**The London School of Economics and Political Science**

# Who cares for our children matters: Early maternal employment, early childcare, and child development in Chile

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## DECLARATION

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others.



I declare that my thesis consists of 81,137 words

## ABSTRACT

Worldwide, non-maternal care during the first years of life has gradually become more prevalent. However, there is little evidence about the effect of non-maternal care—especially for under-three-year-olds—on child development. Hence, this thesis explores the association between both maternal employment and type of care at different stages during children's first three years of life and child development in Chile. My results indicate that there is evidence that maternal employment during the child's first year of life is detrimental to child development and that delaying maternal employment initiation decreases this detrimental effect on child development. On the other hand, the type of care that the child attends during this first year of life also matters. First, children who are looked after by their grandparent during their first year of life exhibit a positive association with child cognitive and socio-emotional development relative to exclusive maternal care. Second, there is a negative association between relative care and child cognitive and socio-emotional development compared to exclusive maternal care. Third, there is a positive association between centre-based care and child cognitive development and a slightly positive association with child socio-emotional development. Finally, controlling for unobserved and fixed child characteristics, I analyse whether the positive association between centre-based care at 6 to 12 months old and child development is also observed on children who entered centre-based care between the ages of 24 and 36 months old. The association between centre-based care between centre-based care and child cognitive development is also positive and there is no significant association with child socio-emotional development. In each of my empirical chapters, I test whether child vulnerability define as lowly educated mothers, single parent and low income families, moderates the association between early non-maternal care and child development. Overall, the previously described associations are slightly more detrimental for more vulnerable children.

In my three empirical chapters, I use a novel Chilean longitudinal panel survey with waves in 2010 and 2012. To deal with selection bias, in two out three empirical chapters I control for an extensive set of child, mother and family characteristics using OLS regressions and propensity score matching techniques. In addition, in the last empirical chapter I control for (unobserved) individual fixed effects.

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| | |
|---|---|
| CASEN | Encuesta de Caracterización Socioeconómica Nacional |
| CCC | Chile Crece Contigo |
| ECD | Early Childhood Policies |
| ECEC | Early Childhood Education and Care |
| ELPI | Encuesta Longitudinal de la Primera Infancia |
| EPPE | Effective Provision of Pre-school Education |
| GDP | Gross Domestic Product |
| INTEGRA | Fundación Educacional para el Desarrollo Integral del Menor |
| JUNJI | Junta Nacional de Jardines Infantiles |
| OECD | Organisation for Economic Cooperation and Development |
| NGO | Non-governmental organization |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation |
| UNICEF | United Nations Children's Fund |

## A GLOSSARY OF TERMS

**Centre-based care**: Type of care for children between zero and five years, eleven months old delivered in a group setting where the teaching staff has formal studies in early childhood education. Governments generally regulate centre-based care.

**Childcare:** 'Indicates routine day care services for preschool children whose parents are at work.' (Gambaro, 2012 p. 85). In this paper, childcare includes all types of care regulated by governments such as centre-based care.

**Day care**: Centre-based care for children between two and three years eleven months old.

**Early childhood education and care (ECEC**): All educational and care arrangements for children from birth to compulsory schooling. ECEC is a government-regulated, non-parental care delivered in a group setting provided outside of the child's home that could include nursery, day care, centres, family day care, registered childminders, and preschool programmes. (Naumann, McLean, Koslowski, Tisdall, & Lloyd, 2013)

**Early childhood development policies (ECD):** Early Childhood Development (ECD) policies are concerned with ensuring young children have a good start in life. The goal of ECD policies is to boost child development. ECD policies target children from before birth to the age of eight years. A wide range of initiatives falls under the ECD umbrella, from working with families to changing systems that marginalise or neglect some children. ECD policies consist of a wide range of actions to support and strengthen the ability of families, communities, and institutions to care for and nurture children.

**Informal care:** Non-parental childcare in either the child's home or elsewhere, and provided by relatives, friends, neighbours, babysitters, or nannies. Informal care is generally unregulated (Naumann et al., 2013).

**Nursery.** In Chile, nursery is centre-based care for children between zero and two years old.

**Non-maternal care:** All types of care provided by adults who are not the child's mother. Non-maternal care implies informal care that could be relative, grandparent, or nanny care, and formal care that in the case of Chile is mainly centre-based care.

# Chapter 1

# Which type of care is best for infants and toddlers?

## 1.1. Motivation

Worldwide, non-maternal childcare during the first three years of life has gradually become more prevalent. Two reasons for this increase stand out: first, women's incorporation to the labour market and second, the evidence that childcare provision may enhance child development, particularly for disadvantaged children. Since the mid-2000s, family policies such as the extension of a wage-dependent parental leave benefit and the decision to gradually increase centre-based care provisions have been vigorously debated in Chile. The government has encouraged these family policies as a way to incentivize female employment that, in turn, Chilean authorities consider as key for tackling poverty. Chile's government also states that the aim of these family policies is to enhance child development and reduce social and to educational inequalities.

There is evidence that high quality early childhood education and care (ECEC) experiences improve child outcomes, increase future earnings and reduce later life inequality (Gertler, et al., 2014; Heckman & Raut, 2013; Ruhm & Waldfogel, 2012). Based on this, many governments are increasing their investment in early childhood education and care policies. When using the existing evidence to inform the policy debate in Chile, there are two main concerns. The first concern is that the previously cited evidence uses data from the USA, UK and other developed countries whose labour markets and centre-based care providers may differ from the same institutions in middle-income countries like Chile. Given that the quality and regulations of centre-based care are different in every country (Economist Intelligence Unit, 2012; EFA Global Monitoring Report, 2007), the effects of early childcare might vary across different contexts (Love et al., 2003).

The second concern is that there is no consensus in the literature about the benefit of ECEC for children under three years old (Gambaro, Stewart, & Waldfogel, 2014). Some studies have not found any association of maternal employment during the first year fof life with child development (Cooksey, Joshi, & Verropoulou, 2009). Other studies have found a detrimental effect of maternal employment during the child's first year of life on child development (Baum II, 2003; James-Burdumy, 2005), especially if mothers work full-time or the quality of centre-based care is low (Brooks-Gunn, Han, & Waldfogel, 2010; Han, Waldfogel, & Brooks-Gunn, 2001). In addition, most studies have found that maternity leave extensions have a neutral or slightly positive effect on child development (Baker & Milligan, 2010, 2011; Washbrook, Ruhm, Waldfogel, & Han, 2011). Finally, the evidence for the effect of attending universal centre-based care programs before three years old shows mixed results (Baker, Gruber, & Milligan, 2008; Barnes, Leach, Malmberg, Stein, & Sylva, 2010; Felfe & Lalive, 2012).

Before funding a substantial increase in centre-based care coverage or extending publicly paid parental leave, understanding how these policies are affecting younger children is important. In the context of changes in family policies and uncertainty about the impact of different types of ECEC on children under three, the aim of this thesis is to shed light on the optimal type and timing of care from the point of view of children's cognitive and socio-emotional development. More specifically, this thesis aims to fill the previously mentioned literature gap in middle-income country contexts and to contribute to the wider literature on what matters for children under three years old.

The structure of this introductory chapter is as follows. In the remainder of Section 1, I further explain the relevance of my research topic, detailing why early experiences during the first three years of life are important for child development and future educational opportunities. In Section 2, I give an overview of the effects of early childhood interventions such as maternal employment and early childhood care on child development. In Section 3, I provide context for Chilean early childhood policies and explain why the case of Chile is interesting to study. Finally, in Section 4, I present an outline of the thesis, including its research questions, methods, results and contributions and the structure of the thesis.

