age 11. Moreover, the findings suggest stronger effects for the lowest-income children and for children at the bottom of the test score distribution. In the US case, results are different. We find that enrollment in school or center based care is associated with higher cognitive scores at school entry, but the beneficial effects erode by age 11, particularly for disadvantaged children. Thus, the US results do not point to larger and more lasting effects for disadvantaged children. This may be because low income children attend poorer quality care and subsequently attend lower quality schools.

Keywords

child care; inequality; cognitive achievement; ECLS-K; DALSC

Introduction

There is mounting evidence that conditions during the earliest childhood years are decisive for later life chances. What is particularly clear is that high quality child care and education during the preschool years yield substantial benefits in terms of school readiness, educational attainment, health and social integration. And research suggests that disadvantaged children tend to reap the greatest benefits if, and this must be stressed, preschool programs are of high quality (Gormley et al., 2005; Heckman and Lochner, 2000; Neuman, Kamerman, Waldfogel, and Brooks-Gunn, 2003; Reynolds et al., 2011; Waldfogel, 2006).

Economists emphasize the positive effects of high-quality preschool programs on skill acquisition and human capital formation (Carneiro and Heckman, 2003). Sociologists take this one step further and argue that programs that raise the achievement levels of disadvantaged children disproportionately will also create a homogenizing effect in terms of educational attainment. This, in turn, should promote greater social mobility and weaken the impact of social origins on life chances (Esping-Andersen, 2004; 2009). Indeed, the most recent expansions in universal preschool provision in countries such as the United Kingdom have been strongly motivated by such equal opportunities concerns (Waldfogel, 2010).

Most of the evidence that demonstrates positive effects of early childhood programs derives from evaluations of limited – mainly U.S.-based -- programs targeted to at-risk children (programs such as the Perry Preschool and other experiments, (see review in Karoly, Kilburn, and Cannon, 2005) or the more recent quasi-experimental Chicago Child Parent Program (see Reynolds et al., 2011). In contrast, there are surprisingly few nation-wide studies. Felfe and Lalive (2010) exploited large regional differences in Germany to explore whether the spread of quality care produced positive effects on children; Havnes and Mogstad (2010) traced the effects of a 1975 Norwegian policy introducing basically universal kindergarten coverage and found, in line with U.S. research, that it had positive effects for children from low income and low educated families. In contrast, a Canadian study comparing Quebec against regions with no large-scale child care coverage found adverse behavioral effects, which appear to be due to the low quality of the child care on offer (Baker, Gruber, and Milligan, 2008). Gregg, Washbrook, Propper, and Burgess (2005) in the UK, however, found no such negative effects and their results suggest, in fact, that high quality care eliminates any potential adverse effects of maternal employment. A few studies have centered on the Danish case which, internationally speaking, is of particular interest since it is widely recognized as a vanguard country in terms of public support for families in general, and for its universal coverage of early child care services in particular (Datta Gupta and Simonsen, 2010a; 2010b; Bingley and Westergaard-Nielsen, 2011; Baumuller et.al., 2010).

All told, the weight of the evidence does suggest that pre-school programs have salutary effects if they are of high quality. But it is also the case that the size and strength of such effects are often quite modest, reflecting the varying quality of programs studied – albeit generally stronger for disadvantaged children. This clearly points to the importance of distinguishing between high and low quality arrangements in any study that – like ours – aims to identify equalizing effects. While a number of single-country studies do measure variations in program quality, there exists (as far as we are aware) no single study that has attempted to compare effects across different countries. The latter is potentially a rewarding research strategy. Firstly, it should help us identify whether or not the effects are similar across different cultures and social structures. Secondly, in addition to the intra-country comparison across program quality-levels we can also exploit inter-country differences in the way their early childhood policies are constructed and in the quality of those programs.

It is in this vein that we test the effects of early childhood care and education in both Denmark and the United States. This comparison is motivated by a number of factors: these countries represent polar opposites in terms of public support for families – Denmark is broadly regarded as an international front-runner, the U.S. as a laggard; they similarly occupy the two tail-ends in terms of social and economic inequality, with Denmark boasting internationally very low child poverty rates and the U.S. the opposite (OECD, 2011). International comparisons of inter-generational income mobility have also shown that Denmark exhibits relatively high inter-generational mobility rates while the U.S. suffers from low mobility – this is particularly the case for mobility chances from the bottom of the income distribution (Bjorklund and Jantti, 2009; Esping-Andersen, 2004).

Denmark is a uniquely suitable case for examining the effects of pre-school care and education. Firstly, Denmark boasts nearly universal attendance among children aged 1-6. In fact, the proportion of preschool age children that are cared for primarily by their parents is a small minority. Near-universal coverage is attained via heavy public subsidization of costs. Secondly, the system is quite homogenous in terms of standards and quality but with one decisive exception: it offers two distinct types of care provision that differ markedly in terms of pedagogical and other standards: a (very) high quality center-based care, and a lower-quality regime in which children are cared for by a non-professional woman in her own

home. Private commercial child care is virtually non-existent. This variation can be exploited to gauge how much quality of early childhood stimulus influences later outcomes, since assignment to high versus low quality care is essentially based on a lottery system.

The United States, our second case, offers a contrasting arrangement. Firstly, the U.S. does not have universal attendance in early child care and preschool education. Secondly, the system is based heavily on private market providers and is, accordingly, quite heterogeneous. The supply of care ranges from often low-quality informal care to sometimes very high-quality preschool education. Since, for the most part, the costs are entirely borne by the parents, both the type and quality of care are strongly linked to family income. That said, there is some provision for public subsidies for some low income children. The Head Start program provides free early education to low-income three and four year olds, serving approximately 50% of eligible low-income children in that age group. However, program quality in Head Start is variable and a recent random assignment evaluation study found that it had fairly modest effects on school readiness (U.S. Department of Health and Human Services, 2005, 2010). In addition, some 4 year olds attend free public pre-kindergarten programs offered by their local schools. The evidence suggests that these pre-kindergarten programs have positive effects on school readiness, particularly for disadvantaged children, but such programs serve only a small minority of children (about 1/6 at the time considered here) (Gormley et al., 2005; Magnuson, Ruhm, and Waldfogel, 2007; NIEER, 2011; Weiland and Yoshikawa, 2010; Wong et al., 2007).

We begin with a brief discussion of the importance of social mobility as a policy objective and what role early childhood care and education may play. Then we provide further details on the Danish and U.S. child care and early education systems and summarize previous research in the two countries. We next introduce the data for the two countries, describe our methodological approach, and present the results of our analysis. We conclude with a discussion of our main findings and their implications for policy as well as further research.

Social Mobility and the Role of Early Childhood Care and Education

Child and family policies, and more generally welfare state policies, pursue multiple objectives including reducing poverty, inequality, and economic insecurity and increasing opportunity, mobility, and fundamental capabilities such as education and health. Though most cross-national studies focus primarily on poverty or inequality (Garfinkel, Rainwater, and Smeeding, 2010), equal opportunity is arguably as important an outcome as equality of results. Some, like Arthur Okun (1975), argue that there is a trade-off between equality and efficiency. But others like Korpi (1985) and Garfinkel, Rainwater, and Smeeding (2010) argue that most welfare state programs actually increase both equality and efficiency. In any case, it is widely agreed that equality of opportunity increases both equity and efficiency (Okun, 1975). While welfare state programs rarely aim to reduce inequality of outcomes, some (such as public education) are explicitly designed to promote equal opportunities (Esping-Andersen, 2009).

Measuring the extent to which opportunity varies within nations over time, let alone across nations, is difficult. Yet, economists and sociologists have recently made great progress in this area by focusing on inter-generational mobility patterns in terms of occupational status, income, and educational attainment (for a review of the key issues, see Bjorklund and Jantti, 2009 and Jencks and Tach, 2005). Three striking findings emerge from this literature (Esping-Andersen, 2009). First, in most nations, children from the poorest and richest quintiles of the population are more likely than children from the middle three quintiles to remain in the same quintile as their parents. Second, mobility is greater in countries that have more equal income distributions. Third, while the high intergenerational transmission among the rich is common to all advanced nations, in countries with more effective child

and family policies and more equal income distributions, the chances of escaping poverty are much greater.

The case for universal, public early childhood education and care can be seen as a special case of the more general commitment to public elementary and secondary education. The benefits of education spill over beyond the individual child and family to other members of society. Thus citizens will have an interest not only in education for their own children, but also for all children. Poorly educated children are more likely to be unhealthy, dependent upon public assistance, and criminal when adults. Education reduces these social costs. More educated children are also more likely as adults to be more informed citizens. In deciding how much to spend on the education of their own children, parents acting individually do not take account of the spill-over or public benefits of education. If, then, reliance on the market will provoke under-investment in education there is a clear case in favour of collective investments.

Universal public education should promote greater equality of opportunity. This is so because children from the poorest families will obtain the greatest relative gains in comparison to the quality of education they would receive were they fully dependent on their parents' purchasing power. Vice versa, in a publicly financed regime it is likely that children from wealthy origins will gain the least to the extent that their parents could, in principle, purchase private education at the same or higher quality standards than those operating in a public system. In short, public education may promote intergenerational mobility by making investments in children less unequal.

Public education, like universal benefits in general, redistributes income, narrows inequality, and levels the playing field. Families at the bottom of the income distribution pay less in taxes than their children receive in benefits while families at the top pay more in taxes than their children receive in benefits. (For a discussion, see Garfinkel, Rainwater, and Smeeding, 2010.) Finally, public education also frees up mothers to work, thereby increasing opportunities for women and diminishing the risk of poverty.

