

DISCUSSION PAPER SERIES

IZA DP No. 15435

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Non-cognitive Skills of Young Children**

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## ABSTRACT

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# The Impact of Centre-Based Childcare on Non-cognitive Skills of Young Children

The early development of non-cognitive skills has longlasting benefits for children's subsequent educational attainment and wages. Drawing on a rich, nationally representative longitudinal sample of young children in Ireland, we present new evidence on whether the use of centre-based childcare (CBC) in infancy and early years promotes non-cognitive skills by school entry. We focus on the type of non-parental childcare used by mothers who are working when their child is nine months, comparing CBC with other form of non-parental care. We consider the impact of childcare type on three domains of socio-emotional skills: externalising, internalising and pro-social behaviours. We find negative effects of CBC on both externalising and pro-social behaviours across most specifications. With a cumulative value added model we estimate that centre-based childcare at age three worsens externalising behaviour at age five by 0.11 standard deviations compared to other forms of non-parental care. This is equivalent to 44% of the difference in externalising behaviour between children with a mother with/out tertiary education. The effect of CBC on the externalising dimension of socio-emotional skills of children entering school is consistent across several specifications and robustness checks. Given planned expansion of CBC for those needing subsidised provision, we conclude that such measures could exacerbate socio-emotional inequalities.

**JEL Classification:** J13, J24, I21, I24

**Keywords:** centre-based childcare, child socio-emotional development, non-cognitive skills, growing up in Ireland

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# 1 Introduction

Early childhood education and care (ECEC) has the potential to enhance the development of children in their critical early years. But ECEC can also offer an important childcare resource to parents aiming to combine paid work and family. With the increase in mother’s labour supply in many countries, there has been a corresponding expansion of ECEC provision. This has stimulated interest in the impact of such care on both cognitive and non-cognitive development of the children using it. It has been argued that ECEC can both enhance the development of non-cognitive skills and close the skills gap between more and less advantaged children (Carneiro and Heckman, 2003). Given the importance accorded to non-cognitive skills for both educational attainment and subsequent labour market outcomes (Kautz et al., 2014), the potential role of ECEC in fostering such skills is highly salient.

The empirical evidence for the causal effects of the benefits of ECEC for development of non-cognitive skills is, however, mixed (e.g. Felfe and Lalive, 2018; Kuehnle and Oberfichtner, 2020; Fort et al., 2020). Part of the reason for the mixed results is likely to derive from the different country contexts used in the studies, from particular methodological choices in the measurement of non-cognitive skills, and the from variation in age at which exposure to ECEC is evaluated. In addition, findings are likely to differ as a result of the typical comparison of ECEC with maternal care, since countries have differing shares of non-working mothers, and mothers who do not work when their children are infants are also differentially selected, for example by education, across country contexts (Andrew and Landais, 2021). With rising maternal participation in the labour force participation across Western nations, the choice for today’s mothers is increasingly not so much whether to use care, but what form of care. We therefore argue that the appropriate comparison is between types of non-parental childcare used by working mothers.

The type of care may be relevant to children’s development, given differences in opportunities for structured activities and for social interaction. Centre-based childcare (CBC) offers a more

structured environment and higher exposure to social interactions compared to informal care, such as that offered by childminders; but it also results in differences in individualised attention, with lower ratios of carers to children.

In this paper, we evaluate the impact of CBC on non-cognitive skills of young children in Ireland, a country which has seen a rapid increase in mother’s employment over recent decades, where ECEC is some of the most expensive in the OECD, and where both access to and quality of ECEC is a topic of substantial policy interest (McGinnity et al., 2013; Gromada and Richardson, 2021; Murphy, 2015). Since the Irish government has expanded financial support for CBC but not for informal care for pre-school children of working mothers in the face of growing maternal labour force, the comparison of the two forms of care is a policy-relevant one. Moreover, given that subsidies for low-income mothers only apply to CBC, the impact of type of care on non-cognitive skills has the potential to reduce or widen socio-economic inequalities in these skills.

We focus on non-cognitive skills since a growing literature shows that the early development of these skills is relevant in many domains of life. Recent studies have highlighted that the demand for and returns to social or soft skills in the labour market is increasing (Aghion et al., 2020; Blanden et al., 2007; Cortes et al., 2021; Deming, 2017; Hansen et al., 2021; Heckman et al., 2006; Kosse and Tincani, 2020). Given the evidence on high degree of persistence of skills in the lifetime (Attanasio et al., 2020b, 2021; Cunha et al., 2010), and the foundational nature of the early years for skills development (Kautz et al., 2014), we are interested in how non-cognitive skills form in early years as this shapes how they develop in later stages of life.

Non-cognitive skills can encompass a range of character attributes, social skills, and personality traits. We focus on a set of socio-emotional skills as captured by the strengths and difficulties questionnaire (SDQ), which can be robustly measured for young children and which have high predictive power for subsequent traits and behaviours. We focus on the influence of childcare type on the levels of these skills at school entry (age 5) for a number of reasons. On starting school children all face similar circumstances in terms of interactions with peers,

regardless of prior ECEC. The start of school is also the point at which non-cognitive skills begin to be critical for cognitive development. Indeed, the SDQ has been shown to be an important determinant of later test scores (Aucejo and James, 2021; Currie and Stabile, 2006). By focusing on entry to school, children are still proximate to their experience of ECEC, even as the school context may change the salience and expression of non-cognitive skills. At school entry, the duration of children’s experience in school will not be impacting the measurement and expression of non-cognitive skills.

We use a nationally representative cohort study, Growing Up in Ireland and provide new evidence on the role of CBC in children’s development of non-cognitive skills for infants whose mothers were in paid work when the child was aged nine months. This sample selection implies that we consider a relatively socio-economically advantaged sector of the society, though the expansion in maternal participation means that it still encompasses mothers with a range of educational attainment and socio-economic position. We evaluate the effect of CBC compared to *non-parental* informal care in infancy (age 9 months) and at age 3 on the development of non-cognitive skills at school entry (age 5). We start by investigating the association of use of CBC at 9 months with three different dimensions of socio-emotional skills (derived from the SDQ): internalising, externalising, and prosocial behaviour, measured at age 5.

We then estimate a cumulative value added model (Del Bono et al., 2016; Guarino et al., 2015; Todd and Wolpin, 2007) as it allows us to investigate the effect of CBC both at 9 months and 3 years and to deal with the issue of unobservables in a robust way. We find that the use of CBC rather than other forms of non-parental care has a statistically significant negative effect on externalising behaviour of an order of magnitude of 0.11 standard deviations. This is driven by exposure to CBC at age 3. This effect is equivalent to almost half the gap in average externalising behaviour between children with a mother with a degree compared to those with a mother with upper secondary education or less. We investigate whether CBC has heterogenous effects across socio-economic status as the literature suggests (e.g. Cornelissen et al., 2018; Felfe

and Lalive, 2018; Fort et al., 2020). We find that less advantaged children (those with a mother with no tertiary education), are more negatively impacted by CBC at 9 months compared to their counterparts, although this difference is not observed at age 3. Results for the negative impact of CBC on externalising behaviours are consistent across different specifications and estimation strategies.

We subject our results to a range of robustness checks. Following the method proposed by Oster (2019) we show that the CVA estimates are unlikely to suffer from omitted variable bias. By splitting the sample according to whether mothers work full-time or part-time, we see that the negative effect of CBC on socio-emotional skills is present among the former group but not the second, suggesting that what we are capturing is indeed the effect of childcare, which is used more intensively by full-time working mothers. Furthermore, we allow for complementarity across different dimensions of past socio-emotional skills and we test whether using the teacher instead of the main respondent report for the SDQ impacts our findings socio-emotional skills. The negative effect on externalising behaviour remains unaltered. Finally, when we implement an instrumental variable strategy where type of childcare at age 3 is instrumented with that at age 9 months, we still find a negative effect of CBC on externalising behaviour, alongside a negative effect on pro-social behaviour.

We suggest that a possible mechanism that could explain our findings is the lower carer to child ratio at age 3 in CBC compared to informal care. For the former, from age 2 and up to age 3 this ratio is 1:6 and from age 3 it increases to 1:8. In non-centre based childcare the ratio is mostly 1:1 and 1:2. This could explain why our findings are comparable to those based in countries with similar carer to child ratios in CBC (Fort et al., 2020; Baker et al., 2019) and differ from those in settings with a higher carer to child ratio (Cornelissen et al., 2018; Felfe and Lalive, 2018; Drange and Havnes, 2019).

The paper proceeds as follows. In the next section, we discuss the relevant literature and our main contributions. Section 3 describes the institutional context our study is based on.

Section 4 presents the methodology and Section 5 describes the data and measures and presents the relevant descriptive statistics. Section 6 shows our main results, while Section 7 presents the sensitivity analyses and robustness checks. In Section 8 we discuss the potential mechanism driving our results; and in Section 9 we conclude.

## 2 Main contributions to the existing literature

Our study adds to the growing literature that highlights the challenges in combining largescale expansion of universal childcare aimed at supporting mother’s labour supply with improving pre-school developmental outcomes, and closing the skills gap between more and less socio-economically advantaged children. Our main contributions are threefold.

First, we focus on early childhood outcomes, and, specifically, on early development of socio-emotional skills. Infancy is a developmental phase which has been less studied in the literature on childcare effects (Berger et al., 2021), but is known to be crucial for human capital development (Shonkoff, 2010), also in part because of the dynamic complementarities of skills (Cunha and Heckman, 2007; Heckman and Masterov, 2007; Heckman and Mosso, 2014). The importance of the early development of non-cognitive skills for both enhancing cognitive development and reducing the attainment gaps between more and less advantaged children is well-attested in the literature (e.g. Cunha and Heckman, 2008; Carneiro and Heckman, 2003); and research on the long-and short-term consequences of non-cognitive skills has proliferated. One route to achieving such gains that has been strongly endorsed by several economists is investment in formal, centre-based ECEC (e.g. Blau and Currie, 2006; Currie and Almond, 2011; Fryer Jr et al., 2020).

The extent to which such formal, centre-based ECEC enhances cognitive skills has provided much positive, albeit some mixed, evidence (e.g. Carta and Rizzica, 2018; Gregg et al., 2005; Del Boca et al., 2016, 2018; Caprera, 2016; Felfe and Lalive, 2018; Blanden et al., 2016; Kuehnle

and Oberfichtner, 2020; Fort et al., 2020; Berger et al., 2021). At the same time, heterogeneous effects are often found, even within the same study. For example, Corazzini et al. (2021) find that attending early childcare improves the language test scores of immigrant children, although it negatively affects natives.

The benefits of CBC for non-cognitive skills, even though understood to be increasingly important (Blanden et al., 2007), have been explored in a more limited range of studies. Using quasi-experimental methods to produce causal estimates of the impact of formal ECEC on children's non-cognitive skills, these have found positive (e.g. Gupta and Simonsen, 2010), but also zero (e.g. Hansen and Hawkes, 2009; Kuehnle and Oberfichtner, 2020) and negative (e.g. Magnuson and Duncan, 2016; Baker et al., 2019; Burger, 2010; Fort et al., 2020) effects. For example, among the latest studies, Fort et al. (2020) using an RDD strategy show that, in Italy, additional daycare attendance at age 0-2 negatively impacts three dimensions of the Big Five personality traits at age 8-14. The results are found for more affluent families and for girls. They explain this finding by the fact that institutional daycare provides fewer one-to-one interactions with adults compared to alternative non-institutional settings, mainly parental care. On the other hand, using a staggered expansion of access to ECEC to estimate marginal treatment effects, Felfe and Lalive (2018) find that, in Germany, the expansion of childcare at age 0-2 benefits socio-emotional skill development (based on pediatrician's observation and the SDQ), especially for children from disadvantaged families and boys. They explain this by the better quality environment in institutional settings. This leaves the benefits of institutional ECEC provision for both enhancing non-cognitive skills and reducing the gaps between more and less advantaged children an open question.

