Do the Perils of Universal Child Care Depend on the Child's Age?

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Abstract

The rising participation of women in paid work has not only heightened demand for universal early education and care programs but also led to increased use of child care amongst children at earlier ages. Prior research investigating Quebec's universal highly-subsidized child care documented significant declines in a variety of developmental outcomes for all children aged 0-4 years. However, past analysis has not explored whether these effects vary for children of different ages. In this paper, we demonstrate substantial heterogeneity in policy impacts by child age. Children who gain access to subsidized child care at earlier ages experience significantly larger negative impacts on developmental scores, health and behavioral outcomes. The sole exception is the negative relationship between access to subsidized child care and hyperactivity scores which steepens with child age. Our analysis additionally provides significant evidence of treatment effect heterogeneity within ages, and reveals benefits from access to universal child care on developmental scores for those that are above three years of age.

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1 Introduction

Faced with both parental demand for government assistance due to the rising costs of child care and a growing body of evidence demonstrating benefits of early education, politicians are increasingly debating whether to introduce universal programs that either subsidize or publicly provide child care. These debates are often not well informed by the small but growing academic literature on the effectiveness of these policies with regard to developmental outcomes (see Baker (2011) for the most detailed review of that literature) and face two challenges.[1] First, the distinctions between preschool, child care and early childhood education remain somewhat opaque. Second, many public programs across countries differ in terms of the age which children are eligible to attend. For example, Gernamy and Norway's universal child care programs are aimed at 3- to 6-year-olds, Quebec's subsidized child care program targets children between 0 to 4, and both Georgia's prekindergarten initiative and Oklahoma's Early Childhood Program target only children aged four. As Baker (2011) states in his survey "from a developmental perspective...the case for universal early childhood interventions does not have a strong foundation in evidence", suggesting we need to identify if there is an optimal age for children to begin attending child care programs.

This paper aims to shed light on this topic by evaluating whether the effects of the introduction of Quebec's universal subsidized child care policy on short-run developmental outcomes varied by the child age. This policy allowed all children aged 0-4 years in the province of Quebec to access provincially subsidized child care at an out of pocket cost of $7 per day. In the first formal evaluation of this policy, Baker et al. (2008) present evidence of significant negative effects on a range of non-cognitive child and family outcomes.[2] We extend that study by re-estimating the mean impacts of the policy on subsamples defined by child age and extend the work of Kottelenberg and Lehrer (2013b) by estimating age-specific

[1] For a detailed review of the broader economics literature on early education and care programs or on early childhood development respectively please see Blau and Currie (2007) or Almond and Currie (2011).

[2] The main findings of a large increase in maternal labour supply were also found in Lefebvre and Merrigan (2009) and both Haeck et al. (2012) and Kottelenberg and Lehrer (2013a) who used additional data further from the timing of the reform. Kottelenberg and Lehrer (2013b) is the sole study that estimated distributional effects of this policy.

distributional impacts of the policy on motor and social development scores. If there is a systematic pattern in the estimated policy effects by age, this research may provide some insight into the most desirable age at which the government can begin providing support to move a child into non-parental care.

The idea that early education initiatives may have differential effects based on child age and the duration of child care use has been investigated in a number of studies in the developmental psychology literature including Haskins (1985), Baydar and Brooks-Gunn (1991), Vliestra (1981) and Belsky et al. (2001). These studies reach conflicting findings and tend to report associations. Currently, only a small body of research focuses on identifying the causal impact of early education and care by age.[3] Behrman et al. (2004) and Berlinski et al. (2008) report on the effects of preschool programs in Bolivia and Uruguay respectively. These authors found that child care attendance lasting at least 7 months boosts child developmental outcomes. However, the evidence in these studies diverges on whether there are statistically significant effects on the intensive margin.

Our empirical analysis has two main findings. First, we demonstrate significant heterogeneity in the policy impacts of access to subsidized universal child care on short run child outcomes by child age. Our estimates indicate that on average, children who gain access to subsidized child care at earlier ages experience significantly larger negative impacts on motor-social developmental scores, self reported health status and behavioral outcomes including physical aggression and emotional anxiety. The sole behavioral outcome for which the significant negative relationship steepens with child age, is that between access to subsidized child care and hyperactivity and inattention scores. Interestingly, for children aged 3 and 4 years, we do not find any evidence that access to child care leads to lower developmental scores. Further, for children aged 4, hyperactivity and inattention scores comprise the only behavioral outcome that has a significant association with access to child care. This set of results indicates that younger children are driving many of the estimated effects reported

[3]There are also studies in the economics literature that predominately report. For example, Loeb et al. (2007) conclude that i) the negative effects on behavior from attending child care are greater the younger the starting age, and ii) the strength of the association between center-based care and performance on reading and math tests is inverse U shaped, peaking for those who start at age 2 or 3.

in Baker et al. (2008).

Second, we conduct a distributional analysis examining how the effects of the policy vary across the age-specific unconditional distribution of motor-social development scores. This analysis reveals significant evidence of treatment effect heterogeneity within ages. For children 0 to 2 years old, we find evidence that child care leads to declines in motor social development scores throughout the distribution. In contrast, we find benefits from access to universal child care on developmental scores among three year olds, with the largest of these effects for children in the lower percentiles of the distribution. This result suggests that access to subsidized child care at 3 years of age may help the most disadvantaged and is consistent with evidence from numerous studies including those evaluating the Perry preschool program. Last, we demonstrate that the full set of distributional results at each age is robust to re-weighting the distribution to account for the changing composition of children that attend child care post policy introduction.

This paper is organized as follows. In section 2, we provide a brief description of both the policy that introduced universal subsidized child care in Quebec and the data used in our analyses. The empirical strategies utilized to recover mean and distributional treatment effect estimates are described in section 3. Our main empirical results are presented in section 4. In a concluding section, our main finding of significant age differences in the estimated policy effects is summarized, broad implications for child care policy debates are discussed, and directions for future research are suggested.

2 Data and Policy Setting

Quebec's Family Policy was put in place in 1997. It comprised multiple measures ranging from an integrated child allowance to enhanced maternity and parental leave and subsidized early childhood education and child care services. Through this policy, the province transformed the delivery of child care services from non-profit day-care centres and home agencies to a network of child care centres for children aged four years and younger. These centres offer low-cost care and are no cost for parents who receive social assistance. The policy also introduced a number of regulations governing the physical layout of child care centers as well

as educational support and staff training.

To evaluate the effects of this policy on a variety of outcomes, earlier studies including Baker at al. (2008), Lefebvre and Merrigan (2008), Haeck et al. (2012) and Kottelenberg and Lehrer (2013ab) use data from Canada's National Longitudinal Survey of Children and Youth (NLSCY). In 1994-95 the first NLSCY survey was conducted with over 15,000 children under the age of 12 years sampled from Canada's ten provinces.[4] Until 2008-2009, follow up surveys were conducted with these children on a biannual basis. During each follow-up a new cohort of children aged 0-1 were added to the survey. In this study, we follow the same sample restrictions used in Baker et al. (2008) and only include children from two-parent families.[5]

The NLSCY contains both child developmental scores and extensive questions relating to child care usage, parental labour supply, and other demographic characteristics. This provides the opportunity to understand the effects of child care policy on a variety of childhood development and behavior indicators. Our main interest will be on the total score obtained in the Motor and Social Development Section of the Child's Questionnaire. This section comprises a set of 15 questions asked of the primary care givers about children in the 0 to 3 age group. The questions vary by child age and ask the person most knowledgeable whether or not a child is able to perform a specific task.[6] The scale has also been used in collections of the National Longitudinal Survey of Youth in the United States and in recent

[4]Children of full time members of the Canadian Armed Forces and those living on Aboriginal reserves were excluded from the sampling frame. These exclusions represent about 2% of the Canadian population.