The first two arguments are widely accepted in the United States which, in fact, was one of the world leaders in the public provision of mass elementary education in the 19th century and the world leader in the provision of mass secondary and college education throughout most of the 20th century. The country was amply rewarded. The U.S. record in economic growth has been outstanding and economists are agreed that educational expansion was a key factor behind economic growth (see, e.g., Goldin and Katz, 2008). Throughout most of the 19th and 20th century, the United States has also been known as "the land of opportunity". Its leadership in education suggests that at least in part the reputation was deserved.

The question is do the same arguments apply to very young children? Or, put another way, why extend the age of school downward? Aren't children below the age of 6 too young to learn? Indeed, doesn't the addition of the term "care" to early childhood education concede that these children would be better off being cared for within the family?

First, we now know from brain science and developmental science that the early years are critical to child development (Shonkoff and Phillips, 2000). Learning begins at birth. Social science research suggests that children are better off if cared for by a parent during the first year of life, but after that, the effect of mother's employment on child outcomes depends upon the quality of child care (Brooks-Gunn, Han, and Waldfogel, 2010; Waldfogel, 2006).

Second, young children from upper income, college educated families receive much larger investments from their families that prepare them to do well in school and adult life than less

affluent children (Kaushal, Magnuson, and Waldfogel, in press; Kornrich and Furstenberg, 2010). Large differences are apparent in spending on early education and child care programs, which are costly and thus difficult for low-income families to afford without public subsidies. In the United States, seventy percent of children aged three to five whose mothers are college-educated attend pre-school compared with only 38 percent of children whose mothers did not complete high school (Karoly and Bigelow 2005). Differences in investments also encompass consumer goods (Kaushal, Magnuson, and Waldfogel, in press) as well as parenting (Waldfogel and Washbrook, in press a and b). For example, higher income and more educated parents spend more time reading to their children. Lower income and less educated parents are more likely to engage in harsh and inconsistent parenting practices that may have negative implications for their children's development. .

Third, we now have evidence that high-quality early childhood education is a very good investment. Benefits far exceed the costs, especially for disadvantaged children (Karoly and Bigelow, 2005; Reynolds et al., 2011). James Heckman reports in *Science* (2006) that the present discounted value of the benefits of the Perry pre-school program, an experimentally evaluated program targeted at very disadvantaged children, was nearly nine times the costs. As with education more generally, children from the poorest families should gain the most from publicly provided high quality care and education: the quality of the service they receive will exceed what their parents could purchase on their own.

Yet it is unclear how much disadvantaged children should be expected to gain from a given level of quality education relative to what more advantaged children gain from the same level of quality. The research on model early childhood education programs suggests that such programs deliver larger benefits for the most disadvantaged children, but few such programs have included both disadvantaged and advantaged children, so the evidence is scant (see, e.g. review in Karoly et al., 2005). Although theoretically we might expect disadvantaged children to have the most to gain from quality child care, a counter-argument is that children who already have strong cognitive skills and interests may actually reap the greatest benefits from high quality care (Heckman, 2006). Thus, while the weight of the evidence inclines us to expect high-quality early childhood education to have an equalizing effect, this is by no means certain. The aim of this paper is to examine to what extent, indeed, high quality early education and care help level the playing field for children.

Finally, as mentioned, early childhood education and care frees up mothers to work. The gains to families extend throughout the income distribution because the costs of working are decreased for all women. But again, the greatest gains come at the bottom of the income distribution, and most especially for poor single mothers, if their labor supply is inhibited by the high costs of child care. Indeed, Esping Andersen (2009) estimates that just the gains in future tax revenues that come from the increase in mother's work and future earnings nearly pay for the costs of early childcare and education.

The Danish Child Care System

Denmark, along with its Scandinavian neighbors, is routinely identified as a world-leader in terms of public support for families (Gornick and Meyers, 2003; Kamerman, 2000; OECD, 2006a; Ploug, in this volume). This is certainly the case with regard to child care, where Denmark boasts the greatest amount of public spending within the OECD (2 percent of GDP, compared to 0.5 percent in the U.S. and 1 percent in France) and also the fullest coverage -- 85 percent of the under-6s are enrolled in child care and preschool education centers (OECD, 2007). Indeed legislation stipulates that supply must meet demand.

The expansion of public child care in Denmark coincided with the surge of female employment that began in the 1960s and accelerated in the ensuing decades. From the onset,

quality norms were set very high thus ensuring internationally exceptionally high standards. Licensed child care personnel are required to have a minimum of two years pedagogical training at the university level. Additionally, staff-to-child ratios are comparatively very small: 1:3 for the under-3s; approximately 1:7 for the preschool level.¹ And to ensure universal access and affordability, two-thirds of the costs are covered by public subsidies, and one third by parental co-payments; the latter are waived for low income and lone parent families. For detailed treatments, see Gornick and Meyers (2003), OECD (2006a), and Ploug (in this volume).

In brief, the Danish system is unusually universal in terms of coverage and it boasts, no doubt, some of the world's highest quality standards. This said, one should expect far more homogeneous child outcomes than in most other countries. Some, albeit not direct, evidence supports this conclusion. In a comparative analysis of social origin effects on educational attainment, Esping-Andersen (2004) finds that the surge in equality that can be observed for Denmark and Sweden is centered in the child cohorts that experienced universal child care. No similar equalization was found for Germany, the U.K. or the U.S.

Child care enrolment interacts with the parental leave system. Until the past decade, leave schemes covered only 6 months post-birth. This meant that a large proportion of children were placed in care prior to age 1. Since then, however, parental leave extends to almost an entire year and the norm now is that children begin attendance at age one. They will typically spend 2 years in early care ('vuggestuer') and subsequently three years in preschool ('boernehave'). Most children attend on a full-day basis.

Preschool-age children in Denmark are distributed across three alternatives. Approximately one tenth do not attend child care. Among the large majority that attend, about two-thirds are placed in high-quality centers and one-third in the low-quality alternative.

Danish policy includes a clause that guarantees all children a place in early care and preschool. But since demand continued to exceed supply, the Danish municipalities were compelled to erect a lower-quality care system in parallel to the high-grade public institutions. In the lower-quality regime, children are cared for by a woman who takes the children into her own home during the day. Legislation posits that the number of children per care-giver must be limited to a maximum of five. As a result, these child care settings are costly, in fact more costly on average than public group care, but the quality is poor. These child-minders are not required to have advanced pedagogical training and, in fact, normally acquire no more than some weeks' training. Unlike the United States or, for that matter, most OECD countries, there are virtually no private commercial child care centers. The few that exist are primarily religiously defined and are, in any case, legally required to adopt identical standards as those in the public sector. In other words, they can be classified together with the public institutions.

Considering the prominent place that early childhood care and education occupy in the Nordic countries, there are surprisingly few studies that have examined their consequences for child outcomes. Indeed, there exist no studies, like ours, that compare across other countries. Datta Gupta and Simonsen (2010a; 2010b), using the same DALSC data we use here, examine whether assignment to low or high quality institutions makes any difference in terms of child behavior outcomes, such as risky behavior. They find that variations in child care make no real difference. In one of their studies they include also a verbal performance measure (the same we shall employ) and, again, find only rather modest effects

¹For the under-3s there has been some relaxation of the norms in the past decade, i.e. staff:child ratios have risen somewhat. But this will have no relevance for our study since we measure attendance for 1998-99 when the children were aged 3.

(Datta Gupta and Simonsen (2010a). But neither of these studies estimates marginal effects across child distributions. Bingley and Westergaard-Nielsen (2011) use a difference-in-difference design to estimate the causal effect of child care expansion in Denmark on inter-generational social mobility (in terms of parent-child educational attainment). They use registry data both for levels of municipal child care provision and to identify parent-child mobility correlations. Like our study, they focus especially on the marginal effects for less privileged children. However, their study is unable to identify whether children attended high or low quality care. Their study finds, rather similar to ours, that children from low educated backgrounds benefit disproportionately (in their study, in terms of educational attainment). Rather similar results emerge from a third recent study (Bauchmuller, Gortz, and Wurtz-Rasmussen, 2010). This study is also based on registry data and identifies quality differences in terms of personnel-child ratios, the proportion male teachers, and staff-turnover. Focusing on children's exam performance at age 16 (9th grade), they find that the quality of early care has positive achievement effects, especially for boys.

The U.S. Child Care System

The United States stands out for its heavy reliance on the private market for early child care and education (Kamerman and Kahn, 1995; Kamerman and Waldfogel, 2005). The share of children enrolled in publicly funded care is low relative to peer countries, and as a result the percentage of costs borne by parents is high (Gornick and Meyers, 2003). Thus, it is no surprise that type and quality of arrangements in which children are placed strongly correlate with parental income (Bainbridge et al., 2005; Magnuson and Waldfogel, 2005; Meyers et al., 2004).

Within the U.S. system, we can distinguish three different types or modes of non-parental care. The first is informal care, which includes care by a relative or non-relative in either the child's home or another person's home. Thus, informal care can range from one-on-one care to care in a small group. Parents often prefer informal care, particularly for young children, because it is delivered in a family-like setting and may have a more convenient location or hours. Informal care is also generally less expensive than more formal care (although the costs vary considerably -- the price of nannies can exceed the cost of high quality centers). The evidence on informal care does not generally point to any developmental benefits as compared to parental care (Waldfogel, 2006).

The second category is school or center based care (often referred to as daycare, nursery school, or preschool). This group also includes pre-kindergarten programs funded by states and local schools, which served approximately 1/6 of four-year olds in the time period considered here. Attendance at school or center-based programs has been found to be associated with improved school readiness, in particular in terms of cognitive skills (Waldfogel, 2006).

The third category is Head Start, the nation's oldest and largest subsidized pre-school program. It aims to be a comprehensive child development program for low-income children and children with disabilities. It now serves roughly 50% of eligible low-income three and four year olds in the U.S.. Evaluations of Head Start over the years have produced mixed results, in large part because of the difficulty of studying such a highly disadvantaged population.. However a recent random assignment study (USDHHS, 2005) provides evidence that Head Start does lead to improved school readiness for the children it serves, although the magnitude of the effects is fairly modest.