Since these studies use largely comparable empirical strategies, relying on staggered implementation of programmes or admissions thresholds, the observed discrepancies in findings may be partly driven by differences in country and therefore institutional context. The nature of CBC, as well as its quality varies substantially cross-nationally (Gambaro and Stewart, 2014;

Kulic et al., 2019) indicating the need to add to the evidence from a wider range of countries. The ways in which non-cognitive skills and ECEC are measured also vary by study. In addition, some studies focus on the effect of being eligible for formal ECEC, or the intention to treat, (e.g. Havnes and Mogstad, 2011) and others on the effect of attending ECEC (e.g. Corazzini et al., 2021). Finally, much of the literature focuses on children post-infancy such as at age 3-5 (though see Drange and Havnes, 2019; Berger et al., 2021). However, it is plausible that it is in infancy and when first beginning to engage in interpersonal interactions that children may be most susceptible to influences on their socio-emotional development (Shonkoff, 2010; Magnuson and Duncan, 2016). Moreover, as children go through a rapid period of development, the type of ECEC may have different impacts at different pre-school ages, helping to account for some of the inconsistency in existing findings. We therefore investigate the impact of CBC relative to informal care on socio-emotional skills at both ages 9 months and 3 years, and examine whether there is a cumulative effect.

Our second contribution stems from the focus on mothers who are in paid work. This paper speaks to pressing issues in terms of child-care expansion. Increasing mothers' labour supply is a widespread policy aim, typically supported by expansion of ECEC, rendering not whether but how that childcare is provided the salient policy question. Additionally, the focus on mothers who are in paid work minimizes the issue of selection into childcare and means we avoid the issue of potential endogeneity between children's endowment of skills (which is unobservable to the researcher) and mother's employment decision. By considering exclusively non-parental childcare this paper differs from those estimating the effects of ECEC on child development by comparison with parental, or specifically maternal care, rather than the alternative forms of childcare available to working mothers (e.g. Cornelissen et al., 2018; Baker et al., 2019). These studies often have advantages in terms of facilitating causal estimation strategies, through, for example using geographical variation in access to ECEC, but do not reflect the nature of the choices facing mothers who have no option but to participate in paid work. By investigating this

topic among working mothers and by focusing on non-parental care, our analysis is both more policy-relevant and is not affected by the issue of endogeneity of the choice to participate in paid employment and children’s non-cognitive skills. It thus offers a cleaner estimate of the effect of formal childcare. The issue of endogeneity in terms of type of childcare chosen is dealt with by testing the robustness of our findings to a range of analytical approaches using our observational data. These are facilitated by the rich set of measures available to us at both nine months and age 3 years old, prior to the outcome age of interest, school entry (age 5).

Finally, our third main contribution is that we explore heterogeneity in effects by maternal education. Most studies on the effect of ECEC on children development find heterogeneous effects among those using it or eligible to use it, showing that ECEC contributes to reducing or increasing inequalities, depending on the context studied. We contribute to this open debate by investigating the heterogeneous effects of ECEC across maternal education to assess the topical and policy-relevant issue of whether ECEC contributes to reducing inequalities in child outcomes (Magnuson and Duncan, 2016).

There is indeed an ongoing debate as to whether ECEC potentially has equalising effects for more disadvantaged children (Björklund and Salvanes, 2011; Carneiro and Heckman, 2003; Currie, 2001). In studies of the impacts of CBC on cognitive skills, the expectation is that these will have heterogeneous effects. The intuition is that formal settings have the potential to enhance children’s learning and school-readiness, particularly where mothers’ inputs may not provide such a level of educational stimulation, given that parental inputs are known to vary by educational background (Rowe, 2008). A similar argument can be made in relation to non-cognitive skills. CBC might thus be expected to particularly benefit those children who come from less structured environments, which vary with maternal background (Lareau, 2011). At the same time, Jessen et al. (2021) have shown that childcare and parental investments are complements rather than substitutes, and that this is particularly the case for lower-educated mothers.

We focus on maternal education to examine potential heterogeneous effects for several reasons. First, in our sample, mothers with tertiary education are more likely to enrol their child in CBC: among working mothers using childcare when the baby is nine months old, about 63% using CBC have a degree, while the share of those with tertiary education using other forms of non-parental care is 43%. If variation in childcare use is one of the reasons for socially stratified variations in non-cognitive skills among school-children, the expansion of pre-school CBC could reinforce such inequalities. Second, the quality of the time spent with their children has been shown to differ across families with different levels of maternal education (Del Bono et al., 2016; Hart and Risley, 1995). Finally, the gap in the socio-emotional skills between children of lower and higher educated mothers increased between the 1970 and the 2000 birth cohorts in the UK (Attanasio et al., 2020a). The UK is a country that is similar to Ireland, the country of our study, in terms of institutional context and socio-cultural characteristics. We might expect a similar gap to prevail in Ireland, and hence it is critical to consider the potential differential effects of CBC on reducing or exacerbating it.

### 3 Institutional context

Our chosen country context provides an informative one in which to explore ECEC. Driven in part by interests in facilitating mothers' labour force participation (Nollenberger and Rodríguez-Planas, 2015) and in part by a conviction of the benefits ECEC for children's development (Nores and Barnett, 2010), state-sponsored childcare has expanded rapidly in many industrialized countries over recent decades. CBC constitutes the primary vehicle of this expansion, though with substantial variation in costs for parents (Thévenon et al., 2013; Gromada and Richardson, 2021). Ireland is no exception in these developments. Ireland has traditionally had a gendered division of paid work and family responsibility; but women's employment rates doubled between 1980 and 2010. This has corresponded with the development of maternity leave policies for women in

work prior to the birth of their child, facilitating their return to employment. All those women who were in employment prior to the birth of their child are entitled to take leave and to return to the same job or one of a similar level (McGinnity et al., 2013). By the early years of the 21st century, paid maternity leave was 26 weeks, with the option for a further 16 weeks unpaid leave. Parental leave is unpaid and therefore take-up among fathers is low. While there is no statutory right to part time work, around one-third of mothers return to or select into part-time work (McGinnity et al., 2013). Maternity pay is not generous by international standards; although for around half of mothers taking leave, employers provide additional pay. Consistent with the major transformation of the labour market in terms of mothers' participation, the share of children under age 3 in formal childcare increased from under 10 per cent in 1995 to over 30 per cent by 2008 (Thévenon et al., 2013). Between 2000 and 2010, grants to private and community providers of CBC accompanied a rapid expansion of these sectors. Nevertheless, costs remain among the highest in the OECD (Gromada and Richardson, 2021).

At the time of our study, some subsidies were in place for low income parents accessing CBC, but not for those using childminders (Russell et al., 2018). A more unified system with more systematic parental subsidies was introduced in 2016, but this continues to focus on CBC rather than child-minders. Since child-minders are also costly, low-income working parents may be incentivized to use CBC, potentially limiting their choice (Russell et al., 2018). If CBC has negative effects relative to child-minders such restrictions on choice for low-income mothers could consequently have implications for educational inequalities going forward. The extent to which CBC does or does not promote positive non-cognitive skills is thus germane, prompting the need for further evidence on its effects.

In Ireland, CBC is regulated by childcare legislation, which stipulates minimum qualifications requirements and specific, age-dependent staff-child ratios. Up to age 1, the ratio is 1:3; from age 1 and up to age 2, it is 1:5; from age 2 and up to age 3, it is 1:6. From age 3 it increases to 1:8. This contrasts not only with one-to-one parental care, but also with childminders and other

informal carers looking after children on their own or with few others. The carer:child ratio of CBC after age 2 is higher than in many European countries, including those that have been the source of previous studies. If, as we posit, one mechanism driving any effects on non-cognitive skills may be the trade-off between greater structure and less individual attention, Ireland then offers a case where less individual attention is likely to be particularly marked in CBC, especially, for those who remain in it over an extended period.

Most children in Ireland start their first-level education in primary schools at 4 or 5 years of age. Legally, children can be enrolled in primary school from the age of 4 upwards and must have started their formal education by the age of 6 years. Children aged between 3 years 3 months and 4 years 6 months on the 1st of September each year are entitled to free part-time preschool places funded by the Government. From the nationally representative dataset used in this paper, Growing Up in Ireland (see Section 5 for a detailed description of the data), we see that by 5 years old all children are in a school setting: 70.8% of children at age 5 are in Junior Infants in primary school (of these, 97.3% also took up the free preschool year) and the rest are in pre-school.<sup>1</sup>

## 4 Methodology

### 4.1 Theoretical framework

We are interested in understanding the impact of being exposed to CBC at early ages ( $C_\tau$ ) on socio-emotional skills at school entry ( $\theta_{(\tau+1)}$ ) among the children of working mothers. Socio-emotional skills are a function of several other inputs, alongside type of childcare. These are the initial endowment of socio-emotional skills ( $\theta_\tau$ ), parental inputs ( $P_\tau$ ) and individual characteristics ( $X_\tau$ ), which all are determined before time  $\tau + 1$ .

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<sup>1</sup>Among the reasons for which these children are not yet enrolled in primary school the most important are: ‘I thought child was too young’ and ‘I didn’t think child was ready to start school’.

$$\theta_{\tau+1} = F(\theta_{\tau}, C_{\tau}, P_{\tau}, X_{\tau})$$

The argument for the impact of CBC on non-cognitive skills is similar to that for cognitive skills: in a more structured environment, children can learn important skills that will ease their transition to formal schooling and will increase their range of non-cognitive skills through multiple interactions. At the same time, especially in infancy, children interact less with their peers, and more individualized attention from the carer may be more important (Fort et al., 2020). Hence the carer-child ratio in different settings might be salient for development as more individualized attention could promote socio-emotional skills.

Given that centre-based settings are characterized by a greater intensity and diversity of contact with other children, socio-emotional skills might plausibly respond differently to such settings compared to the more intimate - and less challenging - environment of informal or family-based childcare. CBC would be expected to positively affect pro-social skills, as it facilitates regular social interaction with peers in a structured setting  $\partial\theta_{\tau+1}/\partial C_{\tau} > 0$ . On the other hand, we might expect a negative effect on behavioural skills stemming from the relative lack of individualised attention, if that results in children having less input into how to regulate their behaviour  $\partial\theta_{\tau+1}/\partial C_{\tau} < 0$ . Ultimately, whether socio-emotional skills are affected by childcare type and in which direction is an empirical question.

## 4.2 Empirical strategy

Our empirical strategy proceeds in stages. We initially present naive estimates from OLS regressions of socio-emotional skills at age 5 on childcare type at age 9 months. Given differences in observables between working mothers using child minders and those using CBC, we refine these estimates using propensity score matching and inverse probability weighting. This provides an estimate of the association of infant exposure to CBC with socio-emotional skills on school

entry. However, given the large continuity of childcare type in infancy and early childhood (80% of children in our sample have the same type of childcare at age 9 months and 3 years), these estimates are likely to capture long exposure to CBC.

In subsequent analysis we use a cumulative value added approach, where we incorporate measures of childcare type at both age 3 and age 9 months while conditioning on skills measures at the same ages. This empirical strategy is our preferred estimation for two reasons. First, it allows us to establish the contribution of childcare type at different developmental stages. Second, it allows to deal with the issues of unobservables in a framework that has been validated for comparable analysis: this empirical method has been widely adopted for studying human capital development. We implement a number of robustness checks and sensitivity analyses. By using multiple estimation strategies, which approximate causality to a different extent, we provide consistent evidence for a negative relationship between CBC in the early years and externalising behaviours on school entry.

## **Childcare type at 9 months: naive regression, propensity score matching and inverse-probability weighting**

We start by investigating the relationship between CBC at 9 months (9m from now on) and socio-emotional skills at 5 years (5y from now on) as described by the equation below.

$$Y_{i,t+1}^j = \alpha_1 + \alpha_2 CBC_{i,t-1} + \alpha_3 X_{i,t-1} + e_{it} \quad (1)$$

Subscript  $i$  stands for individual and superscript  $j$  for type of socio-emotional skill, for example, externalising behaviour, which is measured at 5y, i.e.  $t + 1$ . In Eq. [1](#) the coefficient of interest is  $\alpha_2$  which tells us the association of the outcome with CBC age 9m, i.e.  $t - 1$ . We use  $t - 1$  for 9m and  $t + 1$  for 5y as later we introduce  $t$  to indicate 3y.