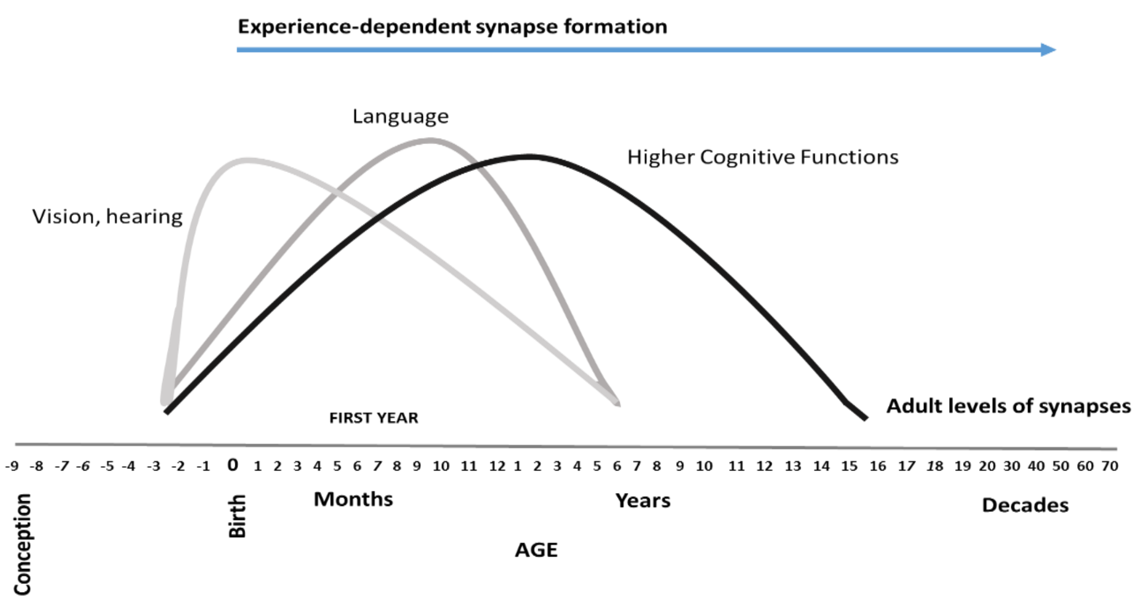
### 1.2. The importance of the type of care received by children aged zero to three

Different theories and frameworks may help us to understand the relevance of the effect of early childhood interventions on child outcomes. During the last two decades, evidence from neuroscience, psychology and the cost-benefit analysis of early childhood interventions jointly point out that children's first three years of life present unique opportunities to enhance child development. At the same time, the first three years of life is also a period of considerable vulnerability and early experiences may have repercussions over a lifetime. That is to say, the relationships and environment where children grow up matters and different early childhood interventions may boost or delay child development in different degrees.

### *1.2.1. The first years of life: key in children's development*

Given that critical aspects of children's brain architecture are forming, the first years of life form an essential stage for child development (Knudsen, 2004; National Scientific Council on the Developing Child, 2005; 2007a). Figure 1 provides a basic overview of the major events of brain development during the first years of a child. The first three years of life are especially important, because there is a window of opportunity to alter neuronal circuits just before they are mature and become more difficult to modify (Fox, Levitt & Nelson, 2010). During this period, it is possible to change some aspects of an individual's genetic plan and brain architecture. After this sensitive period, most of the neuronal connections are established. Even though these neural connections are susceptible to (limited) changes afterwards, it takes a greater amount of energy to alter them after the first three years of life (National Scientific Council on the Developing Child, 2007b).

**Figure 1.1. The Developmental Course of Human Brain Development**




Source: Thompson & Nelson (2001)

The interaction between genetic tendency and early experiences affect child development and, consequently, the child's future learning, behaviour and health (Fox et al., 2010; Meaney, 2010). On the one hand, positive, stable and nourishing experiences and environment should help developing a child's genetic potential (Shonkoff, 2010). For example, if a child has a positive relationship with a caregiver, she can develop the ability to form strong social relationships and manage stress in a healthy way (Liu et al., 1997). On the other hand, if a child's early experiences are negative, neglectful or stressful, this can produce disruption in her brain circuit development, limiting child development (Champagne, 2010; Grantham-Mcgregor et al., 2007). For instance, if a child suffers early stress, insufficient stimulation or limited social interactions, this can affect how the body copes with stress, producing physical problems (Champagne, Francis, Mar & Meaney, 2003; Liu et al., 1997; Meaney, 2010) and increasing the possibility of child mental health problems (Glaser, 2000; Loman & Gunnar, 2009; National Scientific Council on the Developing Child, 2005). Thus, the evidence summarized here suggests that early childhood presents a unique window of opportunity to boost child development using appropriate social policies.

### *1.2.2. Sensitivity and responsiveness of the caregiver is a key factor for healthy child development*

The most important influence on children's development during their first three years of life is the bond they form with the adults who care for them. During the first years of life, the caregiver's sensitivity and responsiveness are central for boosting child development. While the caregiver's sensitivity refers to how appropriate the care is to the individual child, the caregiver's responsiveness refers to how adaptive the care is to changes in the child's needs (Thompson, 2001; Waldfogel, 2006). Infants have a limited ability to regulate their feelings or control their emotions (LeDoux, 2000). Therefore, the role of a sensitive and responsive caregiver mediating the interaction between the child and the environment is critical.

A close attachment between caregiver and child ensures the protection and nutrition of the infant and, ultimately, her survival (Thompson, 2001). Ainsworth and Bowlby (1991) defined attachment as the progressive increase of sense of reciprocal emotional dependency between caregiver and child. Nurturing and stable relationships between the child and the caregiver are fundamental to healthy human development (National Scientific

Council on the Developing Child, 2004). A secure early attachment between child and caregiver provides a solid base for positive relationships with others, a good self-concept and promotes emotional development (Shonkoff & Phillips, 2000; Thompson, 2001). In a secure attachment, a child trusts that the caregiver will meet her needs and the caregiver responds appropriately and consistently to the child's needs. Hence, a secure attachment serves the child as a firm foundation ‘from which to explore the world and as a haven for safety’ (Ainsworth & Bowlby, 1991, p. 6).

In contrast, in an insecure attachment, the caregiver shows confusing and upsetting behaviours and does not answer consistently or competently to the child’s necessities. An insecure attachment may contribute to a child’s negative self-image, troubles in coping with stress (Nachmias et al., 1996; Thompson, 2001) and behavioural problems (Fearon, et al., 2010).

The kind of relationship is key not only in the development of child socio-emotional skills (Ashiabi, 2000), but also have an important role in the development of child cognitive skills (Jaffe et al., 2001; Jaffee, 2007). A stimulating interaction between the child and the caregiver can help enhance child learning. As Dalli et al. (2011) describe ‘learning and care are interrelated’. In addition, a sensitive and responsive caregiver fosters a child’s ability to control her emotions, which in turn aides the child’s cognitive development and learning (Bell & Wolfe, 2004).

Children’s caregivers are the main mediators between children and their environment and they are responsible for helping children to cope with their surroundings’ stressors. Hence, who cares for a child and the conditions under which the individual relationship with the main caregiver takes place are crucial.

### *1.2.3. The importance of a healthy and high quality environment in child’s development*

Beside a responsive and sensitive caregiver, the environment where this relation takes place matters. As children grow, they become more able to focus their attention on their environment, stressing the importance of healthy and rich environments to explore (Mathers, Eisenstadt, Sylva, Soukakou, & Ereky-Stevens, 2014).

Ideally, children's environment should be low-stress settings, which actively isolate children from experiencing 'toxic stress'[1]. In these type of settings, the child may better cope with changes and develop adaptive responses to stress (National Scientific Council on the Developing Child, 2005; Shonkoff, 2010). Hence, the settings of each type of care are crucial for child well-being. For example, children who attend centre-based care exhibit higher cortisol levels than children who do not attend centre-based care. This effect is particularly relevant for children under 36 months old (Vermeer & Vanijzendoorn, 2006; Watamura, Donzella, Alwin, & Gunnar, 2003).

The quality of centre-based care is key in the impact of this type of care on the children's levels of stress. Children in poor-quality centre-based care show larger increases in their cortisol levels compared to children in high-quality centre-based care (Gunnar, Kryzer, Van Ryzin, & Phillips, 2010; Vermeer & Vanijzendoorn, 2006). Vermeer & Vanijzendoorn (2006) speculate that the high level of cortisol in children that attend centre-based care is because the group setting is stressful for them. Gunnar et al., (2010) did not find an association between structural measures of quality (such as group size) and increases in children's cortisol levels throughout the day. However, they found that a centre-based care with an over-controlling style is associated with larger rises in children's cortisol levels throughout the day.

In addition, a recent UK report about the quality of early childhood education and care for children under three by Mathers et al. (2014) describes four key elements in a high quality care: first, a stable relationship with a sensitive and responsible caregiver. This implies low staff turnover and favourable ratios and group size. Second, a teaching style of child led learning. Third, a focus on communication and language. Fourth, a key element in high quality childcare is that the child has the opportunity to be physically active (Mathers et al., 2014).