As mentioned above, the quality and type of pre-school care is strongly correlated with family income (Bainbridge et al., 2005; Magnuson and Waldfogel, 2005; Meyers et al., 2004). Children from low-income families are the least likely to be enrolled in formal school

or center based care and are most likely to be in low-quality care, unless their family has received a child care subsidy or access to publicly supported preschool.² At the other extreme, children from affluent families are most likely to be in formal school or center-based care, and most likely to be in high-quality care. Children from middle-income families experience more informal care and lower quality care than their more affluent peers, and may even attend more informal and lower-quality care than children from low-income families, because middle-income families are much less likely to qualify for subsidized care.

Approximately 18 percent of the preschool-age children in our sample are cared for solely by parents (see Appendix 2). This category is the reference group in all our regression models.

The private and highly skewed nature of the U.S. child care system makes it difficult to predict to what extent the current distribution of child care and early education arrangements might play an equalizing role. While in theory high quality child care and early education offered to low-income children should help narrow gaps in school readiness and later school achievement, it is not clear to what extent low-income children are currently receiving high-quality care relative to their middle- and high-income peers, nor the extent to which they might gain more (or less) than their affluent peers given the same level of quality. It is also worth noting that even high-quality care in the US is of generally lower quality than the high-quality care on offer in Denmark.

Empirical Strategy

Our empirical strategy is straightforward – to estimate the influence of high-quality child care and early education attended prior to school entry on children's school achievement and to test whether any observed benefits of high-quality child care and early education are larger for more disadvantaged children. If the latter is true, this would provide support for the hypothesis that high-quality child care and early education can promote social mobility.

We therefore require data on children's experiences of child care and early education before school entry, children's subsequent school achievement, and other key child and family covariates that might be correlated with both early care and education and child outcomes. We turn to longitudinal data from our two focal countries and attempt to code the data in a way that maximizes comparability across countries, while also respecting the very different child care and early education systems in place in the two countries. It is important to add that the data we use are observational and our analyses do not aim to identify truly causal effects.

The Danish Data

The data for Denmark derive from a panel study (DALSC) of 6,011 children born in 1995 (September-October) to mothers with Danish citizenship and living in Denmark at the time. A special sub-sample (N= 611) of children of immigrant parents was also undertaken. This module, however, suffers from very severe attrition and non-response problems (almost 50% of the sub-sample disappeared already by the second wave). These data are deemed of such low quality that they cannot be used. The 'Danish' survey, in contrast, boasts high response rates and low attrition across all waves so far. The first wave was in 1996 (age 1), the second in 1999, the third in 2003 and the fourth in 2007 (when children were 11 years old). This last

²Low-income families with a working adult may be eligible for a child care subsidy, although it is estimated that such funds reach fewer than 1/5 of eligible families. In addition, there are some subsidy and tax credit policies that help with child care costs for middle-income families, but the portion of costs covered remains very small.

wave included both a cognitive test (CHIPS) and a reading ability test which will be used in this study.³

In 1996, 2003 and 2007 the survey administered a questionnaire to both mothers and fathers and, in 2007, additionally to the child. In the analyses to follow we use exclusively the mother questionnaire data. On almost all counts one can consider the DALSC to be very high quality data: not only are overall response rates high, but the incidence of missing information for individual variables is low. A major reason is that the interviews were carried out in the home of the mother and the questionnaire was filled out by the interviewer. Another reason is that information on a number of 'problem' variables (such as family income) is derived not from the interview, but from public registries. DALSC's one weakness lies in the exclusion of immigrant families (the percentage of all children in Denmark who are of immigrant origin is approximately 8-10%).

To gauge the effects of child care we use the reading test administered in the 2007 wave. This test consists of 34 individual items related to the child's capacity to understand the meaning of words and phrases. The reading variable is derived from summing up the 34 test scores (each one of which is a 0 for fail or 1 for pass) so that it ranges from 0-34. We standardize the scores (to have mean 0, and standard deviation 1) so that our estimates are readily interpretable as effect sizes. Our key independent variable is type of child care measured at age 3. As already described this consists of three dummy variables: cared for in the parental home; in low quality external care; and in high quality external care.

To ensure that the U.S.-Denmark analyses are as comparable as possible, we code all key covariates similarly. Based on the ISCED code, we distinguish between low, medium, and high educated mothers, and use medium education in all analyses as the reference category. Family income (adjusted for family size, using the square root of family size) is categorized in quintiles, and we create a dummy for the bottom quintile to denote poverty. Thus, our definition of poverty is a relative one, representing the poorest 20% of families. Additionally, we include a dummy variable for low birth weight (measured identically to the U.S., as a birthweight less than 2500 grams), a dummy for whether the parents read daily to (or with) the child, a dummy for whether the parents were divorced or separated at any time between birth and age 10, sibling size, whether mother was employed (at age 11), and child's gender. (Descriptive statistics for all variables included in the analyses are shown in endix Table 1).

As mentioned, in Denmark the lottery-type assignment of children to child care should ensure that participation in either the high or low quality regime should not be driven by underlying selection, either on observables (such as parental income), or unobservables (such as parental motivation). Selection may, however, obtain at the neighborhood level due to substantial lingering differences in municipalities' implementation of child care policies (for a detailed discussion, see Datta Gupta and Simonsen, 2010a, 2010b). The strength of the public care guarantee differed across municipalities as did the share of high-quality center based care.⁴

Moreover as already noted, the decision *not* to send one's child to external care is undoubtedly influenced by selection mechanisms. We would, for example, expect that children are more likely to stay at home if the mother is on maternity leave, lives in remote rural areas, or is among the tiny minority of housewives in Denmark. Indeed, we find in our

³A fifth wave of data (for 2010) is currently in preparation. Response rates for the mother questionnaire were: 90.3% in 1996; 88.0% in 1999; 82.7% in 2003; and 80% in 2007.

⁴We could instrument for such potential selection bias using the GAPS variable developed by Datta Gupta and Simonsen, but since there is no credible instrumental variable available for the U.S. analyses, this paper will not conduct IV analyses.

data that care within the family home is correlated with rural residence (as expected) and also with low family income (but only if it falls in the bottom quintile, i.e. poverty). But overall the effects of these factors is modest. Children from top- income households, and children of highly educated mothers are more likely to attend high quality care and children from poor and lower educated families are more likely to be in low quality care. To address such selection, all our models control for the key selection sources.

The U.S. Data

The data for the United States come from the Early Childhood Longitudinal Study-Kindergarten (ECLS-K) cohort study, which follows a large and nationally representative sample of children who were enrolled in kindergarten (the first year of school) in the fall of 1998 (when they were on average age 5). The children were assessed in reading and math in the fall of that year and again at periodic intervals thereafter.

To maximize comparability with the Danish data, we analyze children's reading and math outcomes in spring of fifth grade, when they are on average age 11. However, we also take advantage of the more extensive U.S. data to also analyze children's performance in those same domains at school entry. These analyses of fall kindergarten scores will help to ensure that if there is a short-term effect of child care and early education on academic achievement, we are able to capture it.

The reading and math tests in the ECLS-K were especially developed by the National Center for Education Statistics. They are scored using item response theory (IRT) to take into account the difficulty of items that individual children received. To ease interpretation of the results, we standardized scores (with mean 0, standard deviation 1).⁵

Our key independent variable is the type of child care or early education in which the child was enrolled prior to kindergarten entry, as reported by the parent in the fall kindergarten interview. As already described, we categorize this using four dummy variables: parental care only (the reference group); informal relative or non-relative care; school or center based care; or Head Start. We use school or center-based care as our indicator for high quality care, but it is important to note that the quality within this category is likely to be highly variable and is also likely to be at least somewhat correlated with family income, such that lower- and middle-income children on average attend lower-quality care than their higher-income peers.

As mentioned, we code all key covariates as similarly as possible across the two countries, while also respecting key country differences. We control for level of the mother's education at the time of the child assessment, using four categories: less than high school (the reference category); high school (including GED); some college; or a college degree or higher. To identify families in poverty, we take advantage of a variable provided in the dataset which flags families with incomes below the official poverty line for families of their size and type in the fall of kindergarten. This variable identifies roughly one-fifth (18%) of families as poor, so as in Denmark, this category represents the poorest fifth of families in the country.⁶ Additionally, we include: a dummy variable for low birth weight (defined identically in the two countries); a dummy for whether the parents read daily to (or with) the child; dummy variables for family structure at the time of the assessment -- biological two parent family (the reference category), blended family, single parent, or adopted/other;

⁵We note that by standardizing scores, we obscure the fact that the dispersion of underlying scores is likely wider in the US and therefore a standard deviation difference in the US may be more meaningful than a standard deviation difference in Denmark.

⁶We also tried an alternative method, dividing families into quintiles based on measured family income, but this approach did less well at identifying poor families.

sibling size; child's gender; child's age (in months) at the time of the assessment; child's race/ethnicity -- white (reference category), black, Hispanic, Asian, or other; mother's employment status at the time of assessment -- not working (reference category), full-time, or part-time; whether mom primarily speaks a language other than English in the home at fall kindergarten; whether a parent is an immigrant; the region of the country where the family lives at the time of the assessment -- south (reference category), northeast, midwest, or west; and whether the child attends private school at the time of the assessment. Descriptive statistics for all variables used in the analyses are shown in Appendix 2.

Although the ECLS-K began as a nationally representative study, it does suffer from attrition over time. Some of this is planned attrition, as not all children who move schools are followed, but other attrition is unplanned, due to selective non-response. To ensure that we are not analyzing a select sample, we use multiple imputation to fill in missing values. However, we do not use imputed values for outcome variables. After multiple imputation, our analysis sample size is 15,587.