The vector  $X$  contains a rich set of characteristics of mother, child, and household collected

when the child was aged 9m. The strength of the Growing Up in Ireland data is the rich range of information on several domains such as maternal and child health indicators and financial situation of the household. Table [A1](#) reports all the main variables. These include fixed characteristics (such as the birth weight and sex of the child and the ethnicity of the mother), and time-varying characteristics (such as the mother’s marital status and household socio-economic status and earning quintile group) which are measured when the child was aged 9m. These should not be affected by the choice of type of childcare. We also condition on the health and the depression status of the mother, since the outcome of interest is based on the mother’s responses, and her health status could bias how she classifies her child’s behaviour ([Kiernan and Huerta, 2008](#)). Finally, we also condition on the main reason for choosing that type of childcare (see Table [A2](#)).

We label this method naive regression as it is unlikely that the assumption  $E(u_i|CBC_{i,t-1}) = 0$  holds, even after conditioning on a rich set of characteristics. To tackle this issue and increase the likelihood of comparing similar individuals differing only in their choice of childcare at age 9m we also implement propensity score matching (PSM) and inverse probability weighting (IPW). In this way we should reduce any bias due to the fact that we might not observe all relevant characteristics explaining the different choice in type of childcare. The identification assumption for both methods relies on the selection on observables (the conditional independence assumption or CIA), so that all relevant differences between treated ( $D = 1$ ) and non-treated ( $D = 0$ ) are captured in  $X$ , i.e.  $E(Y_0|X, D = 1) = E(Y_0|X, D = 0)$ . For the PSM, we implement nearest-neighbor matching without replacement and we keep those observations which have common support to compare extremely similar treated and untreated children based on their observables ([Weidmann and Miratrix, 2021](#)). For the IPW we implement exact matching of the covariates moments for the treated and untreated group in the optimization problem (i.e. entropy balance) as this has been found to be the most robust method compared to others depending on the CIA ([Zhao and Percival, 2016](#)). The rationale for this exercise is to recover some bounds in the

estimation of the association of CBC with socio-emotional behaviour by drawing on two different methods (matching and weighting) which solely rely on the CIA.

Furthermore, given that the literature has found that the type of childcare affects different groups of the population in different ways (e.g. [Cornelissen et al., 2018](#); [Felfe and Lalive, 2018](#)), with the IPW<sup>2</sup> we estimate the average treatment effect, as well as the average treatment effect on the treated and on the untreated, ATE, ATT, and ATC, respectively.

## Childcare through infancy and early childhood: cumulative and cumulative valued added models

We are primarily interested in the association between CBC in infancy with socio-emotional skills at 5y as infancy is the point at which mothers returning to work first identify childcare suitable for their children and it is uncontaminated by feedback effects. There is, additionally, substantial continuity in choice of care once it has been adopted, making this initial choice salient for the whole pre-school period: 85% of children who used CBC at 9m are still in CBC at 3y (while the percentage of non-CBC ‘stayers’ between 9m and 3y is 75%). This continuity in childcare type allows us to implement a cumulative model capturing exposure to CBC in the period from 9m to 3y. Eq. [2](#) includes type of childcare at 9m and 3y, where the latter is  $t$ . Eq. [3](#) uses a categorical variable ( $CBCexposure$ ) measuring whether the child attended CBC at age 9m and 3y, only at 9m, only at age 3y, or has never been exposed to CBC (omitted category).

$$Y_{i,t+1}^j = \beta_1 + \beta_2 CBC_{i,t-1} + \beta_3 CBC_{i,t} + \beta_4 X_{i,t-1} + u_{it} \quad (2)$$

$$Y_{i,t+1}^j = \gamma_1 + \sum_{k=1}^4 \gamma_{2k} CBCexposure_{it} + \gamma_3 X_{i,t-1} + \epsilon_{it} \quad (3)$$

These regressions are likely to suffer from omitted variable bias as they do not condition

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<sup>2</sup>It does not make sense to do the same for the PSM, where we retain only those observations with common support.

on skills endowments and, possibly, on all relevant parental inputs. We therefore amplify this model by following [Todd and Wolpin \(2003, 2007\)](#) and [Fiorini and Keane \(2014\)](#). The cumulative value added (CVA) method has been implemented in several recent studies such as [Del Bono et al. \(2016\)](#) and [Anderberg and Moroni \(2020\)](#) to investigate the effect of maternal time and intimate partner violence, respectively, on children’s skills development. We estimate the model described in Eq. [4](#) where past socio-emotional skills ( $Y_{i,t}^j$ ) account for unobserved socio-emotional endowments and omitted past inputs. This enables us to deal with the feedback effect by which CBC could be a response to children’s earlier endowments and to parental characteristics which are not observed by us. By adding prior socio-emotional skills we also capture the persistence in skills development which, starting with the seminal paper of [Cunha and Heckman \(2007\)](#), has been widely documented in the literature.

$$Y_{i,t+1}^j = \Lambda_1 + \sum_{t=1}^2 \Lambda_{2t} CBC_{it} + \Lambda_3 Y_{it}^j + \Lambda_4 \lambda_{i,t-1} + \Lambda_5 X_{i,t-1} + z_{it} \quad (4)$$

Our measure of socio-emotional skills, the SDQ, was collected at age 3, but we do not have it for age 9m, as it is age sensitive. That is, it captures behaviours which are characteristic of young children but not of babies. We therefore use the assessment of the baby’s skills collected at age 9m ( $\lambda_{i,t-1}$ ). This includes the Bates’ Infant Characteristics Questionnaire (ICQ), i.e. whether fussy, unadaptable, dull, unpredictable, and scores on personal social development from the Ages and Stages Questionnaire (ASQ). It is worth noting that interviews are carried out when the child is exactly 9 months old, so that all children are at the same developmental stage. Nevertheless, the ASQ is divided into different levels to investigate whether the age milestones (for age 8m, 10m, and 12m) have been met. In this way, it makes it possible to identify those doing particularly well (i.e. hitting higher age milestones such as 10m and 12m) or doing particularly poorly (i.e. not hitting the 8m milestones yet). Table [A3](#) shows that the correlation between skills at 9 months and socio-emotional skills at age 3 is not particularly strong, but goes in the expected

direction; better socio-emotional skills are negatively correlated with the ICQ and positively with the ASQ, as higher values in the ICQ depict worse traits while the opposite is true for ASQ. Since we do not have a measure of maternal socio-emotional skills other than maternal mental health, these measures of a baby’s skills development should capture the early influence of maternal skills on child development.

The only note of caution in this model is that if measurement error is present in early skills, the coefficient for CBC could suffer from attenuation bias,<sup>3</sup> thus it should be considered as a lower bound estimate.

## 5 Data and descriptive analysis

### 5.1 Data and sample

We use the infant cohort of Growing Up in Ireland, a national longitudinal study of children and young people in Ireland (Williams et al., 2019). The study is a nationally representative probability sample covering the whole of Ireland, with approximately 11,100<sup>4</sup> cohort members born in 2008 and first observed at 9 months old. Follow up surveys were carried out when the children were aged 3, 5, 7, and 9. Interviews are carried out with the child’s carers and information is also collected from the child and, following school entry, from teachers. We use the 9-month survey and the follow ups at age 3 and at age 5, when children entered school. We also use the age 9 survey in additional analysis. The survey contains rich information on the cohort children, their families, and on the type of childcare used. We keep only singleton (i.e. not twins or triplets) children for whom the mother is the main carer respondent in the first three waves (N=8,200).

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<sup>3</sup>Usually a two-period lagged outcome is used as an instrument to account for this (Andrabi et al., 2011; Arellano and Bond, 1991), but this is not possible in our case as there is not a measure of the same socio-emotional skills prior to age 3.

<sup>4</sup>The number of observations is rounded as required by the data provider.

Given the selection issues introduced by labour force participation and childcare availability, and the potential endogeneity of labour force participation and children’s socio-economic development, we retain in our sample only mothers who usually work and who were in paid work 9 months after the cohort child was born (N=4,900). In the context of increasing maternal employment (OECD, 2016), the comparison between maternal care (provided by non-working mothers) and paid-for or formal care (e.g. Felfe and Lalive, 2018) may not be the most appropriate comparison from a policy or estimation perspective. Highly educated mothers who remain out of the labour market to care for their children will both tend to be highly selected and their choice may be endogenous to the skills of the child. For the same reason, we exclude those 1,100 cases where the main form of childcare is the mother or father. The treatment thus consists of having been exposed to CBC as the main type of childcare arrangement versus any other form of *non-parental* childcare. The main form of childcare is explicitly identified by the mother in the survey, and it is this maternal report that we rely on in our classification of childcare type (see further below). We note that in Ireland mothers’ probability of return to work by nine months is impacted neither by perceived availability of formal childcare nor by rural location, which might be expected to have fewer childcare options (McGinnity et al., 2013). Finally, we retain only those observations for which we have information about childcare and non-cognitive skills up to age 5. These restrictions leave us with a sample of 2,900 children with a mother in paid work at age nine months when they are first observed, whose main form of childcare is non-parental care at both 9 months and age 3, and who are observed at the age 3 and age 5 follow-ups, when their non-cognitive skills are measured. All analyses are adjusted for differential attrition using the survey weights provided with the data.

Mothers in our sample are, on average, more likely to have obtained a degree and their household has higher income than the average household in the overall population (see Appendix Table A1). This is consistent with them being in paid work. The percentage of mothers in our sample who are in the top and bottom quintile groups of the equivalised household annual income

is 31.14% and 4.95%, respectively. It is thus important to highlight that this study focuses on the more privileged section of the society, though it captures socio-economic variation across mothers. As women increasingly gain higher qualifications and more mothers are expected to remain in paid work after childbirth, the findings are likely to be increasingly relevant to the wider population.

## 5.2 Socio-emotional skills

As a measure of non-cognitive skills, we use the Strengths and Difficulties Questionnaire or SDQ (Goodman, 1997), a self-completion parental report on five domains of the child’s emotional-behavioural development. Following the literature (Dickey and Blumberg, 2004; Atanasio et al., 2020a) we divide the first four domains into externalising (conduct and hyperactivity), and internalising (peer and emotional). We also use the pro-social scale, which might arguably be expected to be particularly sensitive to contexts with more rather than fewer other children (cf. Cappelen et al., 2020). To ease presentation and comprehension of estimates, we reverse-code externalising and internalising scores so that all three measures have a consistent interpretation: a higher score represents fewer problems or better socio-emotional adjustment. The scores are standardized with mean equal to zero and standard deviation equal to one.

We focus on parental reported SDQ as an outcome at 5y, when pupils start school but we also use parent report of SDQ at 3y in our cumulative value-added models, and we use the subset of respondents for whom we have teacher report of SDQ at age five as a robustness check (see further below). Given that our interest in non-cognitive skills at 5y is predicated on their implications for subsequent cognitive and non-cognitive development we test whether there is any correlation between socio-emotional skills measured with the SDQ at 5y and educational attainment at age 9 (the latest wave available in which we can observe our sample and for which we have measures of academic attainment and skills). Table A4 shows the association of each

socio-emotional skill at age 5 with whether the child performs above average four years after starting primary school. We see that more positive internalising and externalising behaviours are positively correlated with faring well in all sorts of subjects. For example, a 1 standard deviation higher externalising behaviour at age 5 is associated with a higher probability of faring above average in writing in Irish by 6.1 percentage points (pp) (17% relative to the mean) and in mathematics by 8.5pp (15% relative to the mean). For socio-emotional skills to have an impact on attainment we would assume that this goes through their influence on several personality traits, such as being persevering, being able to concentrate when needed, as well as some behaviours, such as not being disruptive in the classroom and doing their homework. In Table [A5](#) we test whether this is the case. We see that externalising behaviour in particular has a strong and statistically significant relationship with a set of traits which are positively correlated themselves with educational attainment. This is not as much the case for the other two skills domains, internalising and prosocial behaviour. For example, a higher (by 1 standard deviation) externalising behaviour score is positively associated with being interested by 8.4pp (10% relative to the mean), being able to concentrate by 10.3pp (16% relative to the mean), and being persevering by 10.7pp (17% relative to the mean). On the other hand, better externalising behaviour is negatively associated with being undisciplined by 3.6pp (180% relative to the mean) and not completing homework by 3.6pp (22% relative to the mean).