[5]As discussed in Kottelenberg and Lehrer (2013a) such a restriction eliminates issues connected to other pre-policy subsidization, which was much higher for single parent families, and also isolates an appropriate comparison group not affected by changes in other policies during the course of the study, such as paternity leave regulations. While such a limitation reduces the reach of this study, the two-parent family remains a key focus of the universal child care debate, which is most concern with extending subsidized access to child care where it is not already available, as it is for many single-parent families.

[6]One may worry that by maturity older children will be able to do more tasks. Thus, standardized scores by age of child in months are calculated. That is, each child is assigned a standard score so that the mean MSD score was 100 and the standard deviation was 15 for all 1 month age groups. Therefore children who are 0 months old will have an average MSD score or 100, children who are 1 month old will have an average MSD score of 100, ..., children 47 months old will have an average MSD score of 100.

versions of the National Child Development Survey in England. In addition, we will explore the effects of the policy on scores on the revised Peabody Picture Vocabulary Test (PPVT) that was taken by children aged 4 years.

The NLSCY contains a series of child behavioral scores. These measure levels of hyperactivity, anxiety, physical aggression and opposition and are collected for children who are at least 2 years of age. These measures were collected by Statistics Canada interviewers who administered a standardized questionnaire to the person most knowledgeable about the child (the biological mother in 89.9% of cases). For example, the Hyperactivity/Inattention Subscale ranges from 0 to 16 on the basis of answers to 8 questions (can't sit still, is easily distracted, can't concentrate or pay attention, can't settle for long, is inattentive, fidgets, or acts impulsive) that are each scored as 0 (not true), 1 (sometimes true) or 2 (often true). We will treat these indices as a continuous scale in the analysis. The person most knowledgeable about the child also provided information about the child's health status and recent specific illnesses.

Table 1 presents summary statistics on the use of child care, maternal employment, and the outcome variables discussed above. We report mean and standard deviations of these variables for samples split by child age, geographic region (Quebec and the rest of Canada), and time in reference to the implementation of the policy. Table 1 reveals patterns in maternal work and child care use that are consistent in both Quebec and the rest of Canada. Our analysis illustrates that many mothers elect to remain out of the work force when their child is under a year old, likely reintegrating themselves in to the work force after their child's first year. In pre-policy Quebec only 37.5 percent of all mothers work while their children are less than a year old while 57.4 percent of all mothers work when their children are a year old. At subsequent child age sub-samples the proportion of mothers working remains relatively steady. After the policy this pattern remains true, although Table 1 illustrates an overall increase in mothers working at all child ages. Not surprisingly, the use of child care follows a similar pattern. Across the child age categories we see a large increase in the proportion of children using child care from less than a year to a year old, while usage rates remain relatively stable for parents with older children. This data also reveals a relative comparability of children in Quebec and rest of Canada prior to the introduction of the

policy: for most ages, the levels of MSD score, PPVT, and child health are very similar.

In Table 2 we present the mean and standard deviation for select family characteristics, broken down by child age, time and geographic region. As expected many family characteristics are relatively stable across child age groups. For example, there appears to be very little difference in the number of families residing in large cities across child age. It should be noted, however, that as children grow older they tend to have more total siblings. At least in part, siblings serve as competition for resources in the home environment. Since younger children are less likely to have as many siblings as their older counterparts the relative change in resources from moving from parental care may to some form of child care may, on average, vary across child age. Further, we examine these family characteristics to establish comparability between Quebec and the rest of Canada. While this table does illustrate some overall differences between Quebec and other Canadian provinces, we suggest, as do previous studies by BGM, Lefebvre and Merrigan (2008), and Lefebvre, Merrigan, and Roy-Desrosiers (2011), that using the rest of Canada as a comparison group should not be problematic after conditioning for these variables.

3 Empirical Strategy

We begin by following Baker et al. (2008) who use a linear difference-in-difference research design where the treatment groups include cohorts of children in Quebec and the comparison groups include children of the same age in the rest of Canada and observations are made before and after the reform. This leads to the following estimating equation

$$Y_{ipt} = \beta_o + \delta' Policy_{ipt} + \beta_2' PROV_p + \beta_3' YEAR_t + \beta_4' X_{ipt} + \varepsilon_{ipt} \tag{1}$$

where Y denotes the outcome of interest and the subscripts i, p, and t index individual, province, and year respectively. The covariates contained in the matrix X encompass a set of controls for child, parent, family, and geographic characteristics and are identical to those used in Baker at al. (2008). The terms $PROV$ and $YEAR$ are respectively province and time fixed effects, and the $Policy$ variable is an interaction between the indicator for living in Quebec after the Quebec Family Policy was introduced. Our focus is on the estimates of

the policy effect δ, which can be interpreted as the average causal effect of having access to universally subsidized child care. We correct the statistical inference procedure to account for multiple correlated outcomes.[7]

The validity of a linear difference-in-difference estimator to recover this causal parameter relies on the maintenance of three key assumptions being maintained. In Figure 1, we illustrate the plausibility of the common trend assumption for children of each age. Notice between 1995 and 1997 the slope of each line for Quebec and the rest of Canada is similar. Further, these figures rule out evidence of any anticipation effects. The assumption of common support was examined for children of all ages in Kottelenberg and Lehrer (2013a). Ex ante, it appears plausible that there would not be any specific age at which systematic differences in the observed and unobserved characteristics of individuals living in Quebec from those living in other provinces would emerge.

To move beyond estimating the mean effects of access to subsidized child care, we use the Athey and Imbens (2006) change-in-change estimator, allowing us to identify treatment effects at specific percentiles of the motor social developmental score distribution.[8] The change-in-change estimator does not make any assumptions on the test score production function (i.e. the additively separable property between observed and unobserved inputs) nor require that province and time effects are constant across individuals.

To provide intuition for how this method recovers distributional effects, we denote the CDF of motor social developmental score (Y) by $F_{Y_{gt}}$, for the pre ($t = 0$) and post ($t = 1$) policy periods from the comparison ($g = 0$) and treatment ($g = 1$) provinces. The treatment is operation in Quebec when $t = 1$ and $g = 1$. Treatment effects are obtained by comparing the actual observed to the counterfactual CDF for the $t = 1$ and $g = 1$ sample. Thus, we need to construct a counterfactual distribution, $F_{Y_{11}^{cf}}$. Athey and Imbens (2006) propose to non-parametrically estimate $F_{Y_{11}^{cf}}$ from the empirical cumulative distribution functions in

[7]That is, since we are investigating the effects of access to child care on a host of developmental outcomes, we ensure that the probability of a false rejection (Type I error) does not increase as additional outcomes are added. See Kottelenberg and Lehrer (2013a) for more details on using this correction in evaluating the Quebec Family policy.

[8]See also Havnes and Mogstad (2012) who use several strategies to identify distributional effects of a Norwegian reform that made child care provision universal.

the other periods and provinces. That is for a specific percentile outcome of $F_{Y_{11}^{cf}}$ can be identified by

$$F^{-1}_{Y_{11}^{cf}}(\tau) = F^{-1}_{Y_{01}}(F_{Y_{00}}(F^{-1}_{Y_{10}}(\tau))) \tag{2}$$

where τ denotes the percentile of interest. The percentile specific treatment effect $\Delta y(\tau)$ is then calculated by

$$\Delta y(\tau) = F^{-1}_{Y_{11}}(\tau) - F^{-1}_{Y_{11}^{cf}}(\tau) \tag{3}$$

which in our context can be interpreted as the policy impact on development scores for children at the τ^{th} percentile in the original outcome distribution.