Results for Denmark

We begin with the general model, focusing on the overall effect of high quality care at age 3 on reading abilities assessed at age 11. Recall that we standardize the scores with mean 0, and standard deviation 1, so the coefficients from our models can be interpreted as effect sizes (indicating the magnitude of the effect relative to the standard deviation of the outcome variable). The high quality care variable is a dummy variable set to 1 for high quality care, and 0 for low quality care or care by parents only.

Results for the full sample (column 1 in Table 1) suggest that, for the Danish child population at large, high quality care does have a significant positive effect on reading, although the effect is small (little more than a tenth of a standard deviation). As expected boys perform much worse than girls -- as also Bauchmuller et.al., (2010) find --, poverty has adverse effects, while having highly educated mothers yields a substantial gain in test scores (the latter is by far the strongest variable).

But this general model, of course, does not address directly our key question which is whether the effect of quality care is larger for less privileged children. Our chief concern, in other words, is with differential effects of high quality care across socio-economic gradients.

Estimating Differential Effects for Poor and Non-Poor Children in Denmark

We propose two different approaches to identify differential effects. The first is to re-estimate the general OLS model for distinct sub-groups. Specifically we estimate the model separately for children from poor and non-poor households.

We see in columns 2 and 3 in Table 1 that the regression coefficient for high-quality care for poor children is .17 compared to .11 for the non-poor. So far we have learned that high quality care does make a difference. In terms of differential effects this would suggest that poor children obtain an extra bonus (although the difference of coefficients in these models are not statistically significant ($p = .387$)).

We propose an alternative methodology to identify differential effects, namely by comparing the effect of high quality care across the distribution of children by reading scores. To this end we adopt a quantile regression approach. Figure 1 depicts a very clear logic as to the effects of high quality care: essentially, the positive effect is very large for the bottom fifth and, in particular, for the bottom 10th of the reading distribution. Hereafter it flattens at very low effect sizes. To illustrate, the effect of high quality care is .30-.40 of a

standard deviation for children at the bottom of the reading distribution and only between 0 and .10 for the remainder.

Results for the U.S.

We begin with models estimating the effects of preschool care attended prior to school entry on reading and math assessed at school entry (fall of kindergarten, when children are about age 5) and spring of fifth grade (about age 11). We control for three different types of child care: informal relative or non-relative care; Head Start; and school or center-based care (so exclusive parental care is the reference category). Based on prior research, we expect school or center-based care to have the largest positive effect on reading and math, although we must bear in mind that quality of care within this category will be highly variable. We also include some supplemental analyses where we separate prekindergarten programs from other school- or center-based care programs. To the extent that prekindergarten programs are of higher and more uniform quality, we would expect them to have larger effects on child cognitive outcomes, and particularly so for disadvantaged children.

In all our models, we standardize the scores to have mean 0 and standard deviation 1. This means that coefficients in the models can be interpreted as effect sizes.

Results shown in Table 2a suggest that school or center-based care does have a significant positive effect on children's reading scores at school entry. In the first model (controlling only for child care type and poverty), children who attended school or center-based care prior to school entry have much higher reading scores at school entry (effect size .42). Results in the second model, after adding covariates, show that much of this difference was due to selection of more advantaged children into this type of care; after the addition of the controls, the effect of school or center based care falls to an effect size of .24. As expected, children from poor families have significantly lower reading scores in both models. Complete results (in Appendix 3a) show that the covariates generally have the expected effects; similarly to Denmark, having a highly educated mother yields a substantial gain in test scores.

Results for reading scores at fifth grade, however, suggest that very little of the benefit of school- or center-based care is maintained. In the controlled model, the effect size associated with school- or center-based care is .08, statistically significant but very small in substantive terms.

Results for math, shown in Table 2b, are broadly similar. In the controlled model, attending school- or center-based care at preschool is associated with a .23 standard deviation gain in math scores at school entry, but only a .11 standard deviation gain by spring of fifth grade. (Complete results for math are in Appendix 3b).

This general model does not address directly our key question which is whether the effect of higher-quality care is larger for less privileged children. Accordingly, we next estimate models for poor vs. non-poor children.

Estimating Differential Effects for Poor and Non-Poor Children in the U.S.

As in the Danish analyses, we adopt two different approaches to identify differential effects. The first is to re-estimate the general OLS model separately for children from poor and non-poor households.

The results of these sub-group models in Tables 2a (reading) and 2b (math) do not suggest that children from poor families obtain greater gains from school- or center-based preschool than do non-poor children. If we look at reading at school entry, the effect size for poor

children is .20, while for the non-poor it is .23. For math at school entry, the effect size (.22) is the same for both sub-groups. Given that we would expect high-quality care to have larger benefits for poor children, these results may suggest that what we are measuring with school- or center-based care may not represent high-quality care. It is also likely that poor children attend on average poorer quality school- or center-based care than their more affluent peers, which would also help explain the absence of larger benefits for them.

By spring of fifth grade, no significant effects for poor children remain, while significant effects are seen for non-poor children (although smaller in magnitude than at school entry). These results suggest that the gains that accrue to poor children do not persist, perhaps because they subsequently attend poorer-quality schools; alternatively, the gains to non-poor children may be confounded with other resources that they receive between school entry and fifth grade (for example, enrolment in high-quality after-school programs or tutoring).

To summarize, in the U.S. there are fairly sizable benefits to school- or center-based care at school entry for children overall, but these benefits are no larger for poor children than for non-poor children, nor are the benefits for poor children maintained over time.

As a parallel to the Danish analyses, we also estimate effects with a quantile regression approach. It is important to note that in doing so, we are asking a slightly different question – whether the effects of school- or center-based care are larger for children with lower reading or math scores, rather than whether they are larger for children from the lowest-income families. To the extent that low scores are not perfectly correlated with low income, results from the quantile regressions therefore might differ from those we have obtained thus far.

For reading, the quantile regression results shown in Figures 2 and 3 show substantial variation in the effects of school- or center-based care on reading both at school entry and spring of fifth grade; effects are not systematically larger at the top or bottom of the distribution although there appear to be smaller effects at the bottom of the distribution at school entry but then larger effects at the bottom in spring of fifth grade. For math, the results shown in Figure 4 and 5 are suggestive of larger positive effects at the bottom of the distribution at school entry, but shifting to a less clear pattern by spring of fifth grade.

Separating Pre-Kindergarten from Other Forms of School- or Center-Based Care

As discussed, our measure of school- or center-based care includes a very diverse set of arrangements, which may vary in quality. In particular, we would expect pre-kindergarten programs, which are operated under standards set by the education system, to be of generally higher quality than the other types of school- or center-based programs (nursery schools, day care centers, and so on). We therefore re-estimated our models separating pre-kindergarten from other types of school- or center-based care. The results conformed to our expectation: pre-kindergarten programs generally do have larger effects on reading and math at school entry than do other types of school- or center-based programs (see Appendix Tables 4a and 4b). However, we do not find that pre-kindergarten programs have larger effects for poor children than for non-poor children. This latter result may indicate that such programs benefit both groups equally, or may reflect the fact that poor children attend generally poorer-quality programs that produce smaller gains. Lacking data on program quality, we can not test this in our data.

Conclusion

Our expectation that high quality child care would play an equalizing role was confirmed in the analyses of the Danish data. Taking advantage of the variation in Danish child care, we

found as expected that enrollment in high-quality formal care at age 3 was associated with higher cognitive scores at age 11, and with probably larger effects for the lowest-income children. Quantile regression analyses confirmed that in general having attended high-quality formal care yields the greatest gains for children at the bottom of the test score distribution. This is exactly the pattern one would hope to see if child care is to play an equalizing role.

So what should we make of the results for the United States? While it is reassuring that formal school- or center-based care is associated with higher reading and math scores at school entry, these benefits do not seem to be very lasting. In addition, and of greatest concern with regard to social mobility, the benefits do not seem to be larger for poor children than non-poor children and what benefits do exist seem to fade the most for the low-income children, exactly the opposite of what one would hope for if child care is to play an equalizing role. Although the quantile regression results for reading provide perhaps a hint that there may be more lasting gains for children with very low scores, the math results do not support such an interpretation. So on the whole, it appears that public support which increases low-income children's access to formal or center-based care is playing an equalizing role, but that there is little evidence that once children gain access to programs – at least as currently configured -- that low-income children benefit disproportionately more than their more affluent peers.

One reason for this may lie in the nature of child care as currently offered. Our measure of high-quality child care – school- or center-based care – is not necessarily high-quality. Some preschool care in the U.S. is very high-quality, but much is not. Lacking data on the quality of programs, we must rely on type and thus we are using what is at best a very noisy measure of quality care. Further confounding this is the likelihood that the quality of center care is correlated with family income, such that children from higher income families attend on average higher quality care than children from lower income families. This does not arise in the Danish case because child care is universally provided by the public sector. In the U.S. in contrast, most child care is privately funded and the quality of arrangements is likely to be highly correlated with family income and other measures of family background. If low-income children are attending systematically poorer quality care, it would not be surprising that they might reap lower long-run benefits from it.

However, there is still the puzzle of why poor children gain about as much initially as non-poor children but then see more of those gains attenuate over time. This pattern points to a second explanation, which is that low income children attend systematically poorer quality schools and/or have lower quality out-of-school learning experiences, all of which lead them to see their gains erode more over time than their more affluent peers. These results confirm that child care investments cannot be isolated from early elementary education experiences, and that, as groups such as the Foundation for Child Development have argued, a coherent pre-K to grade 3 policy is needed to ensure that children maintain gains from preschool.