### 5.3 Type of childcare and its characteristics

We consider childcare to be centre-based if it is a work-based creche (8.9%), nursery (86.5%), Montessori (2.4%), playschool, pre-school, and Naoinra (2.2%). All other non-institutional arrangements involve a relative or non-relative, either in their home (36.6% and 33.5%, respectively) or in the child’s home (17.3% and 12.6%, respectively). Thus, the main counter-factual that we use for identifying the effect of CBC is a non-parental adult in the carer’s home (70.1%

of non-CBC). This will tend to be equivalent to a 1:1 adult/child ratio compared to the 1:3 to 1:8 ratio mandated in CBC. This is important to bear in mind when interpreting the results and comparing them with the existing literature. We discuss this point further in Section 8. About 32% of working mothers made use of CBC when their child was 9 months old. There is high persistence in type of childcare: three-quarters of these children remained in the same type of childcare at age 3.

Table A2 shows the main characteristics of the type of childcare. The average number of children is larger in CBC compared to informal care. For 36% of children in non centre-based settings there are no children cared for with them. This is never the case for those children in CBC; about 80% of them are in a setting with 4 or more other children. Those choosing informal care are more likely to cite quality of care as the main reason for their choice. CBC is more expensive, but this is partly because it is used for more days and hours than other types of childcare. Correspondingly, while financial constraints are an important consideration in the type of childcare chosen, that is equally true for those selecting CBC as for those selecting other forms of non-parental care.

For childcare at age 3 we have some information on the way parents perceived the childcare used, see Figure 1. It is interesting to see that CBC is perceived as offering more activities and toys and is associated with greater learning (of letters and numbers). However, child happiness and the carer's knowledge of the child does not seem to differ by type of childcare.

Turning to the relationship between childcare and socio-emotional skills, Figure 2 shows the cumulative density functions of the non-standardized score of each measure of socio-emotional skills at 5y by type of childcare. If anything, it appears that those who were in CBC have slightly worse outcomes (more skewed to the left) in terms of external and pro-social behaviour but not in internalising skills. When, however, we tested the equality of the two distributions with the Kolmogorov-Smirnov test, we failed to reject equality at conventional statistically significant levels.

It could be that CBC has no effect on socio-emotional skills; but, clearly, these figures do not take into account that children and households with certain characteristics are more likely to choose institutional childcare. Hence, it could also be that the effect of CBC is cancelled out by the type of family that selects into it. This would be the case if CBC has a positive effect but those more likely to choose it are negatively selected, or, if CBC has a negative effect but those more likely to attend it are positively selected. To estimate the effect of childcare on socio-emotional skills, we therefore need an approach that tackles this selection issue. By using several econometric methods, we find supportive evidence for the latter.

## 6 Results

### Childcare at 9 months: naive model, PSM and IPW

Table 1 reports the estimated coefficients of interest in Eq. 1,  $\alpha_2$ . In the first column there are no other control variables than those reported in the table. In column 2 we condition on pregnancy-related characteristics and several maternal socio-demographic characteristics (measured at 9m); we then (column 3) add the characteristics related to economic situation of the household (measured at 9m), and finally, in the fourth column we add the reasons why that type of childcare was chosen. Looking at column 1, CBC at 9m is positively associated with internalising behaviour and negatively with externalising and pro-social behaviour, although the relationship is statically significant only for the latter outcome. However, when we condition on a rich set of characteristics in the most complete specification (column 4) the only coefficient that is statistically significant is that for externalising behaviour where we also have an increase in the magnitude of the effect from about 0.9 to 0.14 standard deviations (SD henceforth). Interestingly, when we introduce pre-natal and maternal characteristics as controls in specification 2, we find a statistically significant effect on externalising behaviour, as the coefficient increases

in magnitude while the standard error only slightly decreases (specifications 2-3) or remains unaltered (specification 4) compared to specification 1, where we have no controls. This suggests that children with similar birth conditions and maternal characteristics develop different externalising skills depending on the type of childcare.

We then implement two different methods relying on the CIA, PSM and IPW, to estimate the correlation between CBC at 9m and SDQ at 5y. In Figure 3 and Figure 4 we report the estimated density of the predicted probabilities that a child in non-CBC is in CBC (untreated) and that a child in CBC is in CBC (treated), i.e. the propensity score  $p(x) \approx Pr(D = 1|X = x)$ . There is very good common support: the probability mass is not too close to 0 or 1 and the two estimated densities overlap with each other where they have most of their respective masses (Busso et al., 2014). This makes us confident that the overlap assumption is not violated and so we can safely identify the ATE, ATT and ATC, by conditioning on  $X$ , which requires that  $0 < p(x) < 1, \forall x$ . After implementing matching in the PSM and applying the weights in IPW, the overlap of the two densities substantially improves, especially in the IPW case.

Table 2 shows that by using PSM, we find a negative correlation of CBC at 9m with externalising behaviour of 0.11 SD statistically significant at 1% and with prosocial behaviour of 0.09 SD statistically significant at 10%. Note that the sample is reduced by about 35% when using this method with the restriction on common support (more than half of non-CBC observations are dropped and only 2 CBC observations are dropped), given that we want to make children not using CBC as similar as possible to those using CBC. The results on externalising behaviour are similar when using IPW. CBC at 9m is associated with a decrease in externalising behaviour of 0.14 SD, statistically significant at 1%.

When comparing the effect sizes of ATE, ATT and ATC in the IPW analysis we see that larger effects are found among those untreated, followed by the average effect and the effect on the treated (ATC > ATE > ATT). This suggests that there might be heterogeneity in the returns to CBC, such that those that do not select into it are those that would be more affected. This

is comparable to the finding of [Cornelissen et al. \(2018\)](#). However, by contrast with [Cornelissen et al. \(2018\)](#), in our study the consequences of selecting into CBC are negative. For [Cornelissen et al. \(2018\)](#) not participating in childcare is detrimental for those more likely to avoid it, whereas for our sample those not participating in CBC benefit from that choice. This can perhaps be explained by the fact that our sample is composed of children in non-parental care, which we have shown to be a relatively advantaged segment of the population, compared to those who remain in parental care. The untreated sample of [Cornelissen et al. \(2018\)](#) instead comprises those children in parental care, who are, on average, more socioeconomically disadvantaged ([Hermes et al., 2021](#)). Moreover, [Cornelissen et al. \(2018\)](#) compare the impacts of parental care vs. non-parental care on cognitive and motor skills, and health, rather than on non-cognitive skills, and for a country (Germany) which appears to demonstrate positive consequences of CBC.

This first set of results shows that there is a statistically significant negative association between CBC at 9m and externalising behaviour of about 0.11-0.14 SD. These effects are not negligible as they are equivalent to 44% of the gap in externalising behaviour between children with a mother with a degree versus those with a mother without a degree. It is worth noting that the magnitude is similar to that found in other contexts. For example, [Drange and Havnes \(2019\)](#) find that infants in public childcare perform better on language and mathematics tests by 0.16 and 0.11 SD, respectively. In their setting, this was equivalent to half the gap between children from high- and low-educated parents.

## Cumulative and cumulative value-added models

We now turn to our preferred cumulative and cumulative value added models. Panel I in Table [3](#) shows that exposure to CBC at 3y is negatively associated with both internalising and externalising behaviour by 0.13 and 0.12 SD, respectively. CBC at 9m is not statistically significantly associated with socio-emotional skills when conditioning on CBC at 3y. Panel II

shows the results of the specification where several dummies describing the extent to which children have been exposed to CBC are regressed on socio-emotional skills. A long exposure to CBC (i.e. at 9m and 3y) is negatively associated with both externalising (0.18 SD) and prosocial behaviour (0.11 SD) vs. not being exposed at all. CBC at 3y only is also negatively associated with externalising behaviour (0.13 SD).

Once we include past skills as controls in panel III of [3](#), the precision of the estimates of CBC on externalising behaviour at 3y and prosocial skills at 9m increases. CBC at 3y negatively impacts externalising behaviour at 5y by 0.11 SD, statistically significant at 5%, and CBC at 9m decreases pro-social behaviour by 0.11 SD, although this is only marginally statistically significant.

As we would expect there is a high persistence in socio-emotional skills between age 3 and 5, as past skills explain between 0.38 and 0.49 SD of current skills (these estimates could be downwardly biased due to the measurement error issue discussed above). The coefficients of lagged skills at age 9m show that these are not systematically correlated with skills at 5y. This could be due to them capturing other dimensions than the outcome of interest (they are retrieved from different types of questionnaires than the SDQ) or substantial measurement error in skills when children are very young.<sup>5</sup>

The cumulative value added (CVA) model provides estimates that bring us the closest possible to a causal interpretation, since they take into account the issue of unobservables by including the lagged values of type of childcare and of socio-emotional skills.<sup>6</sup> From these model results we conclude that CBC at age 3 is negatively associated with externalising skills at 5y

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<sup>5</sup>These variables become indeed only slightly more important in explaining SDQ at 5y if SDQ at 3y is not included in the regression. This is consistent with the low correlation of ICQ and ASQ with SDQ at 3y seen in [Table A3](#)

<sup>6</sup>We cannot test the robustness of these estimates by instrumenting the lagged values with a further lag, as some other studies do ([Del Bono et al., 2016](#); [Anderberg and Moroni, 2020](#)), since we do not have sufficient time periods to do so. It is reassuring, however, that those papers that implement this check find that estimates do not change with the instrumented lagged outcome. We subject our estimates, instead, to a range of other robustness checks and tests, as discussed below.

and that any effects at nine months work through continued exposure up to and including age 3.

## Heterogeneity

As discussed, research has shown that childcare type can affect different groups of the population in different ways, although the directions of the effect depends on the country studied (Felfe and Lalive, 2018; Fort et al., 2020; Cornelissen et al., 2018; Havnes and Mogstad, 2011). We hence investigate whether there are any differences in the effect of CBC by maternal education, a relevant proxy for socio-economic position. Given high levels of tertiary-educated women in Ireland (CSO, 2017), we distinguish mothers with a degree from those with upper secondary education or less. In our selected sample of working mothers, 53% have a higher education degree. Figure A1 shows that children in more educated households exhibit on average better internalising and externalising behaviour, but no difference is found for pro-social behaviour. The results for the cumulative value added specification are shown in Table 4. We observe that the main effect of education is not statistically significant. However, it is important to note that, because we also control for a range of other maternal and family characteristics, including maternal age, income, social class and housing tenure, the estimates for education comprise only the direct effect, not the indirect effects that are mediated by these other measures. The interaction of CBC with an indicator of whether the mother has a degree shows that those children with a mother with no tertiary education are more negatively affected by the use of CBC at 9m in terms of externalising behavior by 0.24 SD compared to children with a more educated mother. This is statistically significant at 5% level.<sup>7</sup> We can speculate that this results from more educated families accessing better quality of CBC than their counterparts and this is relevant especially when children are very young. Indeed, the coefficient of CBC at 9m for children

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<sup>7</sup>The fact that those less likely to be in CBC, children with mothers without a tertiary education, are those more affected by it is also consistent with the heterogenous treatment effects derived from the IPW.

with a mother with a degree is positive, although small and not statistically significant. At age 3, instead, the negative effect of the CBC on externalising behaviour does not statistically significantly differ between children with more and less educated mothers, suggesting that any initial quality advantage is outweighed by the cumulative effects of CBC relative to other forms of non-parental care.

## 7 Robustness and sensitivity checks

### Bounding

Our analysis shows a statistically significant negative relationship between the use of CBC at age 5 and externalising behaviour. We now test the likelihood of this association being driven by unobservable characteristics, and, thus, unlikely to be causal. We follow the method proposed by [Oster \(2019\)](#) which has been widely used in several studies for the same purpose (e.g. [Angelini et al., 2018](#); [Cattan et al., 2017](#); [Dahlen, 2016](#); [Hener et al., 2016](#)). This approach was developed in the spirit of [Altonji et al. \(2005\)](#) in which the extent to which observables can explain the variable of interest is exploited to infer what the impact of unobservables could be. A detailed description of the Oster’s method ([Oster, 2019](#)) used in this paper follows in the Appendix, Section [A1](#).