### *1.2.3. Cost-benefit analysis of education interventions for children aged zero to three*

The first three years of a child's life represent a 'window of opportunity' for fostering child cognitive and socio-emotional development in a cost-effective manner. The existence of

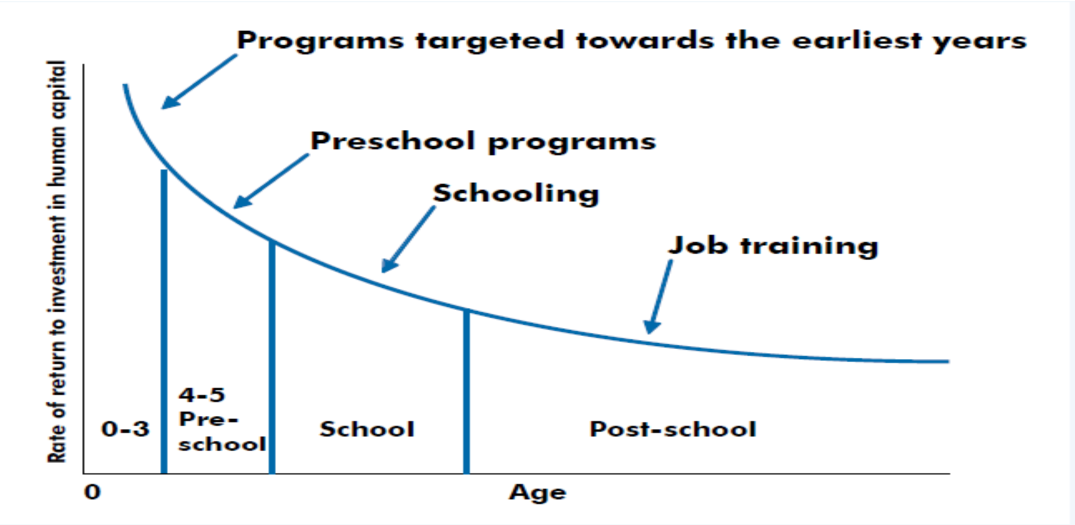
[1] Toxic stress could be caused by poverty, chronic neglect, severe maternal depression, family violence among other factors and it can harm the developing brain architecture, which can produce a lifelong problems in learning, behaviour, physical health and mental health (National Scientific Council on the Developing Child, 2005).

this 'window of opportunity' may explain to some extent the high impact on child development that some specific early childhood programs such as interventions like the US-based Carolina Abecedarian Program, the Chicago Child Parent Program, and the HighScope/Perry Preschool Program have had (Campbell, Ramey, Pungello, Sparling, & Miller-johnson, 2002; Nores, Belfield, Barnett, & Schweinhart, 2005; Reynolds, Temple, Robertson, & Mann, 2002).

Heckman (1999) suggests that it is important that interventions in the development of skills should be early in life and of high quality. A body of literature lead by economists provides insights about the factors that influence the accumulation of human capital over the life cycle and the key importance of early childhood interventions. One of the main findings is that early interventions on students from disadvantaged contexts obtain significant economic and social returns (Cunha, Heckman, Lochner & Masterov, 2005). In contrast, remediating early disadvantages later may be less cost-effective (Cunha & Heckman, 2007).

Heckman and Masterov (2007) concluded that investing in early childhood initiatives promotes positive effects in the long run – future effective learning, lower dropout rates, higher incomes and lower levels of crime. In other words, as shown in Figure 1.2, for the same level of investment at different ages, the return on human capital is higher when the investment is made at an earlier age (Heckman, 1999, 2006).

**Figure 1.2. Rate of return to human capital investment at different ages.**




Source: Cunha, Heckman, Lochner, & Masterov (2006)

The previous arguments about rates of return to education at different ages are part of the rationale that motivated governments across the world to invest in early childhood education. Governments, international agencies and non-profits have also used the arguments that disadvantaged children have most to gain to motivate investment for the sake of promoting equality of opportunity.

### 1.3. The importance of early childhood intervention to reduce initial inequalities

Early environments and experiences may help boost or stall child development. Children raised in poverty have greater exposure to stressful life events compared to non-poor children (Lupie, King, Meaney & McEwen, 2001). Unfortunately, recurrent stressful events have a detrimental influence on child development (Barnett & Belfield, 2006).

The evidence is clear that gaps in skills between children from advantage and disadvantage background start at a very early age (Cunha & Heckman, 2007; Feinstein, 2003). Surprisingly, the association between lack of resources and lagged development has been found as early as in six-months-old children (Kirksey et al., 1994). First, an unfavourable socioeconomic status is associated with poor cognitive performance (Santos et al., 2008; Smith, Brooks-Gunn, & Klebanov, 1997). Second, children living in poverty are more likely to experience learning disabilities and developmental delays compared to non-poor children (Brooks-Gunn & Duncan, 1997). Third, disadvantaged children have a higher probability of experiencing emotional and behavioural problems compared to non-poor children (Brooks-Gunn & Duncan, 1997). Four, children living in poverty have a higher risk of health problems such as low birth weight or malnutrition (Brooks-Gunn & Duncan, 1997).

The short-term development handicap observed in disadvantaged children described above is also associated with long-term disadvantages. Since poorer children develop more slowly compared to wealthier children in their early years (Taylor, Dearing, & McCartney, 2004), the former are at risk of under-developing the abilities they need to succeed in school (Duncan, Brooks-Gunn, & Klebanov, 1994).

Although there is a clear association between poverty and delays in child development, there is no consensus about the mechanisms by which a potentially causal impact may occur. The main factors mediating the effect of poverty on child development could be the type of relationship between the child and her caregiver, the child's environment learning resources, and the stress experienced by the child (Walker et al., 2007).

Children do not develop in isolation. Negative shocks on parental well-being negatively affects the quality of parental care (Repetti,Taylor & Seeman, 2002). Disadvantaged parents undergo irritability, depression, and anxiousness, which might provoke a more punitive type of parenting (Belsky, 1993). Lower-income children are more likely to have stressed, depressed or unresponsive mothers (Berger et al., 2009); in addition, mother's stress is associated with less responsive child caring (Goldstein, Diener & Mangelsdorf, 1996), which, in turn, has a negative association with child development. For example, maternal depression is associated with a child's lower cognitive performance at 18 months of age (Murray, Fiori-Cowley, Hooper, & Cooper, 1996) and less motor development between the ages of 28 and 50 months (Petterson & Albers, 2001) with respect to children whose mothers do not present depression.

Furthermore, low-income parents are less able to afford books and materials for cognitive stimulation with respect to high-income parents; hence, low-income parents engage less in educational activities with their children compared to their wealthier counterparts (Berger et al., 2009). For example, low-income children hear fewer words and are engaged in fewer extended conversations than affluent children (Farkas & Beron, 2004).

Living in poverty worsens the quality of a child's development environment. Consequently, in a context of lack of stimulation, early childhood intervention of high quality may compensate to a certain degree this deficit. In the following subsection, I discuss the evidence about the effects of early childhood intervention on child development.

### 1.4. The impact of maternal employment and early childhood care on child development

As I stated previously, early childhood is a crucial period to foster child development. At this age, children need a stable relationship with a sensitive and responsible caregiver and a low-stress and stimulating environment. Hence, I will now review the evidence about which type of care better responds to children's needs during the first three years of life.

### *1.4.1. Effect of early maternal employment on child development*

There is a large body of US- and UK-based literature on the effects of early maternal employment on child outcomes. The general consensus in this literature is that maternal employment during the first year of a child's life has a neutral or small negative effect on child development (Berger, Brooks-Gunn, Paxson, & Waldfogel, 2008; Bernal, 2008; Brooks-Gunn, Han, & Waldfogel, 2002; Brooks-Gunn et al., 2010; Han et al., 2001; James-Burdumy, 2005; Joshi et al., 2009; Ruhm, 2004).

The impact of maternal employment on child outcomes depends on several factors. The timing of maternal return-to-work matters for child development (Baum, 2004; Baum II, 2003; Baydar & Brooks-Gunn, 1991; Hill, Waldfogel, Brooks-Gunn, & Han, 2005; Ruhm, 2004; Waldfogel, Han, & Brooks-Gunn, 2002a) First, maternal employment initiation during the first year after childbirth is more detrimental for child development than initiating maternal work later (e.g. during the second or third year after childbirth) (Hill et al., 2005; Lucas-Thompson, Goldberg, & Prause, 2010; Waldfogel et al., 2002). Second, some studies suggest that there is a significant association between timing of employment initiation within the first year after childbirth and child development (Baydar & Brooks-Gunn, 1991; Han et al., 2001).