To provide some intuition for the steps used to estimate distributional policy effects, this method assumes that within the same time period, the same realization of Y corresponds to a specific realization of unobserved factors, regardless of the group / province. In other words, there is assumed to be a one-to-one correspondence between the percentiles of the CDF and unobserved factors in each period. To calculate the counterfactual outcome, the point on $F^{-1}_{Y_{11}^{cf}}$ at that specific percentile τ, we add a time effect to $F_{Y_{10}}(\tau)$, the pre-policy outcome in the treatment group at τ. The time effect for that level of unobserved factors is backed out from comparing the percentile functions of $F_{Y_{01}}$ and $F_{Y_{00}}$ at that percentile of y.[9]

To ensure that differences in the unconditional distribution of scores do not reflect differences in observed covariates across cohorts and geographic regions we follow the reweighting procedure developed in Hirano, Imbens, and Ridder (2003). Specifically, a series logit estimator is used to explain the probability of a child being in Quebec after the implementation of the policy conditional on both the full set of covariates in Baker et al. (2008) and their interactions. This method allows us to relax parametric assumptions in producing distributions of both developmental scores where the observed covariates are balanced for the

[9]Formally, the first transformation in equation 2 $F_{Y_{00}}(F^{-1}_{Y_{10}}(\tau))$, provides us an estimate of the time effect at percentile τ. The second transformation $F^{-1}_{Y_{01}}$ in equation 2 adds this time effect to a person with the same value of the outcome variable in $F_{Y_{10}}$ but remember they may correspond to a different unobserved factor than in $F_{Y_{00}}$. Thus, we are saying that individuals in the treated place with a particular outcome at different points in time would be expected to experience the same time effect if the treatment was not offered. Any difference is due to the treatment. Identification of causal effects relies only on an assumption of strict monotonicity in the effects of unobserved characteristics on outcomes, a time invariance condition and that there is some overlap in the support of the unobserved factors between the treated and control.

treatment and comparison in the pre- and post-policy periods. Last, we follow Kottelenberg and Lehrer (2013b) who use Fisher's Exact Test to conduct statistical inference at each percentile since it has been shown to have greater statistical power.

4 Results

Table 3 presents estimates of the policy effect from equation (1) on subsamples defined on the basis of the age of the child. There are gains in maternal labour supply at all child ages, and these gains do not appear monotonic. Among mothers who work, the increase gain in child care use after the policy is similar irrespective of child age from 1 years of age onwards. There is a significant increase in child care among working mothers from ages 1-3 years only. The increased use of child care is driven by enrollment at centre based care. This is somewhat surprising since surveys have shown that half of all Quebec parents express a preference for child care take place in the childs home for children under the age of 2.[10] This is likely because the majority of child care spaces formed after the policy were in center based care.

While the gains in child care usage were somewhat similar for children aged 1-4 after the policy was implemented, there are striking differential consequences on developmental outcomes by age shown in the lower panel of Table 3. For nearly every developmental outcome, there are larger negative effects for children who attended child care earlier in the lifecycle. Newborn children experience large declines in motor social developments scores once access to universal subsidized care is made available. The magnitude of these intent-to-treat estimates falls by approximately 50% among 1 and 2 year olds. For children who are 3 or 4 there is no significant relationship between access to universal child care and either MSD or PPVT scores. A similar time varying pattern is observed for "Child in Excellent Health"; there is a large and statistically negative intent to treat for newborn children, the magnitude of the effect is cut in half for children between 1 to 3 years, and the effect becomes

[10]In 1998, a study on regulated family child care providers, 17.6% of their clientele was under the age of 18 months, a rate that was more than double that of centre-based care. Yet, the estimates indicate the trends in Quebec mirrored the rest of Canada at early ages following the policy.

statistically insignificant for children 4 years of age.

For all behavioral indices with the exception of the hyperactivity and inattention score, we also find negative relationships on these outcomes that diminish in magnitude and statistical significance with child age. The positive effect of access to subsidized care on physical aggression and emotional anxiety falls by over 65 percent and 30 percent respectively between 2 and 3 years. The policy only leads to a significant increase in separation anxiety for 3 year olds. Among 4 year olds, as noted, the intent to treat leads to a statistically significant increase on the hyperactivity and inattention score. Since the standard errors reported in Table 3 correct for multiple inference, this result is unlikely to be a false negative. Access to subsidized child care does not have a significant link to hyperactivity and inattention scores among 2 year olds. These results suggest that on average, the introduction of the policy had a heterogeneous influence on the development of differently aged children. At no age, did the policy have a significant and positive average effect on any of the measured contemporaneous child outcomes.

Figure 2 presents unweighted change in change estimates of the policy on MSD scores by child age. Each graph presents the estimated policy effect at each percentile in MSD score. Among these quantile specific effects those marked by a closed circle differ significantly from zero. Similarly, open circles note quantile specific effects that are statistically different from the mean effect for the given sub-sample.[11] In each graph in Figure 2, we observe a handful of open circles providing evidence of significant treatment effect heterogeneity. In addition, for children aged 0 to 2 we observe that all of the closed circles fall below the line, indicating that there are numerous percentiles of the MSD distribution where access to child care led to a significant decline in performance. Interestingly, for children aged 3, we observe that the policy had a positive effect on MSD performance for children; many of these percentile effects are statistically different from zero.

This last result is the first and only finding in this paper indicating that the introduction of the Quebec Family policy led to improvements on a developmental outcome. As the largest

[11]The change-in-change model calculates a mean effect directly from a comparison of the data and the computed counterfactual. This effect is very similar to that estimated by standard difference-in-difference model.

of these effects takes place in the bottom half of the distribution, this result also suggests that access to subsidized child care at 3 years of age may help the most disadvantaged children. This result is consistent with evidence from numerous studies including those evaluating the Perry preschool program. The Perry program was only offered to children aged 3 or 4, and this timing may have contributed to the program's success.

Since Table 3 documented large changes in the number of children attending child care after the policy, it is possible the heterogeneity is influenced by the changing composition of children who are attending child care in Quebec.[12] As such, to remove differences in composition, we reweight the CDFs in Figure 3 using a propensity score of policy that was estimated with a series logit estimator. The results using reweighted CDFs in conducting the change in change analysis are provided in Figure 3. Notice there very few and quite minor differences in the shape of the percentile policy effect estimates presented between Figures 2 and 3. This indicates that the distributional effects of the policy at each age are robust to reweighting the distribution to account for the changing composition of children that attend child care once the policy was introduced.

5 Concluding Discussion and Directions for Further Research

In this study, we present evidence that the effects of access to universal subsidized child care in Canada on a host of developmental outcomes differ on the basis of child age. Children who gain access to subsidized child care at earlier ages experience significantly larger negative impacts on motor-social developmental scores, self reported health status and behavioral outcomes including physical aggression and emotional anxiety. Among children aged 3 and 4 years, we do not find any evidence that access to child care leads to lower developmental scores. Our analysis additionally reveals significant evidence of treatment effect heterogeneity within ages and indicates benefits from access to universal child care on developmental scores

[12]Further motivation is provided by the instrumental variables estimates presented in Kottelenberg and Lehrer (2013a) show large negative average effect of child care on developmental outcome for those whose child care attendance complied with the policy.

for those that are three years of age.