Table [5](#) shows that all estimates are robust to possible confounding bias as unobservables would need to be up to five times as important as the observables in order for omitted variable bias to explain away the results and reduce the coefficient of CBC to zero. We focus on the results of externalising behaviour as it is the outcome for which we consistently find statistically significant results. The unobservable characteristics would have to have 5.5 and 2.5 times the impact of the observables to nullify the effect of CBC at 9m and 3y, respectively. Furthermore, the CBC coefficients are very close to each other for extreme values of  $\delta$ , which reinforces the

robustness of these estimates to possible unobservables. When assuming that the unobservables have the same magnitude of the observables and their effect is in the same ( $\delta = 1$ ) or opposite direction ( $\delta = -1$ ) of the observables, the effect on external behaviour of CBC at 3y ranges from 0.079 to 0.129 SD and of CBC at 9m ranges from 0.086 to 0.088 SD. The estimated coefficients for CBC at 9m and 3y are within these bounds at 0.108 and 0.087 SD, respectively.

Overall, there is little evidence that the CBC estimates are biased by omitted variables correlated with both socio-emotional skills and CBC. This is particularly marked for externalising behaviour, which the analysis above has already shown to be very robust to different specifications.

## Intensity of childcare exposure

If what we find is truly an effect of type of childcare, it should be observed more among high users than among lower users of childcare. We replicate the analysis on sub-samples of mothers who were working consistently full-time or part-time when their child was aged 9m and 3y. Those mothers working full-time use on average 31.28 hours of childcare p/w and 4.25 days p/w. Part-time working mothers use childcare instead 22.57 hours p/w and 3.35 days p/w. Table 6 shows that the negative impact of CBC on externalising behaviour is found only for full-time working mothers, although it becomes less precisely estimated. Furthermore, we also see a negative and statistically significant effect on prosociability among the same sub-sample. These findings reassure us that the estimates of the cumulative value added model actually capture the effect of childcare and are consistent with the literature showing that more intense (full-time compared to part-time) use of ECEC may exacerbate behavioural problems even if it aids cognitive development (Burger, 2010).

## Accounting for complementarity across different dimensions of socio-emotional skills

The estimates of the CVA in Table 3 do not allow for an influence of past socio-emotional skills other than those evaluated as 5y outcomes. However, we know that different skills interact and promote each other's development (Cunha and Heckman, 2007). We thus replicate the CVA model including all socio-emotional skills at 3y. For example, when the outcome is externalising behaviour, we additionally condition on internalising and pro-social behaviour at 3y.<sup>8</sup> Table 7 shows that the main findings do not change substantively. If anything, they are reinforced. In these models, CBC at 3y decreases externalising behaviour by 0.11 SD and CBC at 9m decreases pro-social behaviour by 0.12 SD, both significant at the 5% level. In addition, CBC at 9m now has a marginally statistically significant negative impact on externalising behaviour, it decreases it by 0.09 SD. Interestingly, only externalising behaviour at 3y is positively and statistically significantly associated with both the other dimensions of socio-emotional skills, i.e. internalising and prosocial behaviour, at 5y. This suggests that across the non-cognitive skills domains, externalising behaviour is the most relevant in determining overall socio-emotional skills, enhancing the relevance of our findings.

## Socio-emotional skills assessed by teachers

The SDQ is answered by mothers. However, we are able to test our results on the smaller sample for whom we have teacher report at age 5. This provides consistent results: see Table 8. CBC at 3y negatively impacts externalising behaviour at 5y by 0.16 SD. When using the teacher report, the negative effect on pro-social behaviour (0.12 SD) is also statistically significant. As this is not driven by the smaller sample for which this information is available, we adduce that

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<sup>8</sup>Including as controls other types of socio-emotional skills which are measured simultaneously with the outcome further allows to deal with possible contemporaneous feedback effect, e.g. parents reacting to contemporaneous outcomes.

this could be driven by teachers being more likely to observe occasions of social interactions in the classroom compared to the mother.

## Instrumental variable strategy

Finally, we implement an instrumental variable approach where we predict the type of childcare at age 3y with the type of childcare at age 9m.<sup>9</sup> We use a two stage-least-square (2SLS) estimator to obtain consistent estimates of the causal effect of CBC on socio-emotional skills. This approach accounts for the endogeneity of those characteristics fixed over time which affect the choice of type of childcare. In the first stage the probability of attending CBC at 3y is instrumented with the probability of attending CBC at 9m. Eq. 5 describes the second stage.

$$Y_{it1}^j = \Phi_1 + \Phi_2 \widehat{CBC}_{it0.5} + \sum_{t=0}^1 \Phi_{3t} Y_{it}^j + \Phi_4 X_{it0} + z_{it} \quad (5)$$

The coefficient of interest is  $\Phi_2$  which reports the type of childcare at age 3y instrumented with the one at age 9m. This specification allows us to control for past disturbances and so captures potential correlation between child outcome shocks (which are not observed by us) and childcare type. The exclusion restriction in our case is that the lagged value of childcare influences socio-emotional skills only through the most recent childcare type. To account for the fact that type of childcare at age 9m influences socio-emotional skills at age 5y through the direct influence on the same skills earlier in life, in both stages we control for socio-emotional skills at 3y.<sup>10</sup>

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<sup>9</sup>Bellemare et al. (2017); Reed (2015) support the use of the instrumental variable strategy when having a lagged value of the endogenous variable. For example, Reed (2015) shows that in case of endogeneity the instrumental variable strategy is preferred to the cumulative model conditional on the lagged variable satisfying the exclusion restriction and being a strong instrument.

<sup>10</sup>In this way the exclusion restriction that socio-emotional skills at age 5 are influenced by childcare type at age 9m through childcare type at age 3y only, should be satisfied. In other words, this approach takes into account any potential feedback effect, which is whether movement in type of childcare between 9m and 3y could be a possible response of parents to the effect of childcare at 9m on children socio-emotional skills. In an additional specification we also include several other characteristics measured at age 3 to check the robustness of our results

Table 9 shows that we have a relevant instrument. CBC at 9m is highly predictive of using it at 3y at the 1% level; and the F-statistic confirms that the instrument is not weak. The 2SLS estimates recover the local average treatment effect, or LATE, which tells us the effect of CBC for the compliers. In our case, it tells us the effect of a prolonged exposure to CBC as the effect is observed for those who have been treated at 9m and, hence, at 3y. We find, again, a negative effect of CBC at age 3y on externalising behaviour at 5y of 0.27 SD and a negative statistically significant effect on pro-sociality of 0.26 SD. By comparing the OLS estimates with those recovered from the 2SLS, we see that not accounting for selection leads us to underestimate the negative effects of CBC on externalising and prosocial skills, i.e. those children selecting into CBC are positively selected - which is consistent with the heterogeneity analysis and the treatment effects estimated in the IPW.

## 8 Possible mechanism: the teacher to children ratio

Our findings suggest that instead of promoting non-cognitive skills in a social context, early contact with other children in a more formal context is not beneficial for children’s externalising behaviour and (in some specifications) for pro-social behaviour when they start school. This is consistent with the literature suggesting that children gain more from informal family-based inputs (e.g. Baker et al., 2019), though it contrasts with some existing evidence on the pro-social benefits of formal programmes (Cappelen et al., 2020). Our findings are distinctive, however. We compare formal care with informal non-parental care, which is sometimes assumed to be of lower quality, partly because providers are less likely to be trained or regulated, rather than with parental care, where effects can be seen to be driven by parents’ direct investment in the children (Felfe and Lalive, 2018). Given this, our findings might seem somewhat counter-  
to possible other changes in characteristics between age 9m and 3y. This last specification is meant to check the robustness of our strategy to the independence assumption (necessary for interpreting the IV results as LATE, Angrist and Pischke, 2009) for which the IV should not be associated with latent outcomes or latent variables of interest, which means that the effect of the lagged IV should be similar to random assignment of CBC.

intuitive. A feature of CBC is that it exposes children from a young age to a rich, as well as more structured, social environment. However, at infancy other inputs, such as attachment (Bowlby, 1969) which could be developed in the more intimate environment of most forms of non-CBC care, may take precedence in aiding development of a range of skills, including social skills, among young children. There is ample evidence on the relevance of interaction with the main caregiver for child development (Eisenberg and Fabes, 1998; Kosse et al., 2020; Rogoff, 1990; Skinner, 1953). Our results, though, suggest that it is child care at 3y or cumulatively through 3y, rather than at 9m - the age when intimate care might be considered to be most important, when the consequences are felt. At the same time staffing ratios in CBC (and the carers themselves) change with the child's age, and it is arguably as toddlers rather than babies that the potential for carers to promote positive interactions with others becomes salient for subsequent socio-emotional development.

The adult/children ratio in Ireland in pre-school childcare is high relative to that in other countries such as Norway and Germany, but closer or equal to that in Italy and Quebec (see Fort et al., 2020). In this context, it is notable that our findings go in the same direction as Fort et al. (2020) and Baker et al. (2019), which are based in Italy and Quebec respectively, and contrast with those of Cornelissen et al. (2018), Felfe and Lalive (2018), and Drange and Havnes (2019), which are based in Germany and Norway. This lends initial support to the contention that it is the differences in the amount of attention from carers that is driving the effect of CBC on externalising behaviours in particular.

In our data we have some information which enables us to build a measure of teacher/pupil ratio within childcare settings at age 3y. This does, though, suffer from some drawbacks in its measurement which means it is not possible to use directly in our estimations.<sup>11</sup> Nevertheless,

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<sup>11</sup>The carer to pupil ratio is computed as a fraction of the two following variables: the number of supervising adults in main care room and the number of children in the room where the child is cared for. These variables are not available (questions not asked) for non-CBC carried out at the home of the child, as here the ratio is assumed to be 1:1. Furthermore, the former variable is truncated at 6 (6 or more adults) and the latter variable groups the range 10-14 at 10, 15-19 at 15, up to 30, where 30 means 30 or more. The final ratio variable is

from Figure 5 it is clear that in non-CBC the adult:child ratio is lower on average than in CBC. The large majority of children in non-CBC settings have a 1:1 or 1:2 ratio. The larger densities of the ratio in CBC settings is instead for the ratio 1 carer to 5 children or above. This is not surprising as, as described in Section 3, the regulated ratios for CBC are 1:3 for children under 1, 1:6 for children up to 3 years old, and rise to 1:8 above that age.

When regressing the ratio at age 3y on socio-emotional skills at age 5y (see Table 10) we see that a higher ratio (i.e. higher attention from the carer) is positively, albeit non-significantly, associated with better internalising and externalising behaviour, though negatively with prosocial behaviour. This provides indicative evidence supporting the contention that the lower carer:child ratio is one of the mechanisms driving our results on externalising behaviour.

## 9 Conclusion

Children’s early development of non-cognitive skills is important for their subsequent educational attainment and their acquisition of skills and behaviours that are shown to bring increasing rewards in the labour market. Researchers such as Heckman and others have emphasised the potential malleability of non-cognitive skills and the potential of ECEC for aiding their development and contributing to closing the gap in educational and occupational attainment between those from more and less socio-economically advantaged backgrounds. Yet, despite the expansion of ECEC, in large part driven by mothers’ increased labour market participation, research on its consequences for non-cognitive skills has been partial; and those studies that do exist have demonstrated positive, negative and null results depending on the study and the particular country concerned.

In this paper we argued that, in the face of increasing maternal labour market participation across Western countries, even those that have previously espoused a more traditional division

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additionally missing for 4.46% of the CBC sample and 1.04% of non-CBC (not at home) sample.

of labour, such as Ireland, the critical question to ask is not whether ECEC brings gains relative to parental care but whether the type of (non-parental) childcare matters for children’s development. In the face of continuing expansion of ECEC in many national contexts and the use of different forms of government subsidy, which can enable or reduce the choice of care for low-income families specifically, it is a policy-relevant question to investigate what types of ECEC are better or worse at promoting non-cognitive skills, and for whom. Ireland is an interesting case, as it has seen a rapid expansion of women’s labour force participation, with a corresponding recognition of the need to expand ECEC and, especially given it is among the most expensive in the OECD, to provide subsidies to support its use by lower income parents.

Using observational longitudinal data, with a rich array of individual and family measures, and implementing a range of estimation strategies, we demonstrated a negative effect of centre-based care relative to informal non-parental care on children’s externalising behaviour, and in many cases on their pro-social behaviour, at the beginning of their formal schooling. Once in school, children face a common, structured educational and social environment, in which, as we demonstrated, their level of pre-existing behavioural skills can help or hinder them from flourishing academically and behaviourally, thus putting in place virtuous or vicious cycles that may have long-term consequences well into their adult lives.