Maternal working hours are another important factor in the effect of early maternal employment on child development. Children whose mothers work full time during their first year of life tend to have more behavioural problems like aggression or impulsivity compared to children whose mother work part time during the same period (Berger, Hill & Waldfogel, 2005; Hill, Waldfogel, Brooks-Gunn, & Han, 2005; Waldfogel, 2006). On average, children develop better if their mothers do not work full time. Controlling for the quality of childcare, home environment, and maternal sensitivity, if mothers work 30 hours or more per week during the first nine months of her child’s life, this has been found to have negative effects on child development (Brooks-Gunn et al., 2002). However, part-time jobs or returning to work after the first year of a child’s life has been found to have positive or neutral effects on child development (Gregg, Washbrook, Propper & Burgess, 2005; Waldfogel, 2006).

In recent studies, Brooks-Gunn, Han & Waldfogel (2010) concluded that maternal employment during the first year of life has no an association on child development. They explain that early maternal employment has both negative and positive effects on child outcomes. Hence, considering the positive effect of early maternal employment on child development through higher maternal earnings and a richer home environment and the negative effect of early maternal employment on child development through childcare, Brooks-Gunn, Han & Waldfogel (2010) concluded that the overall effect of early maternal employment on child development is neutral.

One limitation of previous work is that—with a few exceptions—the research designs are unable to disentangle whether there is a true causal link in the associations found or whether the results are driven by selection of a certain type of mothers (e.g. more work-driven than most mothers) into early maternal employment. A handful of papers have taken steps to disentangle whether the associations imply a causal relation between early maternal employment and child development or these associations are driven by selection. For some examples see Carneiro, Løken, & Salvanes, 2010; Dustmann & Schönberg, 2012; Würtz-Rasmussen, 2010. These papers have used parental leave reforms to analyse the impact of maternal employment on child development.

Although the evidence is still thin, most researchers tend to conclude that increases in maternity leave do not have any significant effect on child development. One of the aims of increasing maternity leave is to improve infant and maternal well-being by enabling mothers to stay at home longer and prolong the exclusive care for their child during their first months of life. Baker & Milligan (2008) concluded that the extension of government-paid maternity leave in Canada in 2001 from six to twelve months did not have an impact on child development. Similarly, Liu and Skans (2010), using a Swedish reform that extended parental leave benefits from 12 to 15 months, did not found an effect on children's educational performance. Using data from Denmark, Würtz-Rasmussen (2010) also found no effect of an increase in government-funded parental leave from 14 to 20 weeks in 1984 on children's long-term educational outcomes.

To my knowledge, the only studies that have found a positive effect of extensions of maternity leave on child outcomes is the one by Carneiro, Løken, and Salvanes (2010). These researchers found that a reform in Norway that extended government-funded maternity leave for four months on average implied a decline of 2.7 percentage points in the high school dropout rate. In addition, Dustmann and Schönberg (2009) did find a small significant improvement in child outcomes (measured as grade attendance, grade repetition, track choice, and graduation from the highest school track) after an extension of government-funded maternity leave in Germany from two to six months in 1979 and from 18 to 36 months in 1992[2].

To my knowledge, there is no evidence about the relation between timing of maternal employment and child development in middle-income countries[3]. Therefore, the question about the optimal timing for maternal return-to-work is relevant but unanswered in middle-income countries. Female labour market participation, the flexibility for part-time employment and non-maternal care options are different in middle-income and developed countries. Hence, the impact of early maternal employment on child development in middle-income countries could be different compared to the same impact in developed countries.

### *1.4.2. The impact of non-maternal care on child outcomes*

When mothers return to work, children must start some type of non-maternal care[4]. Most of the evidence about the association between attendance at centre-based care (compared to exclusive maternal care) and child development is for children aged three to five years old and this evidence points to positive effects. For children under three years old, the evidence about the impact of non-maternal care on child development is thin and not conclusive. In general terms, the association between non-maternal care and infant cognitive development is either neutral or positive (Côté, Doyle, Petitclerc, & Timmins, 2013; Jaffee, Van Hulle, & Rodgers, 2011; Sylva, Stein, Leach, Barnes, & Malmberg, 2011).

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[2] Tanaka, (2005) found that an extension of 10 weeks of paid parental leave decreased child mortality in OECD countries. And, Baker & Milligan (2008) and Berger et al., (2005) found that increased in the length of maternity leave is associated with increased in the duration of breastfeeding. However, the effect of maternal employment policies on child health is out of the scope of my doctoral thesis.

[3] The evidence about the effect of maternal employment on child development in developing countries is scant and not focused on the first year of life. Most existing studies in this topic are descriptive. For example, Agustin and Gultiano, (2008) using the evaluation study of the Philippine Early Childhood Development Project dataset of 5,200 children aged 5-9 years studied the association between mother's employment and childhood development in the Philippines. They found that while maternal employment during the last four years before the survey had positive effects on the cognitive development (score on a nonverbal intelligence test) for the youngest boys in the sample (5 years old), it had no effect on girls or older boys (7-9 years old). In addition, Permani (2011), using data from Indonesia, concluded that there are no effects of maternal employment on children's health (7 to 14 years old).

[4] Non-maternal care implies all types of care provided by adults to children excluding the care provided by their mothers. Non-maternal care may be informal or formal.

Similarly, the association between non-maternal care (relative to exclusive maternal care) and child socio-emotional outcomes is unclear. Studies exploring this association using data from the USA conclude that children who experienced centre-based care during their first year show higher levels of externalising problems compared to children who experienced maternal care during the same period (Belsky et al., 2007; National Institute of Child Health and Human Development Early Child Care Research Network, 2000, 2003; National Institute of Child Health and Human Development., 2006; NICHD Early Child Care Research Network, 2004). By contrast, studies using data from other developed countries, found that centre-based care does not have a detrimental association with child socio-emotional development (Barnes et al., 2010; Borge, Rutter, Côté, & Tremblay, 2004; and Gupta & Simonsen, 2010 using data from England, Canada and Denmark respectively).

The evidence from developing and middle-income countries comes mainly from Latin America and is scarce and the results are ambiguous. Using data from Bolivia, Behrman, Cheng and Todd (2004) found a positive effect of childcare on cognitive and socio-emotional outcomes for children who had attended the program for seven or more months. Rosero (2012) concluded that a large-scale, centre-based early childhood program in Ecuador had no impact on child cognitive outcomes; in addition, evaluating the same program, Rosero and Oosterbeek (2011) found that home visits had a positive impact on child cognitive outcomes and health. In Chile, Seguel et al. (2007) reported no differences between the development outcomes of infants attending nursery and the outcomes of those who remained at home. Finally, Noboa-Hidalgo and Urzua (2012) concluded that attendance to publicly funded centre-based care in Chile had mixed developmental effects on children aged between 5 and 14 months.

Even though the care of infants and very young children often occurs in the child's own home or the home of a caregiver, childcare research has tended to focus on centre-based care (Adams, Tout, & Zaslow, 2007; Hofferth, Shauman, Henke, & West, 1998). For example, only a few studies from the UK have evaluated the association between grandparent care and child development. While Hansen and Hawkes (2009) concluded that grandparent care (relative to exclusive maternal care) is associated with higher vocabulary test scores, Fergusson, Maughan, and Golding (2008); Hansen and Hawkes (2009); and

Sylva et al. (2011) concluded that grandparent care is associated with more behavioural problems.

Given that more children are attending some type of non-maternal care—not necessarily in centre-based care—during their first three years of life, understanding the effect of the different types of care on child development is extremely relevant. The latter is especially important in countries like Chile where most of the children are in informal care (mainly grandparent or other-relative care). As the evidence about the effect of centre-based care for children under three years old is not conclusive, one of the aims of this thesis is to fill the knowledge gap and contribute to the discussion about which type of care is better for infant and toddlers in middle income countries like Chile.

#### *1.4.3. The impact of maternal employment and non-maternal care for more vulnerable children*

Interestingly, children from more vulnerable families benefit more from early childhood interventions compared to children from wealthier families (Burger, 2010; Crosnoe et al., 2010; Felfe and Lalive, 2012; Peisner-Feinberg et al., 2001).