To address this puzzle, one strategy would be to extend the Danish analyses – which now stop at age 11. If our hypothesis is correct, namely that the erosion effect observed for the U.S. has to do with child selection into unequal quality schools, we should not find such an effect for Denmark where, very similar to the pre-school system, the school regime boasts a very high degree of homogeneity in terms of quality standards. The OECD's PISA studies confirm this view, finding that differences across schools play essentially no role in explaining variations in children's test scores (OECD, 2006b). One way to assess this is to re-estimate our Danish models for a sub-sample of children living in rural areas and small towns.⁷ The logic here is that parents in these areas will basically have no school choice – whereas this is possible in large cities. So if the results we found for the entire sample are

similar to those we find for the rural-small town population, we can assume that our conclusions for Denmark remain valid. Indeed, this is precisely what we find: the coefficients we obtain (results not shown but available on request) are almost identical in both the OLS and the quantile regression models.

In either case, taken together, our findings provide reason for hope but also cause for concern. The Danish results show that when high-quality universal child care is offered by the public sector, it can succeed in playing an equalizing role. The U.S. results suggest how far we are in the U.S. from achieving that success.

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Appendix

Appendix Table 1

Descriptive Statistics for Denmark

Variables	Full Sample		Poverty Sample		Non-Poverty Sample	
	Mean	SD	Mean	SD	Mean	SD
Achievement						
Reading (T-score), SPROEG	0.00	1.00	-0.23	1.10	0.09	0.94
Child Care						
High Quality	0.74	0.44	0.60	0.49	.76	0.43
Poverty, KF	0.20	0.40	1.00	0.00	0.00	0.00
Girl	0.47	0.50	0.50	0.50	0.47	0.50
Low birth weight (< 5.5pounds), KF	0.05	0.22	0.05	0.22	0.04	0.20
Number of Children	2.25	0.86	2.57	0.99	2.20	0.75
Reading Dummy	0.21	0.41	0.27	0.44	0.19	0.39
Low Educated Mother	0.23	0.42	0.37	0.48	0.16	0.36
High Educated Mother	0.36	0.48	0.20	0.40	0.43	0.50
Mother Employed	0.87	0.33	0.79	0.40	0.92	0.27

Appendix

Appendix 2

Descriptive Statistics for U.S. Sample

Variables	Full Sample		Poverty Sample		Non-Poverty Sample	
	Mean	SD	Mean	SD	Mean	SD
Achievement						

⁷We thank Anders Holm for suggesting this approach.

Variables	Full Sample		Poverty Sample		Non-Poverty Sample	
	Mean	SD	Mean	SD	Mean	SD
Reading (T-score), KF	0.09	0.99	-0.46	0.85	0.21	0.97
Reading (T-score), 5S	0.06	1.00	-0.40	1.03	0.16	0.97
Math(T-score), KF	0.10	0.97	-0.47	0.91	0.23	0.94
Math(T-score), 5S	0.04	1.01	-0.40	1.05	0.14	0.98
Child Care						
Relative/ non-relative care	0.25	0.43	0.22	0.41	0.26	0.44
Head Start	0.10	0.30	0.27	0.45	0.07	0.25
Center-based	0.47	0.50	0.23	0.42	0.52	0.50
Parental care	0.18	0.38	0.28	0.45	0.16	0.36
Poverty, KF	0.18	0.38	1.00	0.00	0.00	0.00
Girl	0.49	0.50	0.49	0.50	0.49	0.50
Race						
White	0.62	0.49	0.32	0.47	0.68	0.47
Black	0.15	0.36	0.37	0.48	0.11	0.31
Hispanic	0.12	0.33	0.17	0.38	0.12	0.32
Asian	0.05	0.21	0.04	0.20	0.05	0.21
Others	0.06	0.23	0.10	0.30	0.05	0.22
Age (month), KF	68.62	4.33	68.80	4.45	68.58	4.30
Age (month), 5S	134.94	5.90	135.30	6.34	134.87	5.80
Low birth weight (< 5.5pounds), KF	0.08	0.27	0.12	0.32	0.07	0.26
Siblings, KF	1.44	1.14	1.92	1.46	1.34	1.03
Siblings, 5S	1.54	1.13	2.00	1.38	1.44	1.04
Family Structure, KF						
Bio-two parents	0.67	0.47	0.33	0.47	0.74	0.44
Blend families-step parents	0.08	0.27	0.09	0.28	0.08	0.26
Single parent	0.22	0.41	0.51	0.50	0.15	0.36
Any adopted or others	0.04	0.20	0.07	0.26	0.03	0.18
Family Structure, 5S						
Bio-two parents	0.60	0.49	0.31	0.46	0.67	0.47
Blend families-step parents	0.12	0.32	0.15	0.36	0.11	0.31
Single parent	0.23	0.42	0.44	0.50	0.18	0.39
Any adopted or others	0.05	0.22	0.09	0.29	0.04	0.19
Mother's Education, KF						
Less than High School	0.11	0.31	0.31	0.46	0.06	0.24
HS or GED	0.31	0.46	0.42	0.49	0.28	0.45
Some college or voc	0.34	0.47	0.24	0.43	0.36	0.48
College degree or higher	0.25	0.43	0.04	0.19	0.29	0.45
Mother's Education, 5S						
Less than High School	0.11	0.31	0.31	0.46	0.06	0.24
HS or GED	0.27	0.44	0.40	0.49	0.24	0.43
Some college or voc	0.37	0.48	0.30	0.46	0.38	0.49

Variables	Full Sample		Poverty Sample		Non-Poverty Sample	
	Mean	SD	Mean	SD	Mean	SD
College degree or higher	0.28	0.45	0.07	0.25	0.33	0.47
Mother;s Employment, KF						
Full time (> 35hrs per week)	0.47	0.50	0.36	0.48	0.49	0.50
Part time (<35hrs per week)	0.22	0.42	0.18	0.38	0.23	0.42
Not working now	0.31	0.46	0.46	0.50	0.27	0.45
Mother;s Employment, 5S						
Full time (> 35hrs per week)	0.53	0.50	0.47	0.50	0.54	0.50
Part time (<35hrs per week)	0.23	0.42	0.16	0.37	0.24	0.43
Not working now	0.24	0.43	0.36	0.48	0.22	0.41
Mom language, KF	0.16	0.37	0.22	0.41	0.15	0.36
Parents immigration	0.17	0.37	0.19	0.39	0.16	0.37
Read to child, KF	3.26	0.77	3.02	0.86	3.32	0.73
Region, KF						
Northeast	0.19	0.39	0.16	0.36	0.20	0.40
Midwest	0.27	0.44	0.22	0.42	0.28	0.45
South	0.35	0.48	0.44	0.50	0.33	0.47
West	0.20	0.40	0.18	0.38	0.20	0.40
Region, 5S						
Northeast	0.19	0.39	0.15	0.36	0.20	0.40
Midwest	0.27	0.44	0.23	0.42	0.28	0.45
South	0.35	0.48	0.44	0.50	0.33	0.47
West	0.20	0.40	0.18	0.39	0.20	0.40
Private, KF	0.23	0.42	0.05	0.23	0.26	0.44
Private, 5S	0.20	0.40	0.04	0.21	0.23	0.42
Sample Size	15857		2817		13040	

Appendix

Appendix 3a

Complete OLS Regression Results for Reading in the U.S.

COEFFICIENT	Reading, KF				Reading, 5S			
	Full Sample1	Full Sample2	Poverty	Non-Poverty	Full Sample1	Full Sample2	Poverty	Non-Poverty
Child Care (ref: parental care)								
Relative/non-relative care	0.09*** (0.02)	0.05* (0.02)	0.02 (0.05)	0.06* (0.03)	0.07*** (0.03)	0.03 (0.03)	-0.00 (0.07)	0.04 (0.03)
Head start	-0.18*** (0.03)	-0.07* (0.03)	-0.03 (0.04)	-0.11*** (0.04)	-0.24*** (0.04)	-0.11*** (0.04)	-0.11 [†] (0.06)	-0.11* (0.05)
Center-based	0.42*** (0.02)	0.24*** (0.02)	0.20*** (0.05)	0.23*** (0.02)	0.22*** (0.02)	0.08*** (0.02)	0.02 (0.06)	0.10*** (0.03)
Poverty, KF	-0.50*** (0.02)	-0.16*** (0.02)			-0.44*** (0.03)	-0.15*** (0.03)		
Covariates								
Girl	0.19*** (0.01)	0.11*** (0.03)		0.21*** (0.02)	0.11*** (0.02)		0.09* (0.04)	0.12*** (0.02)
Race (ref: White)								
Black	-0.01 (0.02)	-0.06 (0.04)		0.00 (0.03)	-0.28*** (0.04)		-0.24** (0.08)	-0.29*** (0.03)
Hispanic	-0.14*** (0.03)	-0.12* (0.06)		-0.15*** (0.03)	-0.13*** (0.04)		-0.08 (0.08)	-0.14*** (0.04)
Asian	0.28*** (0.04)	0.14 (0.09)		0.31*** (0.04)	0.04 (0.05)		0.20 (0.14)	0.02 (0.06)
Others	-0.13*** (0.03)	-0.26*** (0.06)		-0.08 (0.04)	-0.22*** (0.04)		-0.28** (0.09)	-0.18*** (0.04)
Age, KF/5S	0.05*** (0.00)	0.04*** (0.00)		0.05*** (0.00)	0.00 (0.00)		0.00 (0.00)	0.00** (0.00)
Low birth weight (< 5.5pounds), KF	-0.13*** (0.03)	-0.14** (0.05)		-0.12*** (0.03)	-0.05 (0.03)		-0.01 (0.07)	-0.05 (0.03)
Sibling, KF/5S	-0.09*** (0.01)	-0.07*** (0.01)		-0.10*** (0.01)	-0.05*** (0.01)		-0.06*** (0.02)	-0.05*** (0.01)
Family Structure (ref: Bio-two parents), KF/5S								
Blend families-step parents	-0.16*** (0.03)	-0.12 [†] (0.06)		-0.16*** (0.03)	-0.12*** (0.03)		-0.01 (0.07)	-0.14*** (0.03)
Single parent	-0.17*** (0.02)	-0.09 (0.04)		-0.19*** (0.02)	-0.10 (0.03)		-0.06 (0.07)	-0.09* (0.03)
Any adopted or others	-0.20*** (0.04)	-0.08 (0.07)		-0.21*** (0.05)	-0.19*** (0.05)		-0.05 (0.09)	-0.24*** (0.06)
Mother's Education (ref: Less than HS), KF/5S								
HS or GED	0.21*** (0.03)	0.14*** (0.04)		0.26*** (0.04)	0.22*** (0.04)		0.21** (0.06)	0.23*** (0.05)
Some college or voc	0.39*** (0.03)	0.35*** (0.05)		0.44*** (0.04)	0.34*** (0.04)		0.36*** (0.06)	0.34*** (0.05)
College degree or higher	0.72*** (0.03)	0.71*** (0.10)		0.76*** (0.04)	0.63*** (0.04)		0.65*** (0.12)	0.63*** (0.05)
Mother's Employment(ref: Not working now), KF/5S								
Full time (> 35hrs per week)	-0.10*** (0.02)	0.00 (0.04)		-0.13*** (0.02)	-0.05 [†] (0.03)		0.04 (0.06)	-0.07** (0.03)
Part time (<35hrs per week)	-0.03 (0.02)	0.08 (0.05)		-0.06 (0.02)	0.03 (0.03)		0.16* (0.07)	-0.01 (0.03)
Mom language, KF	-0.09** (0.03)	-0.15* (0.06)		-0.07 (0.03)	-0.05 (0.03)		-0.14 (0.09)	-0.02 (0.04)