We implemented a range of estimation strategies and robustness checks to test the consistency of our findings to different specifications. Our finding on the negative consequences of CBC for externalising behaviours persisted across these estimations. Moreover, our cumulative model demonstrated that the effect was driven by the longer exposure to CBC, as experienced at age three years. We argued that the likely mechanism accounting for both the negative impact on externalising behaviour and its more marked impact at age 3 was likely to be, at least in part, the differences in carer-child ratios between CBC and other forms of non-parental care, which widen as the child gets older. In the Irish context the mandated level of care in CBC is one carer for every eight children by the time the child reaches age 3. The lack of individualised attention

for children, possibly alongside changes in caregivers as the children progress through the age groups, appears to reduce children's ability to learn to regulate their behaviour in desirable ways, with consequences for their behaviour as they start school.

While the analysis of heterogeneity in impacts only found enhanced negative effects for the children of lower-educated mothers at nine months, and no difference by age 3, higher educated mothers are more likely to select into CBC in the first place. Moreover, the findings suggested that those who did not select into CBC would have experienced more negative impacts on externalising behaviours had they not chosen otherwise. To the extent therefore that policy promotes the use of CBC for low-income mothers over other forms of childcare, it may risk increasing the gap in non-cognitive skills between more and less advantaged children at school entry and thus undermine the noted potential of ECEC to reduce inequalities. While our sample was restricted to (and can therefore only be generalised to) the, on average, more advantaged group of mothers who were in paid work when their baby was nine months old, not all mothers were equally well-off. Moreover, as mothers' labour supply is increasing across the board, with enhanced (and subsidised) ECEC being used explicitly to support it, our findings will be increasingly relevant to mothers in general.

Overall, ECEC, and CBC within that, plays an important role in facilitating mothers' participation in the labour market and can support children's development. We add to the literature that suggests that in a context in which child-carer ratios are relatively high, CBC may result in negative impacts on socio-emotional development relative to less structured care. There is likely no single optimal model for ECEC, and policy initiatives to enhance access to ECEC through a focus on specific forms of care need to recognise the potential consequences for children's non-cognitive skills of constraining maternal choice.

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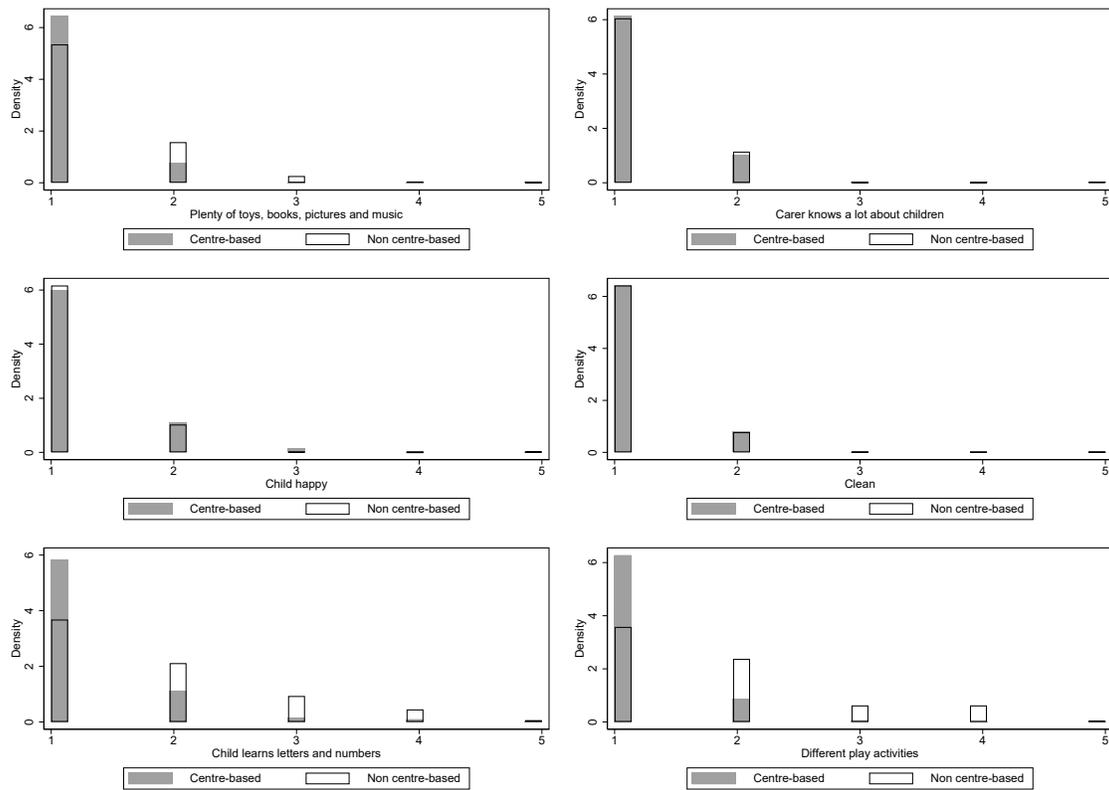
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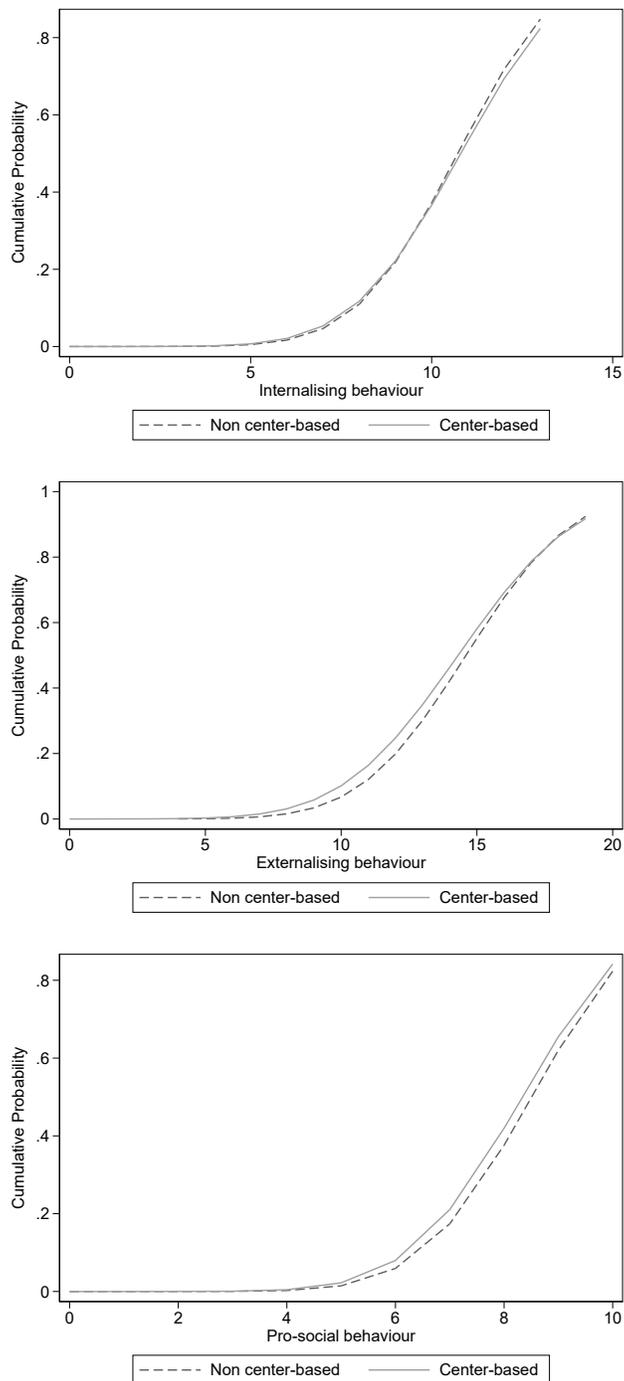
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Figure 1: Characteristics of childcare by its type



Notes: Characteristics by childcare type at age 3. 1 stands for “strongly agree” 2 for “agree” 3 for “either agree or disagree” 4 for “disagree” and, finally, 5 for “strongly disagree”. Based on the responses given by 84% of the sample.

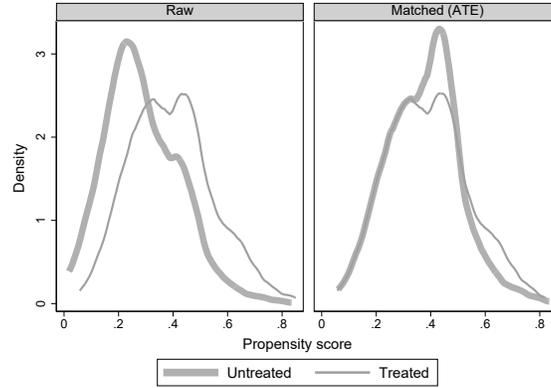
Figure 2: Cumulative distribution of the 3 domains of socio-emotional skills at age 5 by childcare type



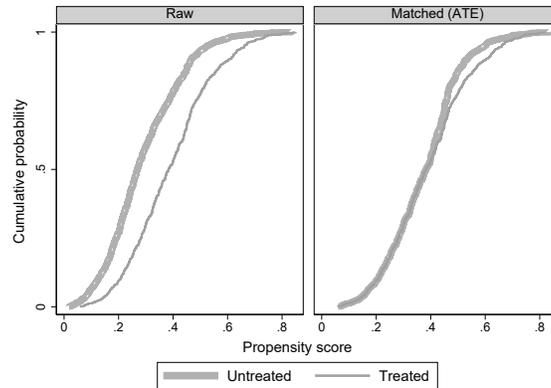
Notes: Childcare type measured at age nine months and socio-emotional skills measured at age five.

Figure 3: Alignment of propensity score densities after implementing PSM

(a) Normal



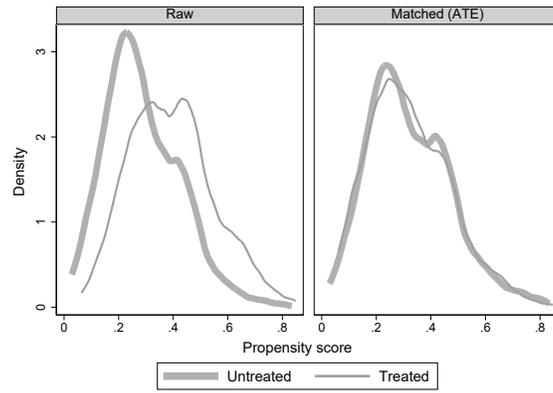
(b) Cumulative



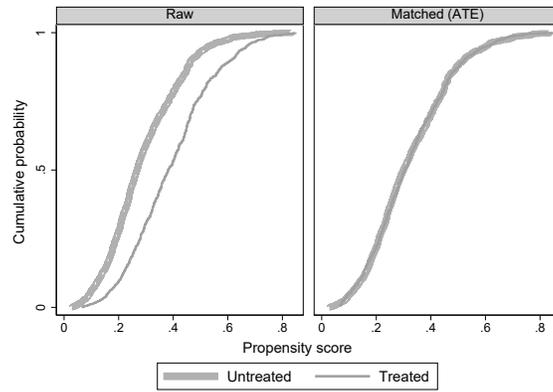
Notes: Covariates: main reason for choosing type of childcare, birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling.

Figure 4: Alignment of propensity score densities after implementing IPW

(a) Normal



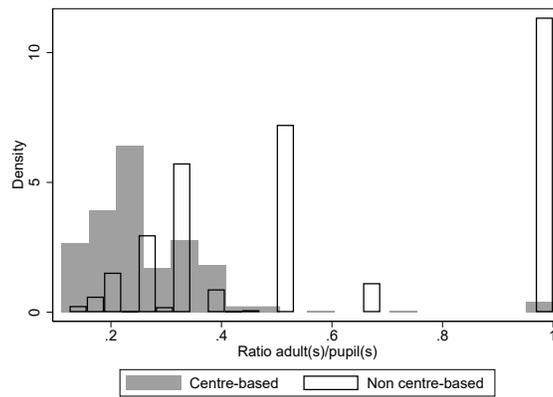
(b) Cumulative



Notes: As in Figure 3.

Figure 5: Ratio carer(s):pupil(s)

(a)



Notes: Section [8](#) describes of how this variable is constructed. This information is available when children are 3 years old for children in CBC and in non-CBC settings outside the child home.