These results suggest that many of the estimated effects reported in Baker et al. (2008) and Kottelenberg and Lehrer (2013a) are driven by children aged 0-2 years. As such, we believe that debates on provision of public child care should also explicitly consider differential effects based on age of attendance. Our distributional results finding positive effects in the lower tail appear consistent with evidence from The HighScope Perry Preschool Project, a well-studied program that offered preschool to disadvantaged children at ages 3 and 4. Our evidence can be interpreted as suggesting societal benefits could be enriched from policies that target early education and care programs to those that would appear to benefit most, rather than making these programs universal.

There are many potential pathways which could explain the findings that child age significantly influences the impact of child care on developmental outcomes including: the quantity and quality of day-care, child's home background, child and parent's temperament. Yet the findings that behavioral problems are more likely to develop the younger the child is placed in day care are consistent with a large body of research from other fields including Haskins (1985), Baydar and Brooks-Gunn (1991), Vliestra (1981) and Belsky (2001).[13] A potential explanation is provided in the scientific literature surveyed in Bradley and Vandell (2007). These authors report that children in child care are at elevated risk of increased cortisol secretions, a hormone associated with stress, if they begin care earlier in life and are in care 30 or hours a week.[14] Increased cortisol secretions have been repeatedly shown to influence brain functioning and lead to poor health and stress-related behavioral problems. Thus, we

[13]Several of these studies postulate that the pathway through which child care attendance may be more beneficial for older children is either by improving peer relations. Other studies suggest the negative developmental consequences for younger children are due to having exposure to multiple care givers leading to behavioral anomalies. We discuss this issue further below in the context of our results suggesting the need for further research to determine if there is an optimal age organization of children in a child care center.

[14]More compelling evidence of this pathway can be found in the Vermeer and van Ijzendoorn (2006) meta-analysis, which concludes that day-care children displayed higher cortisol levels compared to home settings, especially for children younger than 36 months. A particular interesting finding further supporting this hypothesis is from Tout et al. (1998) who report that cortisol levels for 81% of children in a full-day, center-based care rose from morning to afternoon, a reverse of the expected circadian decrease across the day.

hypothesize that the quality of the day-care environment may be quite stressful for younger children.[15] Unfortunately, the NLSCY data does not contain biological measures allowing us to explore this mechanism further and also has the limitation of treating child care as a homogeneous good.

To better inform policy debates, future research is also needed to understand if the gaps from having access to subsidized child care persist over time, and additionally examine whether the length of attendance affects subsequent development. Implicit in the Cunha and Heckman (2007) multi-period model of human capital formation, is the notion that investments during different periods of childhood are complements in the production of human capital. [16] However, past work including Cunha et al. (2010) has not broken down the early childhood period into age intervals such as those from newborn (ages 0–4 weeks), to infant (ages 4 weeks – 1 year), to toddler (ages 1–3 years), and to preschooler (ages 4–5 years).[17] Scientific research has shown that these distinctions may be important in terms of brain development, because the first year is a critical period of development for visual and speech capacities, whereas the second and third years involve more development in the areas of coordination, speech recognition, and speech production. Since the production of human capital is a cumulative process, we believe more work is needed to explore differences in the timing at which treatments are received and investments are made, and how they interact with child characteristics.[18]

[15]We further speculate that this stress would be higher in child care centers where children of different ages are mixed. The form of stream we envision is similar in spirit to that which underlies the practice of academic redshirting (e.g. Datar (2006)). Academic redshirting is the practice of postponing entrance into kindergarten of age-eligible children in order to allow extra time for socioemotional, intellectual, or physical growth.

[16]Related, there is mixed evidence whether there are static complimentarities between home investments and early eduction and care program. For example, Gelber and Isen (2011) present evidence that the introduction of Head Start led to complimentary investments by parents, whereas Kottelenberg and Lehrer (2013b) show that the introduction of the Quebec Family policy led many parents to reduce their investments into their children.

[17]Many organizations including Zero to Three and the World Association for Infant Mental Health use the term infant as a broad category to include children from birth to age 3.

[18]The idea that child care has differential effects on the trajectory of child development has a growing evidence base indicating that the contextual adversity of the child care environment (i.e., low-quality vs.

The results of this study point to two additional issues that require further investigation. First, future research is needed to understand the extent to which heterogeneity in the findings on the effectiveness of universal child care policies summarized in Baker (2011) are due to differences in child age across the studies.[19] Our findings that there are no significant negative effects of child care for relatively older children is consistent with Felfe et al. (2012), Berlinski et al. (2008, 2009), Gormley and Gayer (2005) and Havnes and Mogstad (2011) who each studied programs that granted access to children who were at least three years of age or more. The negative overall effects in Baker et al. (2008) and Datta Gutta and Simonsen (2011) may be due to the availability of universal child care to younger children. Thus, the conflicting results in the academic literature on the impacts of universal child care may not be due to differences in provision of early education and care, but rather due to the ages at which children are eligible to attend these programs across countries.

Second, our results also suggest that additional study is needed to determine if benefits would be derived from using age segregation in early child education and care policies. In Denmark, all children are guaranteed a child care place from age 26 weeks to when they start school, at six years of age. Younger children aged 0-3 years are placed in "Vuggestue", or nurseries, whereas between three and six years, children go to kindergarten.[20] There is little research examining whether child care workers are better able to meet the needs of children

high-quality care) interacts with the child's characteristics (e.g. Belsky and Pluess (2009), Phillips et al. (2011) and Ellis et al. (2011) among others). Further, this research suggests that the response by the same child will vary substantially if they face a positive or negative environment. The developmental responses to the environmental conditions a child faces have been shown to affect outcomes into early adolescence. This reinforces the point made in the last paragraph that as the evidence base develops, targeting may maximize the return on and early education and care investment.

[19]In contrast, there is no heterogeneity in the estimated policy effects from studies evaluating legislative reforms mandating increased length of leave for new parents on child development outcomes across studies exploiting reforms in Canada, Denmark, Germany, and Sweden. All of these studies find no significant effects on child developmental outcomes, making the puzzle of why there are such striking differences in the effects of early education and care programs important to disentangle.

[20]There has been substantial debate historically on this issue among educators. Varga (1997) summarizes how in the Canadian province of Ontario there was a shift from multi-age to age segregated groupings in child care between 1900 to 1980. This trend has reversed over the last twenty years and most child care centers possess multi-age groupings in Canada.

within a group composed of infants, toddlers and preschoolers versus one segregated by age. Opponents of age-grouping argue that the caregiving required for infants is fairly similar from one to the next, and their care is more manageable in an age-segregated grouping. Indeed, Goelman et al (2000) present a negative association between the presence of children under the age of 18 months in family child care settings on the overall quality of the care provided.[21] Proponents of multi-age programs argue there are benefits for young children from continuity with their educators throughout the preschool years, a claim that also lacks an evidence base. Additionally, we do not know which of these child care environments better fosters a child's ability to make friends, behave cooperatively, and generally 'get on' with others, and if fostering these abilities depends on the child's relative age within the group. While there is a large literature in education examining the effects of age structure within school (i.e. age segregation versus age mixing), little is known about these issues in the early childhood education context.[22] We believe these topics present an agenda for future research that can better inform child care policy debates.

[21] Anecdotal evidence indicates that many family child care providers refuse to include infants in multi-aged groups. In response, the Québec government has offered increased financial incentives to family child care providers who look after infants since subsidized child care has been made available. Many providers argue that the additional incentive which amounts to $2.00 per child is insufficient.

[22] See Veenman (1995) or Little (1995) for reviews of that literature. Mason and Burns (1997) criticize the review since many of the studies sunnarized within failed to address sorting of pupils and teachers into combination classes. Economists have looked at a related topic of class composition in the peer effects literature (e.g. Hoxby (2000) and lavy and Schlosser (2011)) as well as age structure in grade combined classrooms. The available studies on the latter find mixed evidence with Sims (2008) concluding combination classes negatively affect performance, whereas Thomas (2011) finds positive effects.