On the one hand, the level of vulnerability of the child has an important moderating role in the association between maternal employment and child development (Goldberg, Prause, Lucas-Thompson, & Himsel, 2008). Gregg, Washbrook, and Team ALSPAC Study (2003) find that the association between maternal employment and child development for children with mothers with a low level of education is positive and large. Some studies have found that children from single mothers benefit more from early maternal employment relative to children from two-parent families (Goldberg et al., 2008; Harvey, 1999).

On the other hand, there is evidence suggesting that the association of non-maternal care varies according to variables that express the child's level of vulnerability such as low socio-economic status or low maternal education (Côté, Borge, Geoffroy, Rutter, & Tremblay, 2008; Côté et al., 2013). For example, children from poor families or with mothers with a lower level of education benefit more from centre-based care relative to their less vulnerable counterparts (Burger, 2010; NICHD Early Child Care Research Network., 2006; Peisner-Feinberg et al., 2001).

This is why in this thesis I test whether the level of child vulnerability proxied by low maternal education or low-income household is an important moderator factor in the effect of early experiences on child development.

## 1.5. The case of Chile: why is it relevant to study?

Early childhood policies sit at the intersection of education, family and development policies. Chile is not an exception in this regard. Since 2006, the Chilean government has been increasing the investment in early childhood development policy. In 2011, Chile's government extended publicly funded parental leave from three to six months after delivery.

### *1.5.1. Maternity leave in Chile*

Until 2010, the maternity leave subsidy in Chile consisted of 100 per cent of women's pre-delivery salary six weeks before and 12 weeks after delivery (126 days in total). The subsidy was capped at £1,450 per month, which is extremely high, considering that the average salary in Chile is £410. The Chilean government also provided this same subsidy to women with a child younger than 12 months if a physician diagnosed the child with a serious illness. Those mothers were eligible for an additional leave that could potentially extend until the sick child was 12 months old.

In 2011, the Chilean government increased post-delivery fully paid maternity leave from three to six months. In addition, the new parental leave was more flexible than the previously existing leave. Under the new regulations, after the first three months after delivery, working mothers may take their leave in full or part-time mode. The Chilean government designed this feature in the newly implemented leave to increase women's desire to participate in the labour market.

This is the policy context where this study was conducted. However, it is important to clarify that in this thesis I am not evaluating the effects of the extension of maternity leave on child outcomes, because there are no available datasets linking accurate information about maternity leave with child development outcomes. Hence, one of the objectives of this study is to shed light on the effect of the timing of maternal employment during the first year after childbirth on child development outcomes in a context of policy change.

### *1.5.2. Childcare coverage expansion*

In 2006, the Chilean government established an early childhood development policy as a key priority to address persistent economic inequality. The goal was to bring to all Chilean children a high quality early childhood education and reduce inequities in the quality of education obtained by students, regardless of their socioeconomic status. The main goals of the Chilean Government were to provide full coverage of early childhood education for children up to four years old for the 60 per cent more vulnerable households and for all children with working mothers (Mineduc, 2010). This centre-based care expansion was part of a broader program named ‘Chile Crece Contigo’ (‘Chile Grows with You’) which sought to protect children with an integrated system of benefits, programs and social services to help the child and her family from before birth to eight years old.

In 2005, the Chilean government passed a law subsidizing centre-based care coverage; between 2005 and 2007, there was an increase of 240 per cent in the number of centre-based care centres (Medrano, 2009). Both before and after this expansion there was a huge heterogeneity in coverage depending on children’s age. While in 2009, the preschool coverage for five-year old children was 90 per cent, the centre-based care coverage for children between two and three years old was 31 per cent, the nursery coverage for children younger than two years old was 7.8 per cent and the one for one-year old children was only 4.4 per cent[5] (CASEN, 2009).

The main reasons provided by mothers to explain why they did not use nursery (between 0 to 1 year old) are that they think nursery is not necessary because children are cared for at home (76.7 per cent) and they think that nursery is not useful (11.1 per cent) (CASEN, 2009).

In the context of a middle-income country investing heavily to expand centre-based care coverage like Chile, unveiling the effect of attendance at centre-based care (relative to other forms of care) is particularly relevant. The evidence about the impact of centre-based care on child outcomes in Chile is extremely thin and inconclusive. In this context, this study provides new evidence about the association between different types of care and child development for children under three years old.

[5] There are three levels: the nursery level is attended by children between 84 days up to two years old; the intermediate level attended children between two and three year olds; and the transitional level children of four and five-years-old.

## 1.6. This Study

Even though since 2006 the Chilean authorities have expressed great concern and invested important resources on early childhood interventions in Chile, there has been little research assessing the impact of these interventions. For this reason, this study uses a rigorous method to shed light on the effects of early maternal employment initiation after childbirth or non-maternal care on child development. According to Blundell and Costas Dias (2009), the selection of the evaluation method depends on three elements: the type of the question to be answered; the type and quality of data used; and the way by which participants are assigned to the service or receive the policy. Following these criteria, I will describe this thesis' research question, the data set and my analytical approach to answer the research question.

### *1.6.1. Statement of Purpose and Research Questions*

Due to the not conclusive evidence on the previously described issues in Chile and other middle-income countries, the knowledge used in Chile to support the maternity leave extension and centre based care expansion policies has relied on research using data from developed countries: mainly the USA, UK, and other European countries. Four points are important in this respect. First, as discussed, even for more developed countries, the evidence about the effect of maternal employment timing on child development is not conclusive. Second, there are significant differences in the female employment rate, flexibility for part-time work, cultural norms, and childcare options between developed countries and Chile. This probably implies that the findings about the effect of maternal employment on child development using data from developed countries are not necessarily valid in the Chilean context. Third, the evidence about the effect of different types of informal care (such as grandparent or non-relative[6] care) during infancy on child development is scarce and the most prevalent types of care for infants in Chile are informal; hence, it is relevant to understand the effects of informal types of care on child development. Fourth, there is, by and large, a consensus in the literature that centre-based care is beneficial for children above three years old; however, there appears to be no consensus about the impact of group settings on children under three years old (Gambaro et al., 2014). This study will help to fill the previously described knowledge gaps and

[6] Non-relative care in Chile refers mainly to the care provided by domestic workers in middle and high socioeconomic status households and neighbors in low socioeconomic households.

provide new knowledge about this issues that are under-researched in middle-income countries.

The purpose of this chapter is to provide evidence about the association between the timing of different types of non-maternal care (relative to exclusive maternal care) and child cognitive or socio-emotional development. Given the theory and evidence that conclude that this association might be different for children with different levels of vulnerability, I will also look at whether the previously mentioned association is heterogeneous depending on the child's level of vulnerability. This study aims to understand which are the types of care—maternal, formal or informal care—that boost child development during the first three years of life to a greater degree and whether the magnitude of the previous association depends on children's background.

The proposed study aims to answer the following research questions:

1. Does the association between early maternal employment on child outcomes between the child's first and third birthdays differ according to the timing of maternal employment initiation (between zero and three, three and six, six and 12, and 12 and 18 months after childbirth)?
    a. Do maternal employment intensity (full versus part-time), maternal education, family structure (single versus two-parent family), child characteristics (gender) and type of care moderate the association between early maternal employment and child development?
    b. Are changes in the child's environment (home environment, household income, and maternal depression) the mechanisms that underpin the association between maternal employment on child outcomes during the child's first year of life?
2. How does non-maternal care during the first year of life affect children's cognitive and socio-emotional development at ages two and three?
    a. Do children in non-maternal care do better or worse than those who are at exclusive maternal care?
    b. Does the association between non-maternal care on child outcomes differ according to the type of care (relative, grandparent, centre-based care or non-relative)?

c. Do characteristics which proxy child vulnerability such as maternal education or family structure (single versus two-parent family), and family income moderate the association between early maternal employment and child development?

3. What are the effects of entering into centre-based care (relative to exclusive maternal care) at two years old on child cognitive and socio-emotional development?
   a. Does the effects of centre-based care on child development vary by children's background (i.e. maternal education and income)?
   b. Does the relation between centre-based care and child outcomes differ according to the intensity of centre-based care (full-time or part-time)?
   c. Does the relation between early centre-based care (relative to maternal care) and child outcomes differ according to the level of vulnerability of the child's family (proxied by low maternal education or single-parent families)?

To address the previously stated questions, I divide this study into three papers. The first paper investigates to what extent maternal employment timing during the child's infancy (i.e. the month in which working mothers started to work after delivery) affects child cognitive and socio-emotional development. The second paper compares the developmental outcomes of children that have attended different types of childcare (non-relative, relative, grandparent and centre-based care) during the first year of children's life. Finally, the third paper explores the effects of attendance at centre-based care during the toddler years (age two) on child cognitive and socio-emotional developmental outcomes.