COEFFICIENT	Reading, KF			Reading, 5S		
	Full Sample1	Full Sample2	Poverty	Full Sample1	Full Sample2	Poverty
Parents immigration		0.03 (0.03)	0.14* (0.06)		0.06 ⁺ (0.03)	0.11 (0.07)
Read to child, KF		0.13*** (0.01)	0.09*** (0.02)		0.06*** (0.01)	0.01 (0.03)
Region(ref: South), KF/5S						
Northeast		-0.02 (0.02)	-0.06 (0.05)		-0.01 (0.03)	0.01 (0.06)
Midwest		-0.09*** (0.02)	-0.09* (0.04)		-0.00 (0.02)	0.00 (0.06)
West		0.01 (0.02)	0.02 (0.05)		0.02 (0.03)	0.13 ⁺ (0.08)
Private, KF/5S		0.22*** (0.02)	0.22** (0.07)		0.14*** (0.03)	0.19 ⁺ (0.11)
Constant	-0.03 (0.02)	-3.81*** (0.12)	-3.20*** (0.26)	0.04* (0.02)	-0.91*** (0.23)	-0.61 (0.52)
Observations	15857	15857	2814	15857	15857	2814
R-squared	0.11	0.27	0.16	0.07	0.14	0.09

Standard errors in parentheses

*** p<0.01

* p<0.05

⁺ p<0.1

Appendix 3b

Complete OLS Regression Results for Math in the U.S.

COEFFICIENT	Math, KF			Math, 5S				
	Full Sample1	Full Sample2	Poverty	Non-Poverty	Full Sample1	Full Sample2	Poverty	Non-Poverty
Child Care (ref: parental care)								
Relative/non-relative care	0.10*** (0.03)	0.08** (0.02)	0.05 (0.05)	0.07** (0.03)	0.03 (0.03)	0.02 (0.03)	0.01 (0.06)	0.03 (0.03)
Head start	-0.23*** (0.03)	-0.07* (0.03)	0.01 (0.04)	-0.11** (0.04)	-0.29*** (0.04)	-0.13** (0.04)	-0.10 (0.06)	-0.14** (0.05)
Center-based	0.39*** (0.02)	0.23*** (0.02)	0.22*** (0.05)	0.22*** (0.02)	0.20*** (0.03)	0.11*** (0.02)	0.04 (0.06)	0.12*** (0.03)
Poverty, KF	-0.53*** (0.02)	-0.18*** (0.02)			-0.42*** (0.03)	-0.14*** (0.03)		
Covariates								
Girl	0.04** (0.01)		0.02 (0.03)	0.05** (0.01)		-0.17*** (0.02)	-0.16*** (0.05)	-0.17*** (0.02)
Race (ref: White)								
Black	-0.19*** (0.02)		-0.19*** (0.04)	-0.19*** (0.03)		-0.36*** (0.03)	-0.30*** (0.05)	-0.38*** (0.03)
Hispanic	-0.19*** (0.03)		-0.20** (0.06)	-0.19*** (0.03)		-0.13*** (0.03)	-0.06 (0.08)	-0.14*** (0.03)
Asian	0.22*** (0.04)		0.14 (0.10)	0.25*** (0.04)		0.22*** (0.05)	0.38* (0.14)	0.20*** (0.05)
Others	-0.21*** (0.03)		-0.38*** (0.06)	-0.13*** (0.04)		-0.21*** (0.04)	-0.27** (0.10)	-0.17*** (0.04)
Age, KF/5S	0.06*** (0.00)		0.05*** (0.00)	0.06*** (0.00)		0.00 (0.00)	-0.00 (0.00)	0.01*** (0.00)
Low birth weight (< 5.5pounds), KF	-0.19*** (0.03)		-0.17** (0.05)	-0.19*** (0.03)		-0.12*** (0.03)	-0.06 (0.08)	-0.14*** (0.04)
Sibling, KF/5S	-0.05*** (0.01)		-0.05*** (0.01)	-0.05*** (0.01)		-0.01 (0.01)	-0.02 (0.02)	-0.01 (0.01)
Family Structure (ref: Bio-two parents), KF/5S								
Blend families-step parents	-0.16*** (0.03)		-0.11 (0.07)	-0.15*** (0.03)		-0.13*** (0.03)	-0.03 (0.07)	-0.14*** (0.04)
Single parent	-0.16*** (0.02)		-0.08 [†] (0.04)	-0.18*** (0.02)		-0.12*** (0.03)	-0.05 (0.05)	-0.13*** (0.03)
Any adopted or others	-0.24*** (0.04)		-0.08 (0.08)	-0.28*** (0.05)		-0.18*** (0.05)	0.02 (0.09)	-0.24*** (0.06)
Mother's Education (ref: Less than HS), KF/5S								
HS or GED	0.21*** (0.03)		0.13** (0.04)	0.27*** (0.03)		0.24*** (0.04)	0.21*** (0.06)	0.25*** (0.05)
Some college or voc	0.39*** (0.03)		0.36*** (0.05)	0.43*** (0.03)		0.36*** (0.04)	0.36*** (0.07)	0.36*** (0.05)
College degree or higher	0.69*** (0.03)		0.68*** (0.10)	0.73*** (0.03)		0.66*** (0.04)	0.70*** (0.11)	0.66*** (0.05)
Mother's Employment(ref: Not working now), KF/5S								
Full time (> 35hrs per week)	0.07*** (0.02)		0.05 (0.04)	-0.10*** (0.02)		-0.03 (0.03)	0.04 (0.06)	-0.05 (0.03)
Part time (<35hrs per week)	0.01 (0.02)		0.06 (0.05)	-0.01 (0.02)		0.04 (0.03)	0.16*	0.01 (0.03)
Mom language, KF	-0.11*** (0.03)		-0.12* (0.06)	-0.10*** (0.03)		-0.05 [†] (0.03)	-0.12 (0.08)	-0.04 (0.04)

COEFFICIENT	Math, KF				Math, 5S			
	Full Sample1	Full Sample2	Poverty	Non-Poverty	Full Sample1	Full Sample2	Poverty	Non-Poverty
Parents immigration		0.03 (0.03)	0.13* (0.06)	-0.00 (0.03)	0.11*** (0.03)	0.18* (0.09)	0.10** (0.03)	
Read to child, KF		0.09*** (0.01)	0.07*** (0.02)	0.09*** (0.01)	0.05*** (0.01)	0.02 (0.03)	0.06*** (0.01)	
Region(ref: South), KF/5S								
Northeast		0.02 (0.02)	-0.01 (0.05)	0.02 (0.02)	0.00 (0.02)	0.05 (0.06)	-0.01 (0.03)	
Midwest		0.01 (0.02)	-0.01 (0.04)	0.01 (0.02)	0.01 (0.02)	0.02 (0.06)	0.01 (0.02)	
West		0.08*** (0.02)	0.11** (0.05)	0.07** (0.02)	0.05+ (0.03)	0.13** (0.07)	0.03 (0.03)	
Private, KF/5S		0.20*** (0.02)	0.31*** (0.07)	0.19*** (0.02)	-0.04+ (0.02)	0.07 (0.11)	-0.05** (0.02)	
Constant	0.01 (0.02)	-4.41*** (0.12)	-4.16*** (0.28)	-4.53*** (0.13)	0.05** (0.02)	-0.49 (0.54)	-1.07*** (0.24)	
Observations	15857	15857	2814	13043	15857	2814	13043	
R-squared	0.12	0.29	0.19	0.25	0.15	0.10	0.12	

Standard errors in parentheses

*** p<0.01

* p<0.05

+ p<0.1

Appendix

Appendix 4a

Summary of OLS Regressions of Children's Reading Achievement(T-Score) on Pre-Kindergarten and Other Types of Child Care, Poverty, and Covariates, Kindergarten, Fall

COEFFICIENT	Full Sample	Poverty	Non-Poverty
Child Care (ref: Parental Care)			
Pre-Kindergarten	0.28 ^{***} (0.03)	0.26 ^{***} (0.06)	0.27 ^{***} (0.03)
Other center-based care	0.21 ^{***} (0.02)	0.18 ^{***} (0.05)	0.20 ^{***} (0.02)
Head Start	-0.07 [*] (0.03)	-0.01 (0.04)	-0.11 ^{**} (0.04)
Others	-0.01 (0.03)	0.00 (0.05)	-0.02 (0.03)
Poverty, KF	-0.17 ^{***} (0.02)		
Observations	15857	2824	13033
R-squared	0.28	0.17	0.24