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Table 1: Summary Statistics by Age

	Age 0				Age 1				Age 2				Age 3				Age 4			
	Quebec		Other Prov.		Quebec		Other Prov.		Quebec		Other Prov.		Quebec		Other Prov.		Quebec		Other Prov.	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
Mother Working	0.375	0.533	0.490	0.539	0.574	0.722	0.613	0.590	0.559	0.658	0.611	0.651	0.562	0.727	0.617	0.641	0.578	0.717	0.624	0.684
	(0.485)	(0.499)	(0.5)	(0.499)	(0.495)	(0.448)	(0.487)	(0.492)	(0.497)	(0.475)	(0.488)	(0.477)	(0.497)	(0.446)	(0.486)	(0.48)	(0.494)	(0.451)	(0.485)	(0.465)
Child in Care	0.212	0.354	0.253	0.263	0.479	0.735	0.446	0.464	0.442	0.734	0.458	0.506	0.445	0.768	0.428	0.523	0.497	0.713	0.444	0.490
	(0.409)	(0.479)	(0.435)	(0.441)	(0.5)	(0.441)	(0.497)	(0.499)	(0.497)	(0.442)	(0.498)	(0.5)	(0.497)	(0.422)	(0.495)	(0.5)	(0.5)	(0.453)	(0.497)	(0.5)
Child Outcomes																				
MSD Score	99.2	91.6	100.1	96.8	99.2	97.5	100.2	100.0	100.4	97.0	100.0	99.0	98.5	98.9	101.3	100.3				
	(15.5)	(16.5)	(15)	(15.6)	(15.4)	(14.8)	(15.1)	(14.9)	(13.7)	(14.1)	(15)	(14.3)	(15.3)	(14.6)	(16.2)	(14.3)				
PPVT Score																	99.8	99.5	100.5	101.3
																	(15.1)	(15.1)	(15.3)	(15.1)
Hyperactivity and Inattention									2.297	2.756	2.743	3.014	2.525	2.901	2.691	2.777	2.296	2.734	2.522	2.622
									(1.81)	(1.836)	(1.853)	(1.793)	(1.893)	(1.777)	(1.819)	(1.705)	(1.885)	(1.745)	(1.845)	(1.711)
Emotional Anxiety									0.852	1.394	0.921	1.235	1.076	1.397	1.236	1.386				
									(1.252)	(1.401)	(1.254)	(1.543)	(1.416)	(1.536)	(1.51)	(1.518)				
Physical Aggression									4.041	4.864	5.091	4.918	4.689	4.681	5.099	4.770				
									(2.922)	(2.881)	(2.989)	(2.962)	(3.117)	(3.067)	(2.934)	(2.766)				
Separation Anxiety									2.557	2.621	2.647	2.509	2.774	2.715	2.771	2.567				
									(1.987)	(1.924)	(2.056)	(1.983)	(2.063)	(1.797)	(1.922)	(1.969)				
Excellent Health	0.720	0.672	0.700	0.733	0.618	0.628	0.625	0.679	0.632	0.620	0.634	0.684	0.618	0.631	0.612	0.679	0.621	0.633	0.614	0.649
	(0.449)	(0.47)	(0.458)	(0.443)	(0.486)	(0.484)	(0.484)	(0.467)	(0.483)	(0.486)	(0.482)	(0.465)	(0.486)	(0.483)	(0.487)	(0.467)	(0.486)	(0.482)	(0.487)	(0.478)

— Note: Each row corresponds to a dependent variable and contains the mean and standard deviation (in parentheses) specific to the time, geographic region, and age group as denoted in the column header. The data is split by Quebec and the rest of Canada (Other Prov.) as well as by the pre-policy period, from 1994-97, and the post policy period, from 2002-07. The NLSCY sample weights, designed to accurately reflect the make up of the Canadian population, are applied in these and all calculations throughout the paper.