Table 1: Association of socio-emotional skills at 5 years with CBC at 9 months

	(1)	(2)	(3)	(4)
	<b>Internalising behaviour</b>			
CBC <sub>9m</sub>	0.043 (0.053)	0.017 (0.051)	0.019 (0.051)	0.024 (0.051)
	<b>Externalising behaviour</b>			
CBC <sub>9m</sub>	-0.089 (0.055)	-0.132** (0.053)	-0.142*** (0.053)	-0.136** (0.055)
	<b>Pro-social behaviour</b>			
CBC <sub>9m</sub>	-0.148*** (0.053)	-0.127** (0.053)	-0.096* (0.054)	-0.084 (0.054)
Obs.	2,300	2,300	2,300	2,300
Pre-natal characteristics		Y	Y	Y
Socio-demographic char. mother		Y	Y	Y
Economic indicators			Y	Y
Main reason for childcare choice				Y

Notes: Childcare measured at age 9 months and socio-emotional skills measured at age 5. Covariates: main reason for choosing type of childcare, birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling. Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table 2: Estimates from propensityscore matching (PSM) and inverse probability weighting (IPW)

	PSM		IPW	
	Coef.	<i>Std. Err.</i>	Coef.	<i>Std. Err.</i>
<b>Internalising behaviour</b>				
ATE	0.010	<i>0.053</i>	0.040	<i>0.050</i>
ATT			0.000	<i>0.049</i>
ATC			0.059	<i>0.055</i>
<b>Externalising behaviour</b>				
ATE	-0.112**	<i>0.053</i>	-0.143***	<i>0.056</i>
ATT			-0.121**	<i>0.052</i>
ATC			-0.154***	<i>0.062</i>
<b>Prosocial behaviour</b>				
ATE	-0.088*	<i>0.053</i>	-0.049	<i>0.049</i>
ATT			-0.061	<i>0.050</i>
ATC			-0.044	<i>0.053</i>
Obs.	1,500		2,300	

Notes: Childcare measured at age 9 months and socio-emotional skills measured at age 5. Covariates: main reason for choosing type of childcare, birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling. ATE: average treatment effect; ATT: average treatment for the treated; ATC: average treatment for the control group. The sample is restricted to those observations on the common support for PSM. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table 3: Cumulative and cumulative value added (CVA) model

	<b>Int. beh.</b>	<b>Ext. beh.</b>	<b>Pro-soc. beh.</b>
Panel I: Cumulative model I			
CBC <sub>3y</sub>	-0.126** (0.063)	-0.116* (0.061)	-0.058 (0.058)
CBC <sub>9m</sub>	0.096 (0.064)	-0.070 (0.065)	-0.051 (0.063)
Panel II: Cumulative model II			
CBC <sub>9m,3y</sub>	-0.016 (0.056)	-0.182*** (0.061)	-0.114* (0.061)
CBC <sub>3y(only)</sub>	-0.181** (0.072)	-0.128* (0.069)	-0.041 (0.067)
CBC <sub>9m(only)</sub>	-0.075 (0.113)	-0.109 (0.118)	0.005 (0.100)
Panel III: Cumulative VA model			
CBC <sub>3y</sub>	-0.068 (0.056)	-0.108** (0.051)	-0.056 (0.052)
CBC <sub>9m</sub>	0.018 (0.059)	-0.087 (0.056)	-0.105* (0.055)
Outcome measured at 3y	0.379*** (0.025)	0.494*** (0.022)	0.443*** (0.025)
Personality traits at 9m:			
ICQ Fussy	-0.049* (0.029)	-0.049* (0.025)	-0.050* (0.026)
ICQ Unadptable	0.011 (0.027)	0.011 (0.023)	-0.016 (0.025)
ICQ Dull	-0.002 (0.022)	0.013 (0.021)	-0.034 (0.023)
ICQ Unpredictable	-0.046* (0.027)	-0.021 (0.025)	-0.031 (0.026)
ASQ total personal social score (8m)	-0.022 (0.038)	0.025 (0.030)	-0.010 (0.031)
ASQ total personal social score (10m)	0.041 (0.052)	-0.022 (0.044)	0.014 (0.048)
ASQ total personal social score (12m)	0.003 (0.041)	0.016 (0.036)	0.046 (0.039)
Obs.	2,300	2,300	2,300

Notes: Covariates: main reason for choosing type of childcare, birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother's highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling. The omitted category in Panel II is "never been in CBC". Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table 4: Heterogeneity

	<b>Internalising behaviour</b>	<b>Externalising behaviour</b>	<b>Pro-social behaviour</b>
CBC <sub>3y</sub>	0.034 (0.071)	-0.113* (0.060)	-0.056 (0.065)
CBC <sub>9m</sub>	-0.018 (0.070)	0.026 (0.063)	-0.112* (0.068)
CBC <sub>3y</sub> * <i>NoDegree</i>	-0.174 (0.111)	0.026 (0.096)	0.011 (0.099)
CBC <sub>9m</sub> * <i>NoDegree</i>	0.055 (0.118)	-0.241** (0.108)	0.006 (0.109)
NoDegree	0.059 (0.062)	0.001 (0.054)	-0.023 (0.060)
Obs.	2,300	2,300	2,300

Notes: As in Panel III of Table 3. An indicator on whether the mother has tertiary education is interacted with the dummy on whether care is centre-based. Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table 5: Bounding the CVA estimates

$\tilde{\beta}, R^2$	(1) $\hat{\beta}, R^2$	(2) $\beta^*$	(3) $\delta$ when $\delta = [-1, 1]$	(4) when $\beta^* = 0$
<b>Internalising behaviour</b>				
CBC <sub>3y</sub>	-0.106 <i>0.003</i>	-0.068 <i>0.230</i>	[-0.046 -0.083]	2.284
CBC <sub>9m</sub>	0.043 <i>0.000</i>	0.018 <i>0.230</i>	[0.004 0.028]	1.224
<b>Externalising behaviour</b>				
CBC <sub>3y</sub>	-0.159 <i>0.006</i>	-0.108 <i>0.357</i>	[-0.079 -0.129 ]	2.549
CBC <sub>9m</sub>	-0.089 <i>0.002</i>	-0.087 <i>0.357</i>	[-0.086 -0.088]	5.485
<b>Pro-social behaviour</b>				
CBC <sub>3y</sub>	-0.124 <i>0.004</i>	-0.056 <i>0.282</i>	[-0.018 -0.083]	1.356
CBC <sub>9m</sub>	-0.148 <i>0.005</i>	-0.105 <i>0.282</i>	[-0.080 -0.123]	2.695

Notes: The bounding approach (Oster, 2019) is described in Section A1. Column (1) and (2) show the estimated coefficient and  $R^2$  without and with controls, respectively. Column (3) reports the estimates of the coefficient when  $\delta$  is fixed to be equal to 1 and -1. Column (4) shows the value that  $\delta$  should have for the coefficient of interest to be equal to 0. Observations: 2,300.

Table 6: Sample restriction: full-time and part-time working mothers

	<b>Internalising behaviour</b>	<b>Externalising behaviour</b>	<b>Pro-social behaviour</b>
	Full-time		
CBC <sub>3y</sub>	-0.065 (0.099)	-0.154* (0.083)	-0.172** (0.084)
CBC <sub>9m</sub>	0.028 (0.100)	0.043 (0.084)	-0.089 (0.092)
Obs.	900	900	900
	Part-time		
CBC <sub>3y</sub>	-0.228 (0.183)	-0.082 (0.163)	-0.000 (0.190)
CBC <sub>9m</sub>	0.131 (0.199)	-0.104 (0.170)	0.061 (0.181)
Obs.	200	200	200

Notes: As in Panel III of Table 3. The sample is split in mothers who worked completely full-time and part-time in the first two waves of Growing Up in Ireland. Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table 7: Cumulative value added (CVA) model controlling for all SDQ dimensions at age 3

	<b>Int. beh.</b>	<b>Ext. beh.</b>	<b>Pro-soc. beh.</b>
CBC <sub>3y</sub>	-0.070 (0.056)	-0.106** (0.051)	-0.045 (0.051)
CBC <sub>9m</sub>	0.024 (0.059)	-0.094* (0.056)	-0.118** (0.054)
Socio-emotional skills at 3y:			
Int. beh.	0.363*** (0.026)	0.021 (0.022)	0.074*** (0.025)
Ext. beh.	0.115*** (0.026)	0.479*** (0.023)	0.042* (0.024)
Pro-soc. beh.	-0.039 (0.028)	0.035 (0.023)	0.417*** (0.026)
Personality traits at 9m:			
ICQ Fussy	-0.033 (0.028)	-0.049* (0.026)	-0.039 (0.025)
ICQ Unadptable	0.007 (0.026)	0.014 (0.023)	-0.009 (0.025)
ICQ Dull	-0.008 (0.022)	0.019 (0.021)	-0.031 (0.023)
ICQ Unpredictable	-0.037 (0.027)	-0.016 (0.025)	-0.024 (0.026)
ASQ total personal social score (8m)	-0.020 (0.038)	0.020 (0.030)	-0.020 (0.031)
ASQ total personal social score (10m)	0.042 (0.051)	-0.014 (0.044)	0.031 (0.048)
ASQ total personal social score (12m)	-0.002 (0.040)	0.007 (0.036)	0.030 (0.038)
Obs.	2,300	2,300	2,300

Notes: Covariates: main reason for choosing type of childcare, birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling. The omitted category in Panel II is "never been in CBC". Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table 8: Socio-emotional skills assessed by teachers

	<b>Internalising behaviour</b>	<b>Externalising behaviour</b>	<b>Pro-social behaviour</b>
CBC <sub>3y</sub>	-0.035 (0.064)	-0.157** (0.068)	-0.121** (0.061)
CBC <sub>9m</sub>	0.004 (0.070)	0.000 (0.071)	0.017 (0.067)
Obs.	2,100	2,100	2,100

Notes: As in Panel III of Table 3. The Strength and Difficulty Questionnaire is reported by teachers (when surveyed children are 5 years old). Weights to account for intra-waves attrition included. Robust standard errors in parenthesis.  
 $\ast \rho < 0.10$   $\ast\ast \rho < 0.05$   $\ast\ast\ast \rho < 0.01$ .

Table 9: Instrumental variable strategy

	<b>Internalising behaviour</b>	<b>Externalising behaviour</b>	<b>Pro-social behaviour</b>
2SLS estimates			
CBC <sub>3y</sub>	-0.049 (0.083)	-0.266*** (0.080)	-0.259*** (0.084)
First stage estimates			
CBC <sub>9m</sub>	0.577*** (0.021)	0.574*** (0.021)	0.574*** (0.021)
F-stat	763.6	761.7	759
Structural equation estimates			
CBC <sub>3y</sub>	-0.071 (0.046)	-0.157*** (0.042)	-0.123*** (0.045)
Obs.	2,300	2,300	2,300