Standard errors in parentheses

+ p<0.1

p<0.001

**

p<0.01

*

p<0.05

Appendix 4b

Summary of OLS Regressions of Children's Math Achievement(T-Score) on Pre-Kindergarten and Other Types of Child Care, Poverty, and Covariates, Kindergarten Fall

COEFFICIENT	OLS	OLS	OLS
Child Care (ref: Parental Care)			
Pre-Kindergarten	0.26 ^{***} (0.03)	0.24 ^{***} (0.06)	0.25 ^{***} (0.03)
Preschool	0.21 ^{***} (0.02)	0.22 ^{***} (0.05)	0.20 ^{***} (0.02)
Head Start	-0.06 [*] (0.03)	0.02 (0.04)	-0.11 ^{**} (0.04)
Others	0.03 (0.03)	0.05 (0.06)	0.02 (0.03)
Poverty, KF	-0.19 ^{***} (0.02)		
Observations	15857	2824	13033
R-squared	0.29	0.19	0.25

Standard errors in parentheses

+ p<0.1

p<0.001

**

p<0.01

*

p<0.05

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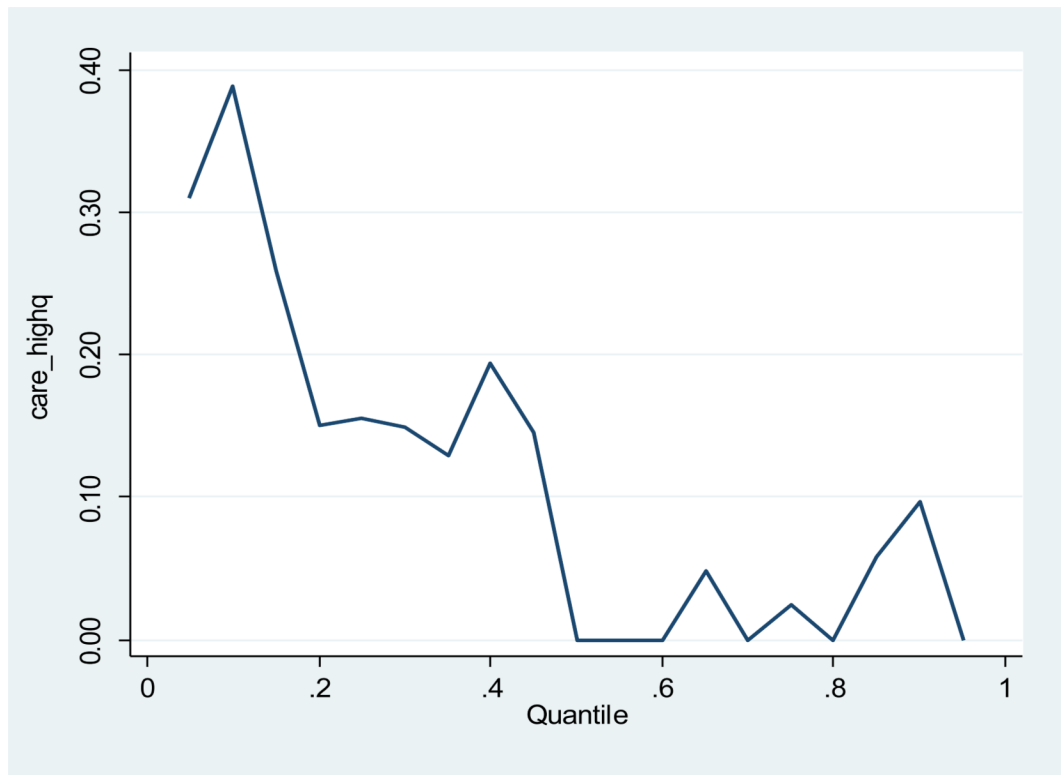


Figure 1.
Results of Quantile Regression for Effects of High-Quality Child Care on Reading in Denmark

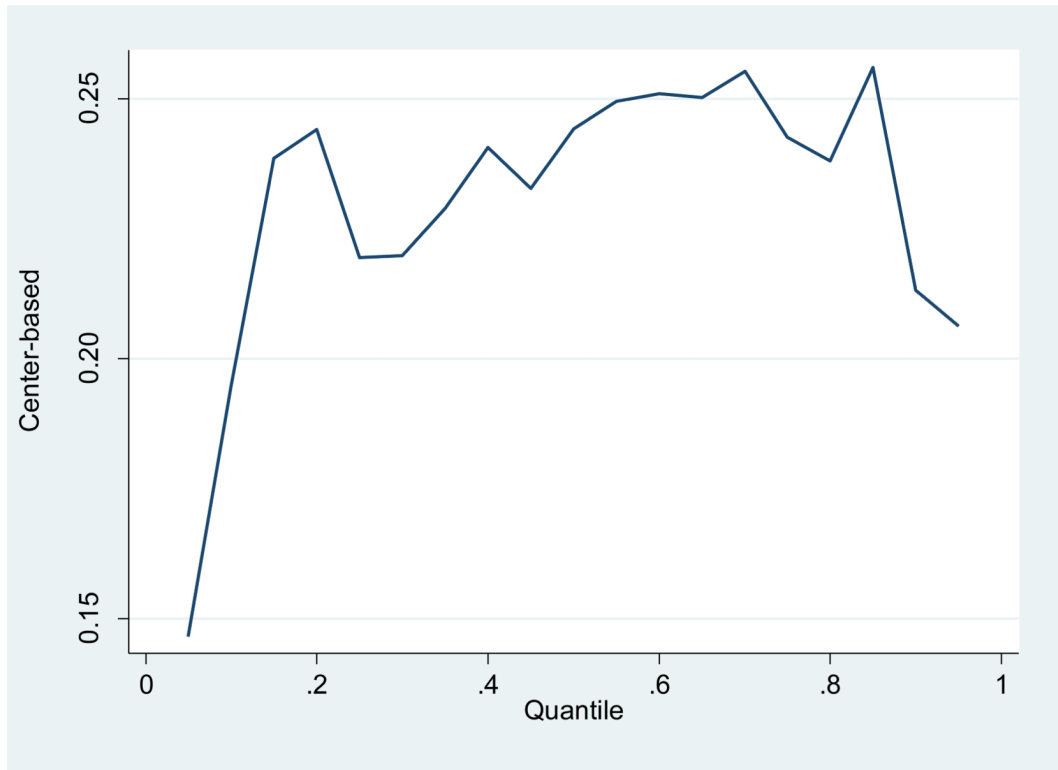


Figure 2. Results of Quantile Regressions for Effect of School- or Center-Based Care on Reading at Kindergarten in the U.S.

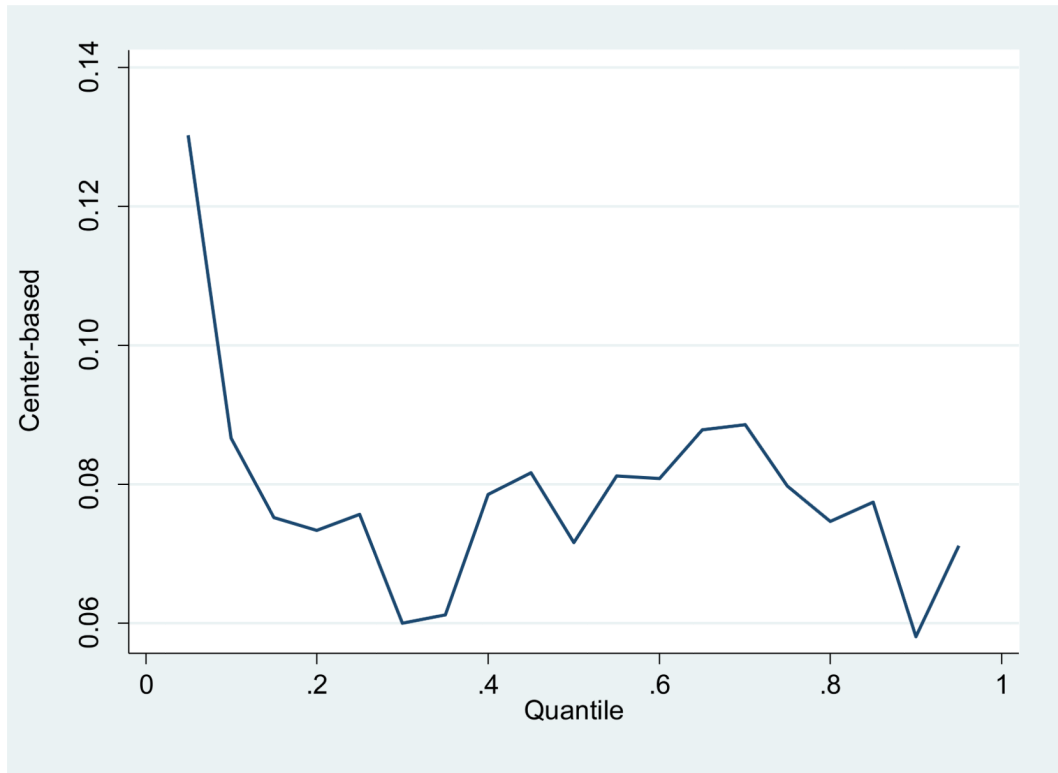


Figure 3. Results of Quantile Regression for Effect of School- or Center-Based Care on Reading at 5th Grade in the U.S.