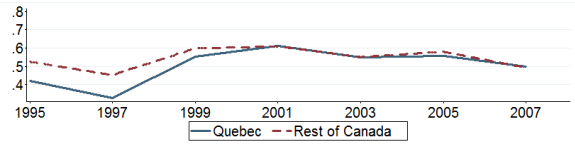
Table 2: Summary Statistics by Age

	Age 0				Age 1				Age 2				Age 3				Age 4			
	Quebec		Other Prov.		Quebec		Other Prov.		Quebec		Other Prov.		Quebec		Other Prov.		Quebec		Other Prov.	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
Child and Family Characteristics																				
Child is Male	0.524	0.514	0.508	0.519	0.514	0.497	0.523	0.504	0.503	0.520	0.510	0.521	0.501	0.517	0.509	0.512	0.506	0.523	0.493	0.515
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Num. of Older	0.846	0.682	0.804	0.736	0.696	0.660	0.788	0.768	0.688	0.712	0.785	0.751	0.729	0.681	0.793	0.766	0.618	0.691	0.807	0.756
Siblings	(0.747)	(0.708)	(0.725)	(0.735)	(0.728)	(0.718)	(0.783)	(0.749)	(0.731)	(0.714)	(0.745)	(0.738)	(0.751)	(0.723)	(0.792)	(0.756)	(0.722)	(0.721)	(0.761)	(0.741)
Num. of Same Aged	0.040	0.000	0.033	0.038	0.078	0.086	0.082	0.115	0.254	0.192	0.259	0.227	0.405	0.359	0.409	0.371	0.542	0.446	0.498	0.464
or Younger Siblings	(0.197)	(0)	(0.187)	(0.191)	(0.27)	(0.286)	(0.283)	(0.334)	(0.449)	(0.401)	(0.458)	(0.434)	(0.544)	(0.515)	(0.545)	(0.525)	(0.624)	(0.562)	(0.596)	(0.585)
Resides in Rural	0.136	0.135	0.141	0.107	0.144	0.141	0.143	0.117	0.152	0.120	0.160	0.110	0.162	0.150	0.162	0.114	0.162	0.133	0.167	0.107
Region	(0.343)	(0.342)	(0.348)	(0.309)	(0.351)	(0.348)	(0.35)	(0.321)	(0.359)	(0.326)	(0.367)	(0.312)	(0.369)	(0.357)	(0.368)	(0.318)	(0.368)	(0.34)	(0.373)	(0.31)
Resides in a Large	0.604	0.593	0.454	0.435	0.610	0.565	0.446	0.466	0.578	0.592	0.429	0.437	0.566	0.563	0.388	0.446	0.539	0.593	0.421	0.438
City (>500K+)	(0.489)	(0.492)	(0.498)	(0.496)	(0.488)	(0.496)	(0.497)	(0.499)	(0.494)	(0.492)	(0.495)	(0.496)	(0.496)	(0.496)	(0.487)	(0.497)	(0.499)	(0.492)	(0.494)	(0.496)
Mother's Characteristics																				
Age	28.8	29.8	30.0	30.7	30.3	30.7	30.9	31.8	31.1	31.1	31.9	32.6	31.7	32.4	32.3	33.7	32.6	33.0	33.7	34.4
	(4.482)	(4.386)	(5.132)	(5.28)	(5.002)	(4.538)	(5.163)	(5.344)	(4.549)	(4.95)	(4.718)	(5.145)	(4.62)	(4.977)	(4.72)	(5.233)	(4.846)	(5.458)	(5.063)	(5.143)
Immigrant Status	0.104	0.160	0.211	0.240	0.111	0.160	0.231	0.285	0.079	0.130	0.217	0.242	0.077	0.106	0.199	0.263	0.075	0.128	0.211	0.232
	(0.306)	(0.367)	(0.408)	(0.427)	(0.314)	(0.367)	(0.422)	(0.452)	(0.271)	(0.337)	(0.412)	(0.428)	(0.267)	(0.308)	(0.399)	(0.44)	(0.264)	(0.335)	(0.408)	(0.422)
Did Not Complete	0.158	0.082	0.115	0.068	0.131	0.089	0.121	0.076	0.095	0.133	0.089	0.073	0.173	0.112	0.113	0.080	0.107	0.136	0.089	0.078
High School	(0.365)	(0.274)	(0.319)	(0.252)	(0.338)	(0.285)	(0.326)	(0.265)	(0.294)	(0.34)	(0.285)	(0.26)	(0.378)	(0.316)	(0.317)	(0.271)	(0.309)	(0.343)	(0.285)	(0.268)
University Graduate	0.174	0.354	0.218	0.363	0.214	0.360	0.195	0.363	0.207	0.304	0.231	0.340	0.208	0.335	0.182	0.337	0.212	0.301	0.205	0.312
	(0.379)	(0.479)	(0.413)	(0.481)	(0.411)	(0.48)	(0.396)	(0.481)	(0.405)	(0.46)	(0.421)	(0.474)	(0.406)	(0.472)	(0.386)	(0.473)	(0.409)	(0.459)	(0.404)	(0.463)
Father's Characteristics																				
Age	31.6	32.6	32.4	33.3	32.9	33.5	33.4	34.4	33.6	34.0	34.2	35.3	34.5	35.1	34.7	36.2	34.8	36.1	36.0	37.0
	(4.908)	(5.65)	(5.78)	(6.119)	(5.628)	(5.373)	(5.704)	(6.154)	(5.129)	(5.781)	(5.215)	(6.122)	(5.506)	(5.424)	(5.535)	(5.767)	(5.154)	(6.199)	(5.597)	(5.97)
Immigrant Status	0.087	0.178	0.216	0.250	0.131	0.192	0.214	0.273	0.080	0.152	0.219	0.249	0.092	0.138	0.187	0.246	0.096	0.148	0.202	0.243
	(0.282)	(0.382)	(0.411)	(0.433)	(0.337)	(0.394)	(0.41)	(0.446)	(0.271)	(0.36)	(0.414)	(0.432)	(0.29)	(0.346)	(0.39)	(0.431)	(0.295)	(0.356)	(0.401)	(0.429)
Did Not Complete	0.176	0.104	0.140	0.099	0.192	0.130	0.162	0.102	0.113	0.146	0.122	0.098	0.205	0.155	0.137	0.087	0.150	0.160	0.129	0.102
High School	(0.381)	(0.305)	(0.347)	(0.299)	(0.394)	(0.337)	(0.369)	(0.302)	(0.317)	(0.354)	(0.327)	(0.297)	(0.404)	(0.362)	(0.344)	(0.282)	(0.358)	(0.367)	(0.336)	(0.302)
University Graduate	0.178	0.322	0.210	0.308	0.207	0.318	0.204	0.321	0.213	0.272	0.235	0.303	0.176	0.302	0.211	0.301	0.196	0.239	0.214	0.295
	(0.383)	(0.468)	(0.407)	(0.462)	(0.406)	(0.466)	(0.403)	(0.467)	(0.41)	(0.445)	(0.424)	(0.46)	(0.381)	(0.46)	(0.408)	(0.459)	(0.397)	(0.427)	(0.41)	(0.456)

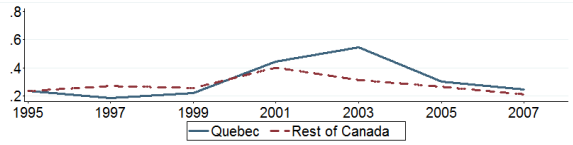
— Note: Each row corresponds to an independent variable and contains the mean and standard deviation (in parentheses) specific to the time, geographic region, and age group as denoted in the column header. The data is split by Quebec and the rest of Canada (Other Prov.) as well as by the pre-policy period, from 1994-97, and the post policy period, from 2002-07. The final column provides the sample size for these measurements.

Figure 1: Trends in Uptake and Development

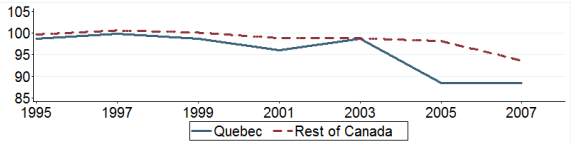
(a) Age 0: Proportion of Mothers Working



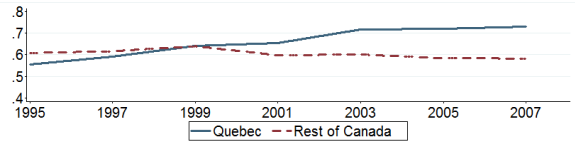
(b) Age 0: Proportion of Children in Care



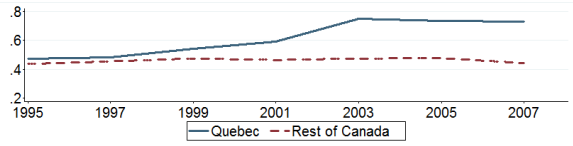
(c) Age 0: Motor and Social Development Score



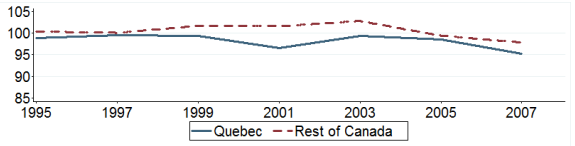
(d) Age 1: Proportion of Mothers Working



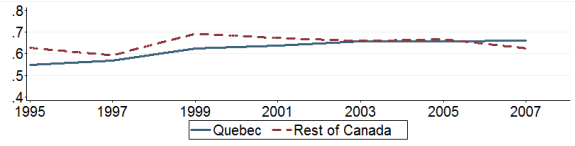
(e) Age 1: Proportion of Children in Care



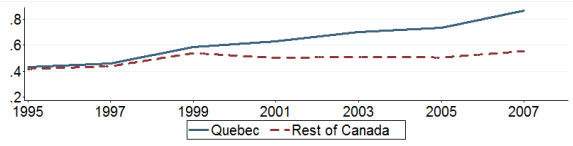
(f) Age 1: Motor and Social Development Score



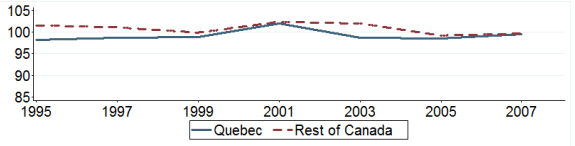
(g) Age 2: Proportion of Mothers Working



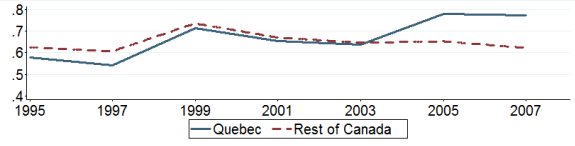
(h) Age 2: Proportion of Children in Care



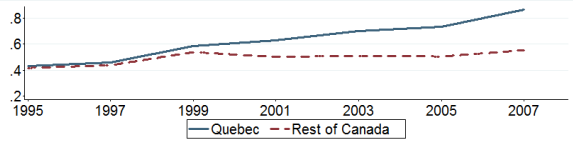
(i) Age 2: Motor and Social Development Score