*1.6.2. Methods*

To address these questions, the study undertakes a quantitative analysis of a large Chilean dataset *Encuesta Longitudinal de la Primera Infancia* (Longitudinal Survey of Early Childhood—in Spanish, ELPI). In the first two papers, I use multivariate OLS regression models and propensity score matching (PSM) techniques to control for observed covariates. The regression models and PSM analyses regress different measures of child cognitive and socio-emotional outcomes on child, mother, and family background characteristics. In the third paper, for which I have the benefit of the second wave of data, I use OLS, PSM, and individual fixed-effects models for handling individual unobserved and time invariant characteristics that could be causing selection bias.

Dataset

The data comes from the first two waves of the ELPI, which were administered in 2010 and 2012. This survey seeks to enable researchers to evaluate the development of children living in Chile. In addition, this survey provides a great opportunity to evaluate different social policies in Chile such as the extension of maternity leave or the expansion in centre-based care provisions or childhood health services.

The 2010 wave of ELPI has a sample size of 15,000 children between six months and five years old (born between 1st January, 2006 and 31st August, 2009). The first wave of this panel was available in December 2010. ELPI collects demographic data from each household in the sample and gathers information on the children's physical, cognitive and social-emotional development. In addition, ELPI assesses the physical, cognitive and emotional condition of the child's main caregiver. Given the rich set of data about the children, the children's family, caregiver and home environment, I am able to control for a large set of the children's variables that could bias estimates between the association between maternal employment timing or child type of care and child outcomes. More generally, this dataset gives information about the members of the household (socio-demographic characteristics, educational achievement, and employment and pregnancy history) that enables the researcher to control for children's observed heterogeneity (for more information about the ELPI survey, see www.elpi.cl ).

In the three empirical articles of this thesis, I mainly use the 2010 ELPI wave. In the third empirical article, to control for unobserved individual fixed characteristics, I used both the 2010 and 2012 ELPI waves. (For more information about the detail of the data used in each empirical chapter, see Chapter 3.)

Analytical approach

A key issue in this thesis is that observable or unobservable characteristics of the child or parents could affect both the selection into the treatment—maternal return-to-work timing or the child's type of care—and child outcomes, biasing the estimates obtained in the analyses.

Mothers who initiate work early are different in *observable* characteristics compared to those who start to work later. For example, Tanaka (2005) noted that in OECD countries, poorer women return earlier to their jobs compared to wealthier women, who are more prone to use unpaid maternity leave. In addition, children who access ECCE are different in both family characteristics and geographic area from children who do not access ECCE programs. One example is that children of mothers with higher levels of education are more likely to attend ECCE compared to children of mothers who have lower education levels (Barnett & Yarosz, 2007).

Mothers who start working early are also different in *unobservable* characteristics compared to those who start working later. For example, both groups might differ in the value they give to education, their expectations about their children's academic future, and the value they give to maternal care. For example, parental beliefs about child rearing and attitudes towards non-maternal care—both unobserved characteristics—are likely to be correlated with the type of care choice. The latter may happen because parents with higher expectations in their children's future achievements could invest more resources in childcare. In addition, the previously mentioned beliefs and attitudes could have an impact on child development through parental investment of time in their children.

The descriptive analyses in the empirical chapters of this thesis provide evidence for differing observable characteristics for mothers who choose different return-to-work timing and different types of care for their children. Following the program evaluation terminology, I will call such differences 'selection on observables'. To avoid selection bias, in all analyses I control for these observables. This is the aim of including relevant observable characteristics as covariates in ordinary least squares (OLS) regressions or as part of the propensity score in propensity score matching (PSM) analyses. To control for unobserved characteristics that could potentially induce omitted variable bias, the two most commonly used approaches are panel data fixed effects models, and instrumental variable approaches (Hill et al., 2005).

In the first two articles of this thesis, I use OLS regressions and PSM analyses. In the third paper, I use fixed effects models. This latter technique was feasible in the third article because measurements of child development before and after the age range of my target population (children between 24 and 36 months old) were available. Given that it was impossible to find a variable that could have affected the timing of early maternal employment or the choice of the children's type of care and would not be related by other means with child development, I did not use an instrumental variables approach in any of my papers[7].

*1.6.2. Contribution of the thesis*

This thesis is the first research project that assesses the association of early childhood policies on child cognitive and socio-emotional development, with a focus on the first three years of children's life, exploiting changes in development outcomes and key variables in a large panel data set in Chile.

The thesis moves the literature forward in a number of important ways. Firstly, the ELPI survey collected data from children as young as six months old. This enables me to characterise how different types of care and timing from an early stage in development affect Chilean children and to evaluate the effects of early childhood interventions in infants and toddlers. This type of information about early childhood development indicators is extremely scarce in middle income and developing countries. Secondly, the large amount of socio-demographic characteristics included in this survey enables me to control for most variables that could be causing selection of children and mothers into the different modes of treatment and to control for potential differential trends in the fixed effects analyses. Thirdly, ELPI's large sample size (15,000 households) provides enough power to calculate the potentially heterogeneous effects of type of care and timing for children of different socioeconomic status and born to mothers with different characteristics. Finally, the fact that ELPI is a panel data set enables me to control in one of the chapters, for unobserved individual characteristics that could be biasing cross-section results. There are very few early childhood panel datasets in middle-income countries that enable researchers to control for individual unobserved characteristics.

To my knowledge, this is the first study that provides evidence about the effect of maternal return-to-work timing on child development in a middle-income country context. This is

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In each paper I describe the key variable construction, the covariates chosen and the main sets of analyses conducted.

key for understanding the consequences of increasing maternity leave on child development. More generally, this study may also provide policymakers and families with information regarding, on average, the optimal period during which mothers should exclusively care for their child from the point of view of child development.

Finally, this thesis also moves forward the literature about the effects of non-parental care (grandparents, relatives, centre-based care) relative to maternal care on child development during the children's first years of life. It provides useful information regarding the short-term effect of different types of care on child development. This information could help policymakers and families to better assess which is the optimal type of care at different stages for boosting child development; especially, the development of children from low-income households.

### 1.7. Structure of the thesis

The thesis is comprised of seven chapters. Chapter 2 introduces the policy context in which this thesis is located. The first section provides an overview of the Chilean context and the main social policy changes that are affecting families and children in Chile. In this chapter I describe how the new model of social policy emerged, the economic indicators and the political context that promote the increasing importance attributed to early childhood interventions. In the second section, I describes changes in patterns of childcare, female labour market participation rate and family structure in Chile. In the third section, I focus on the main early childhood policies develop in Chile the last decade: childcare and maternal leave extension. In addition, I describe with more details the access, quality and regulations of childcare services in Chile focusing on some weaknesses that could affect children's well-being.

Chapter 3 explains the data source and the methods of the thesis. It is mainly focused on the description of the novel data source used – the *Encuesta Longitudinal de la Primera Infancia* or ELPI – and the instruments used to measure child development. The description also includes an overview of the strengths and limitations of using this longitudinal panel survey. Furthermore, I give an overview of the methods used in the empirical analyses. Finally, I conclude the chapter by presenting some reflections on my fieldwork in Chile in 2011 and 2013.

Chapters 4 to 6 present the study's empirical findings. These three chapters describe the association between type of care at different stages during children's first three years of life and child development. The title of Chapter 4 is 'Early maternal employment and child development: does timing matter?' This chapter investigates how maternal employment timing during the first year after childbirth (between zero and three, three and six, and six and 12 months after childbirth) affects child development and whether this association differs by maternal employment intensity, family vulnerability (lowly maternal education, single parent family) or child's characteristics (gender or type of care attended). To preview my results, I find a significant association between maternal employment timing and child development. Controlling for an extensive set of covariates, children whose mothers initiated employment between zero and three, three and six, and six and 12 months after childbirth exhibited worse cognitive and mixed socio-emotional outcomes relative to children whose mothers did not work during their child's first year of life. However, children whose mothers initiated employment between 12 and 18 months after childbirth exhibited better cognitive outcomes and exhibited no difference in socio-emotional outcomes relative to children whose mothers did not work during their child's first year of life.