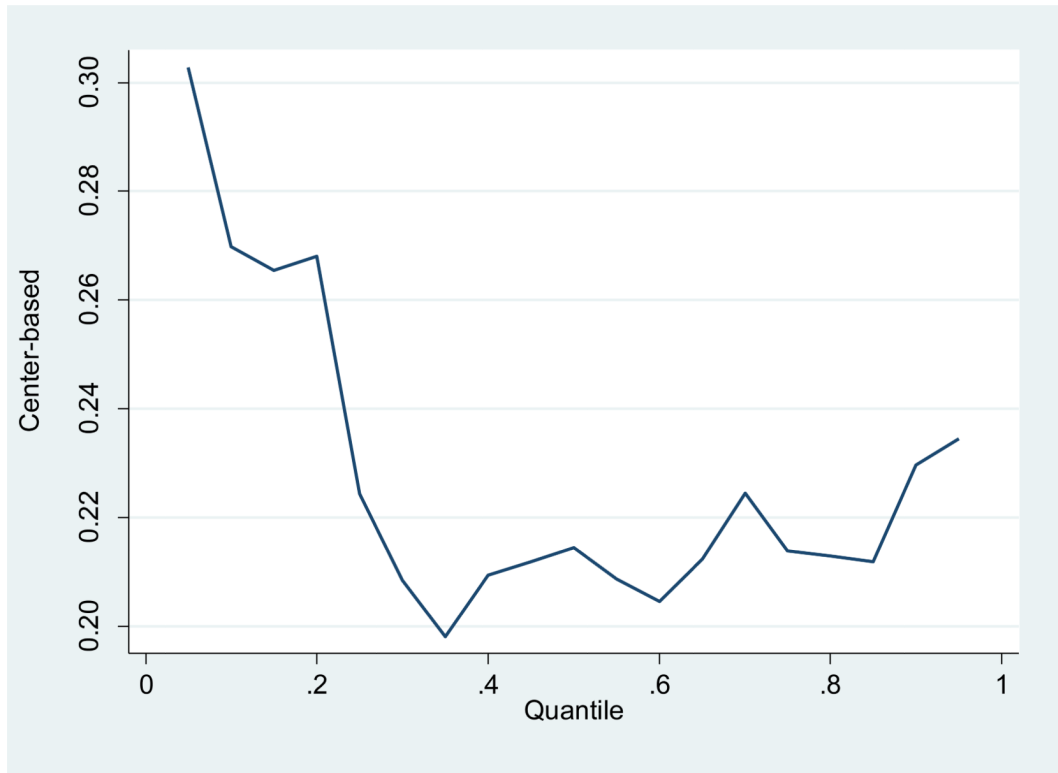


Figure 4. Results from Quantile Regression for Effects of School- or Center-Based Care on Math at Kindergarten in the U.S.

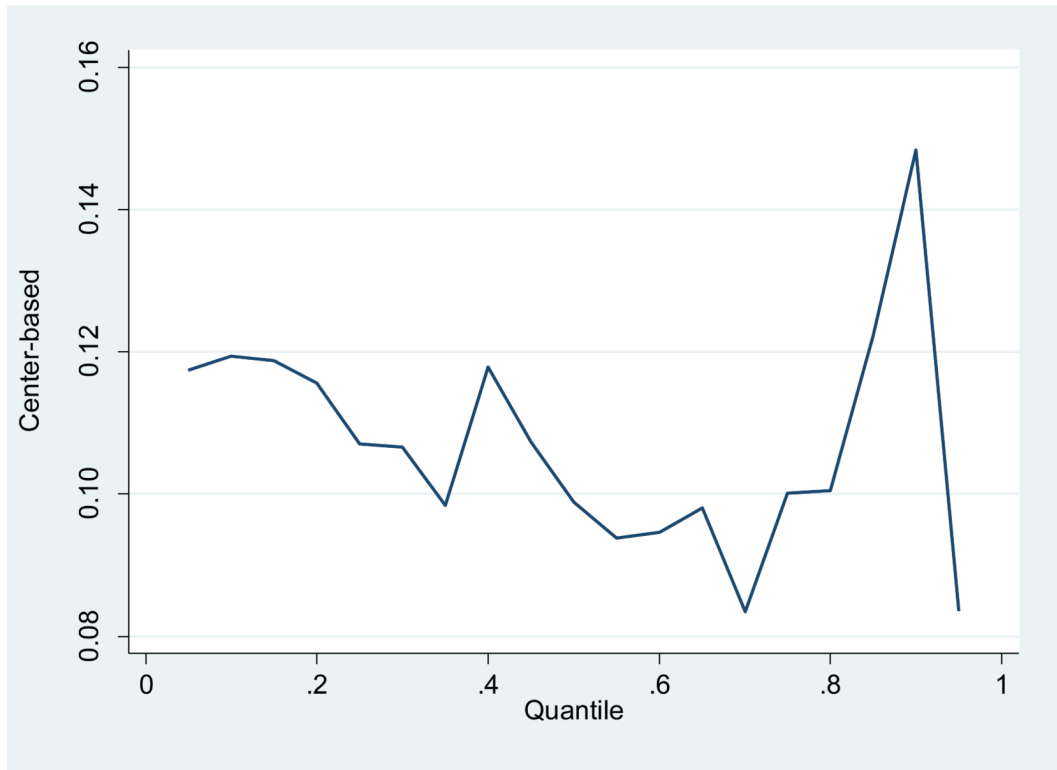


Figure 5. Results from Quantile Regression for Effect of School- or Center-Based Care on Math at 5th Grade in the U.S.

Table 1

Results from OLS Regressions of Children's Standardized Reading Test Scores at Age 11 on High-Quality Child Care, Poverty, and Covariates in Denmark

	Full Sample	Poor Children	Non-Poor Children
Quality care	.123 ^{**} (.037)	.174 [*] (.089)	.106 [*] (.041)
Poverty	-.234 ^{**} (.044)		
Siblings	.040 ⁺ (.021)	.050 (.047)	.050 (.047)
Low birthweight	-.129 (.083)	.093 (.202)	.194 [*] (.090)
Reading daily	.065 (.041)	.046 (.100)	.064 (.045)
Divorce	-.073 (.047)	-.214 (.116)	-.032 (.052)
Boy	-.210 ^{**} (.033)	-.324 ^{**} (.087)	-.182 ^{**} (.035)
Low-educated mother	.007 (.042)	-.100 (.097)	.040 (.046)
Hi-educated mother	.376 ^{**} (.041)	.569 ^{**} (.158)	.368 ^{**} (.041)
Mother employed	.104 (.056)	.051 (.113)	.120 ⁺ (.065)
Constant	-.213 (.090)	-.359 ⁺ (.201)	-.222 [*] (.101)
N	3327	621	2706

^{**} p<0.01

^{*} p<0.05

⁺ p<0.1

Table 2a

Summary of OLS Regressions of Children's Standardized Reading Achievement Scores on Child Care, Poverty, and Covariates in the U.S.

COEFFICIENT	Reading, KF			Reading, 5S				
	Full Sample	Full Sample2	Poverty	Non-Poverty	Full Sample	Full Sample2	Poverty	Non-Poverty
Child Care (ref: parental care)								
Relative/non-relative	0.09*** (0.02)	0.05* (0.02)	0.02 (0.05)	0.06* (0.03)	0.07** (0.03)	0.03 (0.03)	-0.00 (0.07)	0.04 (0.03)
Head start	-0.18*** (0.03)	-0.07* (0.03)	-0.03 (0.04)	-0.11** (0.04)	-0.24*** (0.04)	-0.11** (0.04)	-0.11 [†] (0.06)	-0.11* (0.05)
Center-based	0.42*** (0.02)	0.24*** (0.02)	0.20*** (0.05)	0.23*** (0.02)	0.22*** (0.02)	0.08*** (0.02)	0.02 (0.06)	0.10*** (0.03)
Poverty, KF	-0.50*** (0.02)	-0.16*** (0.02)			-0.44*** (0.03)	-0.15*** (0.03)		
Constant	-0.03 (0.02)	-3.81*** (0.12)	-3.20*** (0.26)	-4.03*** (0.14)	0.04 (0.02)	-0.91*** (0.23)	-0.61 (0.52)	-1.06*** (0.24)
Covariates	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Observations	15857	15857	2814	13043	15857	15857	2814	13043
R-squared	0.11	0.27	0.16	0.23	0.07	0.14	0.09	0.10

Standard errors in parentheses

*** p<0.01

* p<0.05

[†] p<0.1

Table 2b
 Summary of OLS Regressions of Children's Standardized Math Achievement Scores on Child Care, Poverty, and Covariates in the U.S.

COEFFICIENT	Math, KF				Math, 5S			
	Full Sample	Full Sample2	Poverty	Non-Poverty	Full Sample	Full Sample2	Poverty	Non-Poverty
Child Care (ref: parental care)								
Relative/non-relative	0.10*** (0.03)	0.08** (0.02)	0.05 (0.05)	0.07*** (0.03)	0.03 (0.03)	0.02 (0.03)	0.01 (0.06)	0.03 (0.03)
Head start	-0.23*** (0.03)	-0.07* (0.03)	0.01 (0.04)	-0.11** (0.04)	-0.29*** (0.04)	-0.13** (0.04)	-0.10 (0.06)	-0.14** (0.05)
Center-based	0.39*** (0.02)	0.23*** (0.02)	0.22*** (0.05)	0.22*** (0.02)	0.20*** (0.03)	0.11*** (0.02)	0.04 (0.06)	0.12*** (0.03)
Poverty, KF	-0.53*** (0.02)	-0.18*** (0.02)			-0.42*** (0.03)	-0.14*** (0.03)		
Constant	0.01 (0.02)	-4.41*** (0.12)	-4.16*** (0.28)	-4.53*** (0.13)	0.05 (0.02)	-0.90*** (0.22)	-0.49 (0.54)	-1.07*** (0.24)
Covariates	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Observations	15857	15857	2814	13043	15857	15857	2814	13043
R-squared	0.12	0.29	0.19	0.25	0.06	0.15	0.10	0.12

Standard errors in parentheses

+ p<0.1

** p<0.01

* p<0.05