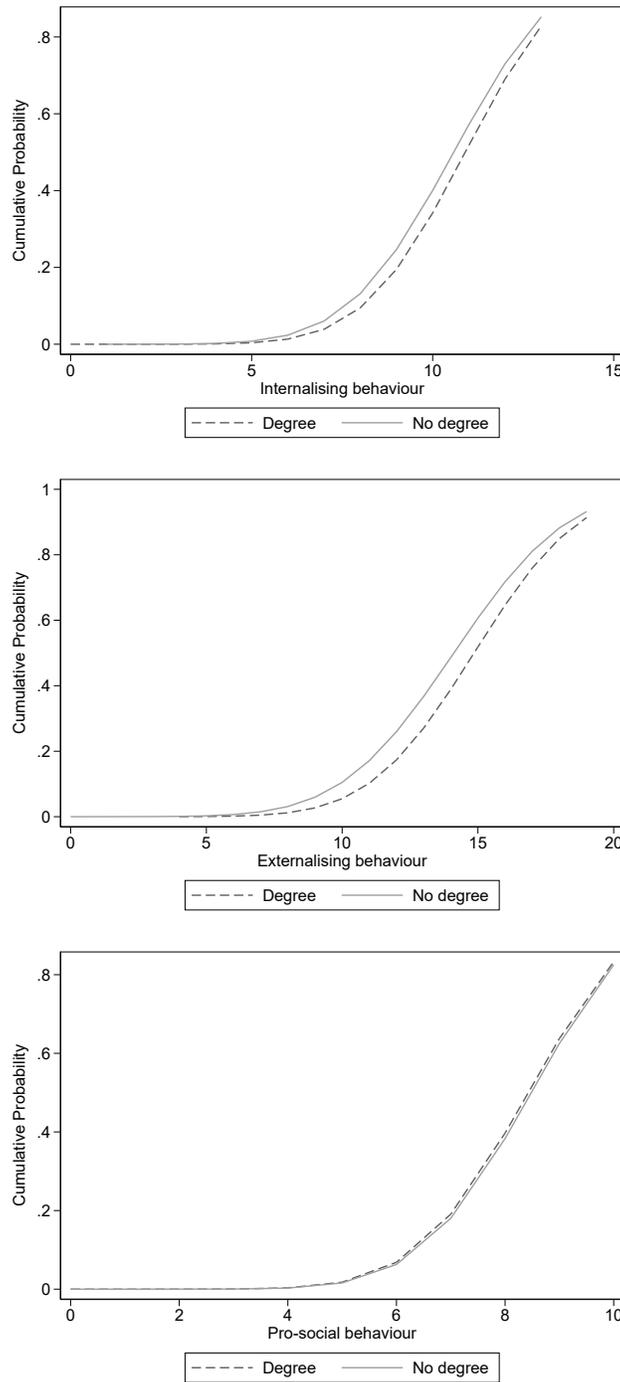
Notes: The first panel reports the estimates from a 2SLS method where whether the child is CBC at age 3 is predicted by use of CBC at age 9 months. The second panel shows the first stage results, including the F-statistics on the strength of the instrument adopted. The third panel report the estimated coefficient of CBC at 3 years when this is not instrumented. Covariates: main reason for choosing type of child-care, birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling, SDQ at age 3 years, skills at age 9 months. Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table 10: Teacher to pupil ratio

	<b>Internalising behaviour</b>	<b>Externalising behaviour</b>	<b>Pro-social behaviour</b>
Ratio	0.007 (0.051)	0.047 (0.044)	-0.031 (0.057)
Obs.	2,200	2,200	2,200

Notes: The teacher to pupil ratio is available when children are 3 years. Covariates: main reason for choosing type of childcare, birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling, SDQ at age 3 years, skills at age 3. Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Figure A1: Cumulative distribution of the SDQ at age 5 by mother's education



Notes: Whether the mother has acquired a tertiary education qualification when the child is nine months. The two-sample Kolmogorov-Smirnov test for equality of distribution functions shows that the internalising and externalising behaviour CDFs differ for children with a mother with and without an higher education degree at 1% level of statistical significance.

Table A1: Mother, child and household characteristics (%) when the child was nine months old, by sample

		Whole sample	Mums working at 9m Non-centre-based childcare	Centre-based childcare
<b>Children/birth characteristics</b>				
Birthweight	>=4 kg	19.93	20.47	19.49
	3.5-3.9 kg	38.01	39.55	41.64
	3-3.4kg	29.58	28.56	30.2
	2.5-2.9kg	8.78	7.95	6.86
	<2.5kg	3.69	3.47	1.81
Gestation term	PreTerm (<37GW)	4.59	4	3.13
	Term (37-41 GW)	83.67	83.58	84.72
	PostTerm (>41 GW)	11.74	12.42	12.15
Older siblings	Yes	60.14	51.98	49.7
Gender of child	Child sex			
	Female	49.14	48.74	45.49
<b>Mother characteristics</b>				
Age	40+	6.87	5.14	6.38
	35-39	28.09	26.27	33.45
	30-34	36.82	39.89	46.09
	25-29	19.98	22.51	12.03
	20-24	8.25	6.19	2.05
Ethnicity	Irish	83.48	90.43	92.66
	White other	11.39	7.09	6.14
	Other	2.47	2.48	1.2
Marital status	Married	71.21	72.49	79.9
	Sep/divorced	2.8	2.33	1.68
	Never married	25.99	25.18	18.41
Lone mother	Yes	9.5	7	2.53
Highest qualification	Tertiary	38.4	43.46	62.58
	Upper secondary	52.06	52.21	35.38
	Lower secondary or less	9.54	4.33	2.05
Health scale	1	31.92	35.32	35.74
	2	39.85	42.03	42.48
	3	22.5	19.47	17.33
	4	5.13	3.19	4.45
Currently miserable or depressed	Yes	9.39	6	7.46
<b>Household characteristics</b>				
Social class	Professional workers	19.98	21.28	35.26
	Managerial and technical	33.15	42.93	45.97
	Non-manual	16.99	24.18	15.52
	Skilled manual	12.9	6.95	2.05
	Semi-skilled	7.11	4.66	1.2
	Unskilled/Never worked	9.87	0	0
Equivalentised Household Annual Income quintiles	bottom fifth	16.71	5.81	2.77
	second fifth	16.65	10.47	5.9
	third fifth	18.37	19.37	13.72
	fourth fifth	21.8	33.84	27.32
	top fifth	19.96	25.04	46.57
	unknown	6.52	5.47	3.73
Has difficulty making ends meet	Yes	41.06	31.6	29.12
Housing tenure	Owner occupation	73.01	83.48	88.33
	Public (LA) rented	6.56	2.57	1.68
	Private rented	18.95	12.09	9.39
	Other	1.48	1.86	0.6
Observations		8200	1500	700

Table A2: Descriptive statistics of childcare characteristics by childcare type

	Non-centre-based	Centre-based
Number of other children in care setting (%)		
0	35.99	0
1	26.82	3.34
2-3	26.2	12.07
4-9	10.71	49.68
>9	0.29	34.92
Travel distance (%)		
0-9 mins	48.69	44.44
10-19 mins	33.56	36.47
>19 mins	17.75	19.09
Main reason of choice (%)		
Only one affordable	3.72	1.56
Convenient to my home	11.16	16.73
Linked to my job	1.1	4.57
Quality of care provided	72.87	61.49
Only one available	3.2	5.66
Other	7.96	9.99
Determined by financial constraints (%)		
Completely/Large extent	14.65	10.83
Some degree/A little	33.3	38.63
Not at all	52.05	50.54
Pay p/w (%)		
<=49	33.27	3.75
50-90	22.3	12.83
100-200	44.43	83.42
Hours p/w	24.28	30.68
Days p/w	3.57	4.13
Obs.	1500 (68%)	700 (32%)

Notes: Characteristics of centre-base and non-centre-based childcare at age 9 months.

Table A3: Correlation of SDQ at 3y with measures of skills at 9m

9m → 3y ↓	ICQ				ASQ		
	Fussy	Unadaptable	Dull	Unpredictable	8m	10m	12m
<b>Int. beh.</b>	-0.165	-0.168	-0.073	-0.167	0.069	0.065	0.072
<b>Ext. beh.</b>	-0.224	-0.102	-0.021	-0.185	0.042	0.059	0.074
<b>Pro-soc. beh.</b>	-0.112	-0.103	-0.166	-0.121	0.090	0.133	0.131

Notes: ICQ stands for "Bates' Infant Characteristics Questionnaire" and ASQ for "Ages and Stages Questionnaire".

Table A4: Socio-emotional skills at age 5 and educational attainment at age 9

	Speak/ listen Eng.	Speak/ listen Irish	Read Eng.	Read Irish	Write Eng.	Write Irish	Science	Maths
<b>Internalising beh.</b>	0.065*** (0.018)	0.053*** (0.015)	0.043** (0.018)	0.042*** (0.016)	0.048*** (0.018)	0.040*** (0.015)	0.055*** (0.017)	0.041** (0.018)
<b>Externalising beh.</b>	0.097*** (0.019)	0.076*** (0.017)	0.074*** (0.020)	0.061*** (0.017)	0.087*** (0.017)	0.062*** (0.016)	0.101*** (0.017)	0.085*** (0.018)
<b>Prosocial beh.</b>	0.037** (0.017)	0.017 (0.015)	0.028 (0.018)	0.030* (0.016)	0.023 (0.017)	0.025* (0.015)	0.018 (0.017)	-0.011 (0.018)
Obs.	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Mean Y	0.646	0.382	0.614	0.355	0.496	0.311	0.505	0.574

Notes: Covariates measured when child is 9 months: birth weight, gestation, whether there are older siblings, child's gender, mother age, mother ethnicity, mother marital status, whether lone mother, mother highest qualification, mother health status, whether mother depressed, household social-class, earning quintile, house tenure status, whether financially struggling, personality traits; teacher's experience (years in teaching). Weights to account for intra-waves attrition included. Robust standard errors in parenthesis. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

Table A5: Socio-emotional skills at age 5 and attitudes and behaviour at school (age 9)

	Interested	Involved	Independent	Motivated	Confident	Concentrates	Perseverant	Undisciplined	NoHomework
<b>Int. beh.</b>	0.015 (0.017)	0.027 (0.018)	0.015 (0.018)	-0.011 (0.018)	0.055*** (0.018)	-0.010 (0.019)	0.014 (0.019)	-0.006 (0.010)	0.003 (0.016)
<b>Ext. beh.</b>	0.084*** (0.018)	0.082*** (0.017)	0.096*** (0.018)	0.089*** (0.018)	0.062*** (0.019)	0.103*** (0.018)	0.107*** (0.018)	-0.036*** (0.012)	-0.036*** (0.017)
<b>Pro. beh.</b>	0.076*** (0.016)	0.047*** (0.016)	0.041** (0.017)	0.037** (0.017)	0.042** (0.018)	0.022 (0.017)	0.038** (0.018)	-0.011 (0.009)	-0.023 (0.014)
Obs.	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Mean Y	0.823	0.811	0.675	0.715	0.682	0.629	0.614	0.020	0.162

Notes: As in Table A4. \* $\rho < 0.10$  \*\* $\rho < 0.05$  \*\*\* $\rho < 0.01$ .

## A1 Selection on unobservables: estimating bounds

The method developed by [Oster \(2019\)](#) uses both information on changes in coefficients and R-squared values once all controls are included to bound the values for the treatment effect. Following this method, we first estimate the scaling parameter  $\delta$  which tells us the relationship between the endogenous variable and the linear combination of unobserved control variables by extrapolating it from the relationship of the endogenous variable with the observables.

$$\frac{Cov(CBC, \widetilde{W}_2)}{Var(\widetilde{W}_2)} = \delta \frac{Cov(CBC, W_1)}{Var(W_1)} \quad (6)$$

where  $\widetilde{W}_2 = W_2 - e$  is the residual variation in socio-emotional skills that cannot be explained by CBC and the observables  $W_1$ .<sup>12</sup> Thus, we know how much CBC is explained by observables vs. unobservables, although the latter is derived from the correlation of CBC with the control variables in  $W_1$ . The second parameter necessary to derive the unbiased estimate of CBC is the highest possible value of the R-squared,  $R_{max}$ . This is not identified, as it would require regressing socio-emotional skills on observables, which is possible, and on unobservables, which is not possible. However, Oster provides a useful bound (derived from analysing several RCTs) i.e.  $R_{max} = \min(1.3 \times \tilde{R}, 1)$ , which we use for our estimates.

The unbiased estimate is then derived by combining all these pieces of information:

$$\beta^* \approx \tilde{\beta} - \delta(\dot{\beta} - \tilde{\beta}) \frac{R_{max} - \tilde{R}}{\tilde{R} - \dot{R}} \quad (7)$$

where  $\tilde{\beta}$  represents the coefficient in CBC in a model with no controls,  $\dot{\beta}$  represents the CBC coefficient in a linear regression on socio-emotional skills with an intercept, and  $\tilde{R}$  and  $\dot{R}$  are the respective R-squared.

Table [5](#) shows the results when we implement the Oster's procedure on the CVA. It shows

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<sup>12</sup>Assuming  $Cov(CBC, e) = 0$ ,  $Cov(W_1, e) = 0$ , and  $Cov(\widetilde{W}_2, e) = 0$ .

$\hat{\beta}$  and  $\tilde{\beta}$  with their associated  $R^2$ s. It then shows estimated  $\beta^*$  when  $\delta = 1$  and  $\delta = -1$  that is when the unobservables are assumed to have the same effect in terms of magnitude of the observables (1) and affect the the estimated coefficient of interest towards the same (+1) as the opposite (-1) direction. The final column tells us how big should  $\delta$  be to nullify completely the treatment effect.