The title of Chapter 5 is 'Type of care in infancy and child cognitive and socio-emotional development in Chile'. This chapter investigates to what extent the type of non-maternal care affects children's cognitive and socio-emotional development in their first year of life. To preview my results, in findings consistent with the ones in Chapter 4, I find that attendance at non-maternal care (versus maternal care) during the child's first year of life exhibits a negative association with child cognitive development and a non-significant association with child socio-emotional development. However when non-maternal care is decomposed into the different types of care, it is found that the type of care that infants receive matters. First, there is a positive association between grandparent care (versus maternal care) and child cognitive and socio-emotional development. Second, attendance at relative care (versus maternal care) exhibits a negative association with child cognitive and socio-emotional development. Finally, attendance at centre-based care (versus maternal care) does not exhibit a relevant association with child cognitive development and exhibits a positive association with some dimensions of child socio-emotional development.

The title of chapter 6 is ‘Centre-based care in toddlerhood and child cognitive and socio-emotional development: evidence from Chile’. The aim of this article is to improve our knowledge about the association between centre-based care attendance (between 24 and 36 months old) and child development in Chile. To preview my results in this chapter, attendance at centre-based care (versus maternal care) between 24 and 36 months old is associated with a positive link with child cognitive development and no link child socio-emotional development. This association varies depending on child socio-economic status: the children that benefit the most from centre-based care are children from the second quintile of income. In Chapter 6, I discuss the reasons potentially underlying my findings.

Finally, Chapter 7 summarises and concludes the thesis by discussing the empirical findings. The first section of the chapter synthesises the main findings of the thesis, enriches the conclusions with insights from previous research and provides alternative explanations for the findings. The second part of the chapter analyses the strengths, weaknesses and limitations of the thesis and implication for future research. Finally, the third part of the chapter explores implications for family policies and recommendations for future interventions.

# Chapter 2

# Improving child well-being: parental leave and early childhood education and care for children under the age of three in Chile

## 2.1. Introduction

During the last decade, the Chilean government extended parental leave and significantly increased centre-based care coverage for children between zero and five years old. This implied a threefold increase in the Government's expenditure on policies that affect early childhood in the last decade (Ideas Pais, 2013). Unfortunately, the evidence about the effects of the previously mentioned policies is scarce, and for children under three is extremely thin. What were the goals of these policies? What is the political discourse supporting the increase in government expenditure on policies affecting early childhood? How do female employment and demographic changes relate to these new policies? Finally, what is the current state of early childhood policies in Chile and are these ensuring improvements in child well-being, especially for younger children? All of these questions motivate the present chapter and my whole thesis.

Over the last several years, governments have deepened their interest in early childhood development policies for at least three reasons. The first is to facilitate the increase in the female employment rate. The second is a response to the decrease in birth rates and the increase in single mother families. The third is due to the surge in the importance of 'human capital' theory and its implications for economic competitiveness, among other aspects (Kamerman, 2010; Staab & Gerhard, 2010).

As I mention in the introductory chapter, the evidence from economics, psychology, and neurosciences suggest that early intervention (during the three first years of life) could have important effects on child development. Motivated by this evidence, policy makers have considered that a viable and probably cost-effective way for reducing economic inequality in the long term is through investing in early childhood interventions aimed at fostering child development. Policy makers have justified the increase in investment in early childhood education and care (ECEC) services in both the evidence that early years are a period of considerable vulnerability (Thompson, 2001) and the evidence that a child's early years are a unique opportunity to foster their current and future development (Fox, Levitt, & Nelson, 2010; Meaney, 2010). It is in this context that a domain which has been traditionally private—the care of infants and toddlers—became public through the increase in government investment in ECEC services (Britto, Yoshikawa, & Boller, 2011; Vegas & Santibanez, 2010).

In addition, international organizations such as the Organisation for Economic Co-operation and Development (OECD, 2006), the Economic Commission on Latin America and the Caribbean (ECLAC, 2006) and the World Bank (World Bank, 2006) promote early childhood development policies as a social investment (Williams, 2010). Viewing early childhood development policies as a social investment is an attempt to reconcile social and economic goals, balancing economic efficiency with social justice.

In the case of Chile, the debate about the benefits and disadvantages of increasing investment in early childhood development policies is done in the context of high poverty rates and rampant economic inequality. A context of economic inequality is a fertile ground to promote the discourse of the importance of early childhood development policies as a way to invest in children, equalize opportunities, and reduce the intergenerational transmission of poverty (Staab & Gerhard, 2010).

The rest of the chapter is structured as follows. Section 2.2 describes the Chilean context of social policies and economic inequality; Section, 2.3 describes the employment, family structure and demographic changes in Chile during the last 20 years. These changes are key reasons why Chilean government deepened its interest in early childhood development policies. Section 2.4 provides an overview of the main early childhood development policies in Chile: the public expansion of childcare coverage and the parental leave extension. Following a brief overview of those policies, Section 2.5 provides a detailed account of early childhood education and care policies in Chile focusing on the main weaknesses of those policies that could affect children under three and introduces the relevance of the empirical chapters in this context.

## 2.2. Social policies and economic inequality in Chile

The increase in the relevance and expenditure on early childhood development policies in Chile came hand-in-hand with a transformation of the vision about the country's social policy system. In the early 1990s, when Chile experienced the transition to democracy, the country had inherited a neoliberal social policy model with a reduced expenditure on social policy, an increased incorporation of the private sector in the production and delivery of social services, and a focus of social policy on alleviating extreme poverty. Hence, the Chilean government had a subsidiary role in social policy (Frenz, 2007; Raczynski, 2000). A new social policy model emerged during Chile's *Concertación* governments (administrations during 1990–2010). The *Concertación* policy makers saw social policy as an investment in human capital that contributes to economic growth and with the understanding that economic growth is not enough to overcome poverty and reduce inequality (Raczynski, 2000).

Although there is a consensus about the importance of early childhood development policies, the definition of these policies is highly complex because there is no agreement about the fundamental objective of such policies. In most countries, these policies focus on increasing women's labour market participation, increasing fertility rates, and improving child outcomes. Hence, in these countries, early childhood policies are viewed as an investment in human capital to secure competitiveness. A crucial issue is that the objectives behind early childhood policies are not always compatible. For example, policies to enhance mothers' employment rates could have a detrimental effect on the very young children who need a closer relationship with one adult in the first year of life (Waldfogel, 2006). In the case of Chile, the goals of the recent changes in early childhood development policies are primarily fostering child development and secondarily, increasing the low female labour force participation as a way to reduce income inequality.

This discourse takes place in the context of a country that is both highly prosperous and economically unequal. Regarding average economic prosperity, Chile has had a high and stable average annual economic growth—5.5% from 1990 until 2005 (Aninat et al., 2010). In addition, Chile has one of the lowest poverty rates in Latin America and the Caribbean region. In 2011, while 14.4 per cent (2.5 million people) of Chile's population lived below the country's poverty line[8], 2.8 per cent (472 thousand) lived in extreme poverty (CASEN, 2011). In contrast, the population of Latin America living in poverty and extreme poverty was 30.4 per cent and 12.8 per cent respectively (ECLAC, 2011). In addition, Chile's Human Development Index (HDI), that reflects the level of well-being of a country's population through income, health, and education is among the best in Latin America (United Nations Development Programme UNDP, 2010). However, Chile exhibits one of the highest rates of economic inequality (according to its Gini index) in Latin America and is within the 12% most unequal countries in the world (United Nations Development Programme UNDP, 2010). For comparison, while the United Kingdom has a Gini index of 0.36 (Organisation for Economic Co-operation and Development (OECD), 2008), Chile has an index of 0.55 (UNDP, 2010). For more information, Appendix 2.1 provides an overview of Chile's economic, social, demographic, and spending indicators contrasting these values to the average values in OECD countries.

Chile exhibits not only high economic inequality, but also low intergenerational income mobility. We should expect both conditions together because, higher income inequality limits economic mobility for the next generations (Corak, 2013; Solon, 2004). Nunez and Miranda (2010) conclude that Chile's intergenerational income elasticity[9] was in the range of 0.57 to 0.74 and 0.63 to 0.76 for ages 25-40 and 31-40 respectively. Chile has a low level of intergenerational income mobility even compared to the UK and the USA that are the countries with lowest intergenerational income mobility among high-income countries. Both countries exhibited an intergenerational income elasticity of 0.50 and 0.47 respectively (Causa & Johansson, 2010). In this context, the government of Chile committed to break the cycle of disadvantage between generations.