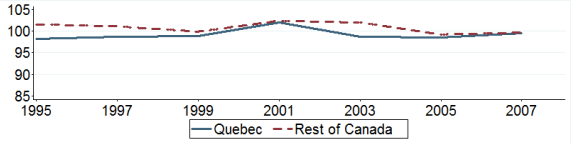
(j) Age 3: Proportion of Mothers Working



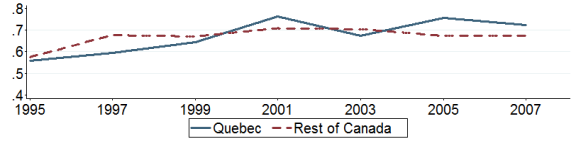
(k) Age 3: Proportion of Children in Care



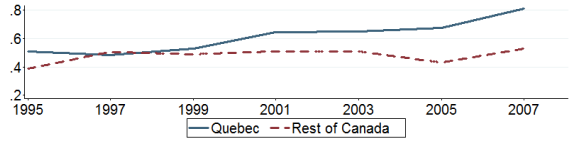
(l) Age 3: Motor and Social Development Score



(m) Age 4: Proportion of Mothers Working



(n) Age 4: Proportion of Children in Care



(o) Age 4: Peabody Picture and Vocabulary Test

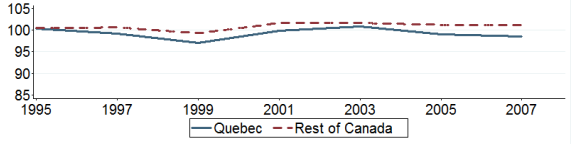


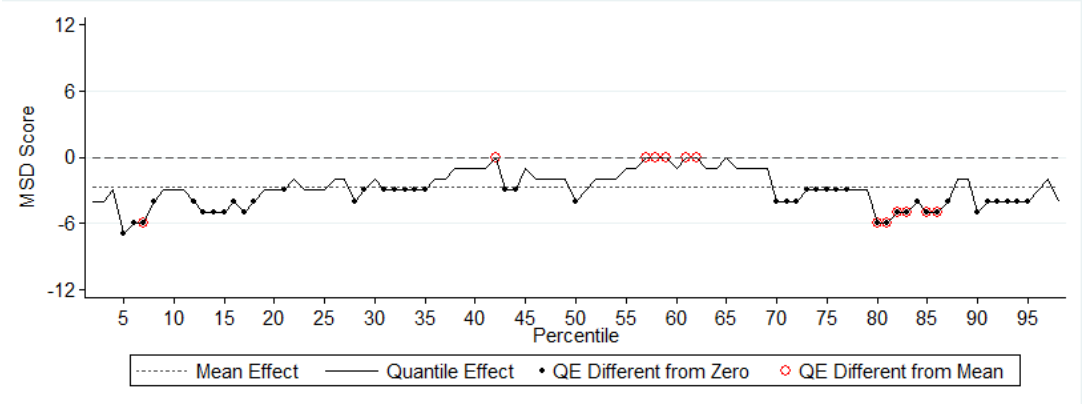
Table 3: Estimates of the Causal Effect of Access to Universal Childcare by Child Age

	Age 0 (P-Value)	Age 1 (P-Value)	Age 2 (P-Value)	Age 3 (P-Value)	Age 4 (P-Value)
Child Care and Work Decisions					
In Child Care	0.125	0.224	0.250	0.219	0.178
	(0.018)**	(0.000)***	(0.000)***	(0.000)***	(0.002)***
Care in Another's Home	0.021	-0.023	-0.022	-0.018	-0.113
	(0.59)	(0.338)	(0.492)	(0.261)	(0.000)***
Care in Own Home	-0.018	0.005	-0.026	-0.034	-0.018
	(0.23)	(0.769)	(0.046)**	(0.000)***	(0.472)
Center Based Care	0.121	0.239	0.298	0.280	0.302
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Hours in Care	4.886	7.957	11.974	9.464	9.609
	(0.004)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
In full time care - More than 20 hours	0.128	0.211	0.298	0.264	0.235
	(0.001)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Mother Works	0.089	0.152	0.078	0.140	0.088
	(0.000)***	(0.000)***	(0.002)***	(0.000)***	(0.015)**
Mother Works / Uses Childcare	0.097	0.185	0.180	0.169	0.161
	(0.009)***	(0.000)***	(0.000)***	(0.000)***	(0.001)***
Mother Works / Does not use Childcare	-0.013	-0.035	-0.100	-0.033	-0.074
	(0.654)	(0.052)*	(0.000)***	(0.082)*	(0.000)***
Mother does not Work / Uses Childcare	0.028	0.040	0.075	0.051	0.018
	(0.12)	(0.000)***	(0.000)***	(0.000)***	(0.199)
Mother does not Work / Does not use Childcare	-0.113	-0.190	-0.155	-0.187	-0.106
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.021)**
Child Development, Behavior, and Health Outcomes					
MSD Score	-4.049	-1.496	-2.346	1.179	
	(0.044)**	(0.018)**	(0.017)**	(0.217)	
PPVT Standardized Score					-0.435
					(0.57)
Hyperactivity and Inattention Score			0.200	0.468	0.552
			(0.135)	(0.004)***	(0.01)***
Emotional Anxiety Score			0.239	0.166	
			(0.017)**	(0.000)***	
Physical Aggression Score			0.933	0.316	
			(0.000)***	(0.017)**	
Separation Anxiety Score			0.173	0.167	
			(0.141)	(0.052)*	
Excellent Health	-0.082	-0.044	-0.051	-0.054	-0.019
	(0.027)**	(0.007)***	(0.037)**	(0.03)**	(0.57)

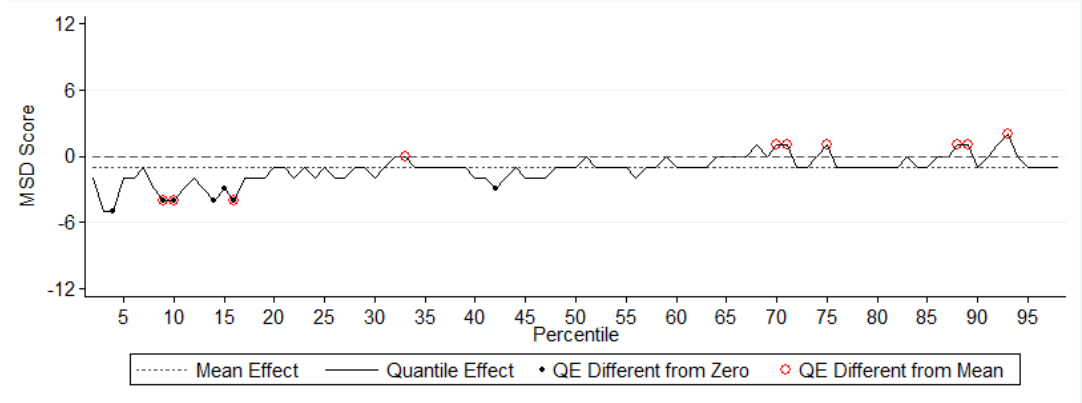
— Note: For the outcome variable in each row we present the estimates of the policy coefficient δ as specified in Equation (1). We split the sample by age category as denoted in the column header. These regressions also include a set of dummies derived from the covariates listed in Table 1 as well as province and cycle indicators. We test the reported coefficients for statistical difference from zero using a two-tailed test and report adjusted p-values (presented in parentheses) corresponding to the estimate in the row above. These p-values make use of a Simes p-value adjustment procedure to account for testing effects on multiple related outcomes. The standard errors underlying the hypothesis tests are also corrected at the province-year level. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Figure 2: Unweighted Change in Change Results by Age: Motor and Social Development Score

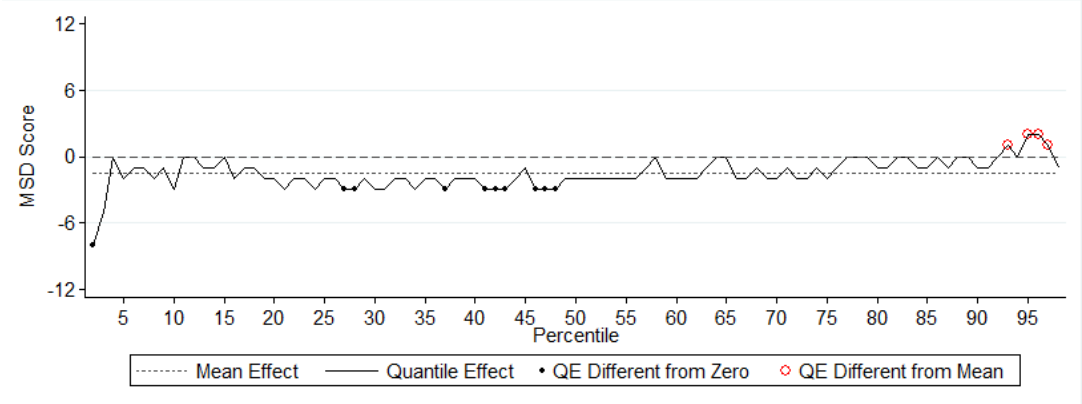
(a) Age 0



(b) Age 1



(c) Age 2



(d) Age 3

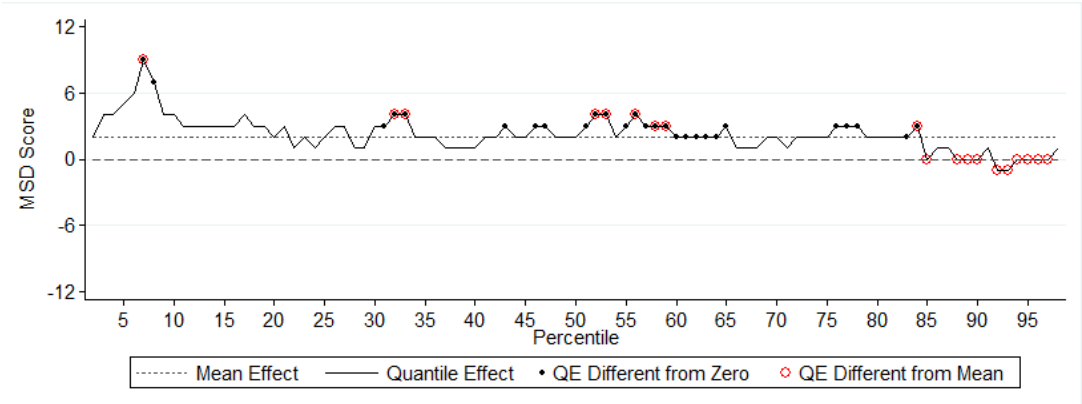
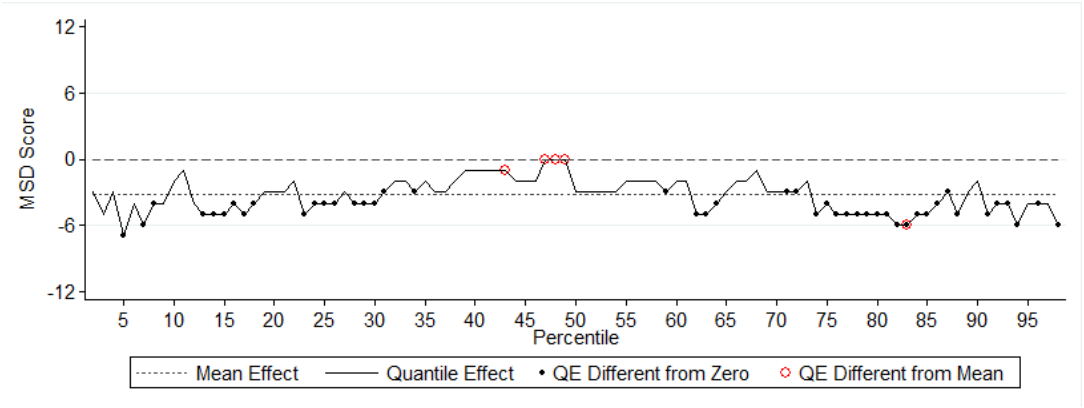
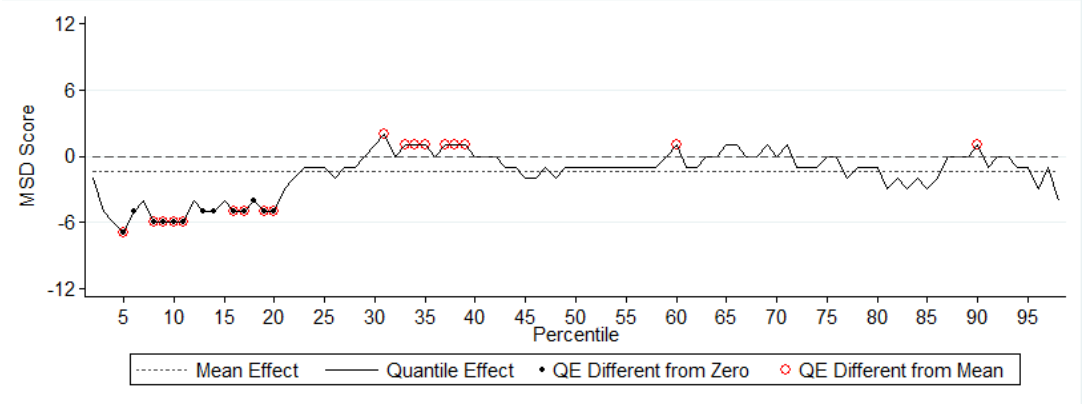


Figure 3: Weighted Change in Change Results by Age: Motor and Social Development Score

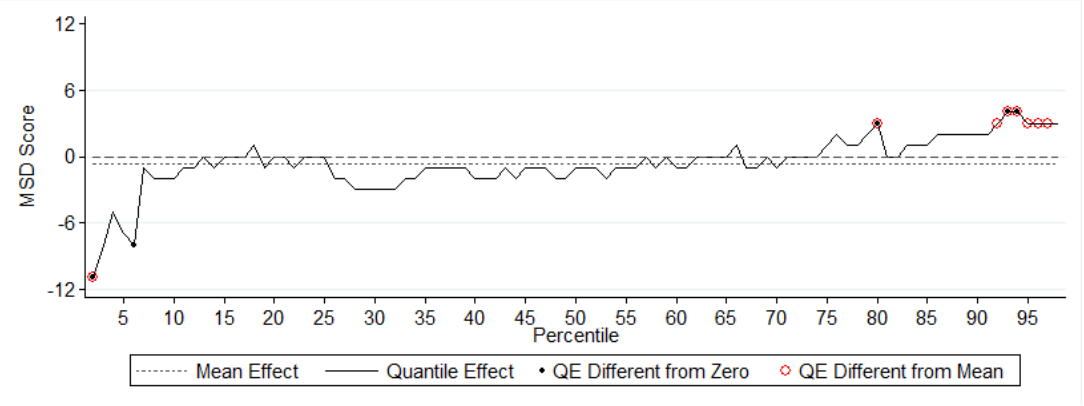
(a) Age 0



(b) Age 1



(c) Age 2



(d) Age 3