## 2.3. Changing patterns of childcare: changes in the female labour market participation rate and family structure in Chile

An increase in the female employment rate and in single parent households headed by a woman has increased the demand for childcare. Chile is ranked 108 among 134 countries worldwide in terms of women's access to employment opportunities and income generation, based on economic participation and opportunity, educational attainment,

[8] The Chilean poverty line is defined as 70 pounds per capita (64,000 Chilean pesos) per month.
[9] The interpretation of this indicator is the average percentage change in the income of a child resulting from a 1% increase in the income of her parent. Intergenerational income elasticity is inversely proportional to intergenerational income mobility.

health and survival, and political empowerment (Hausmann, Tyson, & Zahidi, 2010). Even though Chile's female employment rate increased steadily between 1990 (32%) and 2009 (42%), Chile's female employment rate in 2009 was 28 percentage points (pp) below the country's male employment rate, and 15 pp below the OECD female employment rate of 57 per cent (OCDE, 2011). Moreover, Chile's female employment rate was 10 pp below the average female employment rate of Latin American countries (52,9%) (ILO, 2013). Chile's female labour market participation rate exhibits a clear income gradient. While the female labour market participation is 24 per cent in the poorest income quintile, this same figure is 63 per cent among the richest income quintile (CASEN 2011). As expected, the income gradient also can be viewed as an educational gradient. While only 16.7 per cent of women without formal education worked in 2009, this same proportion for women with a college degree was 76.6 per cent (CASEN, 2009). This gradient is common across all OECD countries (OECD, 2011).

In addition, Chilean mothers of younger children tend to participate less in the labour market relative to women who either do not have children or have older children. This is the same path observed across OECD countries (OECD, 2007).· In Chile, women without children under 18-years-old have a labour market participation rate almost 20 percentage points (henceforth, pp) higher than women with children under one year old (see rows (A) and (F) in Table 2.1). Moreover, while only a 38.5 per cent of women with children under four years old work in Chile, this same rate is 57.2 and 60.1 per cent in the UK and OECD countries respectively (OECD, 2007).

**Table 2.1. Employed women under 60 years old with and without children in Chile in 2006**

| | Employed | Unemployed | Inactive |
|---|---|---|---|
| (A) Women with children of less than 1 year old | 34.2 | 3.4 | 62.4 |
| (B) Women with children under 2 years old | 35.7 | 4.6 | 59.7 |
| (C) Women with children under 4 years old | 38.5 | 5.3 | 56.3 |
| (D) Women with children under 6 years old | 41.5 | 5.7 | 52.9 |
| (E) Women with children up to 6 and under 18 years old | 47.2 | 5.2 | 47.7 |
| (F) Women without children under 18 years old | 53.7 | 5.7 | 40.6 |

Source CASEN 2006, in Dussaillant, 2009

There are several hypotheses that attempt to explain the relatively low female employment rate in Chile. First, Schkolnik (2004) argues that Chilean employers could be discriminating against women of childbearing age because the Chilean law mandates employers who employ at least 20 female workers to provide childcare and because of the decreased productivity of a woman that interrupts her career because of maternity leave. This is despite the fact that the government –not the employer– pays the leave subsidy. Second, he argues that the Chilean labour market is a male-oriented market with a lack of flexibility, and with a significant gender wage gap. The gender wage gap is even clearer among high earners. For example, women with a tertiary degree earn 35 per cent less compared to the salary of men with a tertiary degree (OECD, 2013a). Other potential explanations for Chile's low female employment rate are the precarious working conditions in the labour market and the conservative social norms. Regarding female workers' working conditions, around 40 per cent of female workers have an informal and/or precarious job. Women in informal work in Chile -as in most countries- do not have access to maternity leave or employer childcare provisions. Regarding the role of social norms in female labour market participation in Chile, Contreras and Plaza (2010) found that in Chile's conservative cultural context social norms decrease the likelihood that women participate in the labour market. In Chile's traditional gender roles, men are the sole breadwinners and women are the main providers of unpaid maternal childcare. For example, economically non-active women who are not looking for a job list their main reasons for not seeking employment as housework (50%) or care of others (13%) (CASEN, 2009; ECLAC, 2012). Childcare for children under three years old in Chile still depends heavily on mothers, limiting these women's option of entering into the labour market.

During the last two decades, the proportion of households headed by women has doubled, increasing from 20 per cent in 1990 to 39 per cent in 2011 (CASEN 2011). Women are the main breadwinners in 39 per cent of Chilean households (almost 2 million households)[10]. On a related matter, 83.7 per cent of single-parent families are headed by a woman (Ministry of Planning, 2012). In addition, households in extreme poverty are more likely than others to be headed by a woman. A woman heads 51 and 55 per cent of poor and extremely poor households respectively (CASEN, 2011). It is also relevant to consider that younger children are the population that exhibits the highest risk of being in poverty. The proportion of children under three years old in poverty is 67 per cent higher than the proportion of children in poverty (24 per cent versus 14.4 per cent) (CASEN, 2011).

[10] One could argue that this figure is distorted upwards because the system of subsidies incentivizes households to 'hide husbands' (report that male partners do not live there while in reality they do).

Hence, the chance that a household led by a woman and with children under three years old is poor or extremely poor is large. However, because the Chilean equalisation scale considers the same weight for adults and children, this boosts the rate of child poverty artificially.

A decrease in the marriage rate and an increase in divorce rate are the main factors leading to the previously described increase in single-parent households led by a woman. Marriage rates in Chile have fallen from 7.00 marriages per thousand people in 1970 to 3.67 marriages per thousand people in 2009, one of the lowest in OECD countries (that on average celebrate 5.0 marriages per thousand people) (OECD, 2014a).

In this socio-demographic context, the Chilean government has implemented policies to incentivise women's participation in the labour market as a strategy to reduce poverty, to enhance economic growth, and to decrease the high level of inequality that exists in the country. To meet these goals, the Chilean government has expanded the coverage of childcare and extended maternity leave, also transforming it into parental leave. There are no studies yet about the impact of Chile's extension of maternity leave on the female employment rate. Regarding the impact of extending the coverage of centre-based care, Medrano (2009) did not find an impact of more access to publicly-funded childcare on women's employment rate.

A less discussed driver of early childhood development policies in Chile is demographic change. In Latin America, an abrupt reduction in the fertility rate and a decrease in the mortality rate have driven a 'demographic transition'. Latin America has experienced this transition more rapidly than most developed countries (UNESCO, 2010). Chile is in an advanced stage of transition to population aging, as older adults (60 years or older) have gradually increased and children under 15 years old have decreased their share in the general population. Chile's fertility rate in 2010 was 1.91 children per woman, a figure that is under the replacement level (Instituto Nacional de Estadisticas Chile (INE), 2010).

UNESCO (2010) suggests that the demographic transition due to a decrease in the children's population and the increase in the population of older adults provides an opportunity for the expansion and improvement of early childhood policies. This period is considered a window of opportunity to increase social investment in poverty alleviation, and to improve the education and health systems. However, this 'demographic window' is time-limited due to the pressure on fiscal spending that will be exerted by the future larger share of older adults in the population (UNESCO, 2010).

The current demographic moment could be a unique opportunity to increase investment in early childhood development policies in Chile. The increase in the female employment rate and the proportion of households led by women, have increased the need for childcare services that support women to combine employment with raising a child. Moreover, culturally, the care of children is still mainly women's responsibility. High-quality ECEC services and adequate and flexible parental leave could enhance child development and facilitate maternal employment. At the same time, maternal employment could increase household income and reduce child poverty, having a potentially positive impact on child development. Each country chooses its own way of implementing different portfolios of early childhood development policies. In the next subsection, I discuss Chile's goals and strategies regarding early childhood policies.

## 2.4. Early childhood development policies

There are different strategies for implementing early childhood development policies. According to Williams (2010) , there are four types of such policies: financial, such as tax benefits; employment-related provisions, such as maternity or parental leave; service provisions, such as day care[11]; and incentives for employment creation, such as vouchers to employ a caregiver. Depending on their histories, constraints, and political demands, different countries opt for a different combination of the different types of early childhood development policies. In the case of Chile, the main policy instruments affecting children under three years old that the government has chosen during the last decade are employment and services provision. Specifically, the Chilean government increased childcare coverage between 2006 and 2010 and extended parental leave from three to six months after childbirth in 2011.

According to Morgan (2012), early childhood development policies could have three main goals: increasing the female employment rate, promoting gender equality, and enhancing child development. Usually, countries focus on one of these dimensions. However, since the 1970s, northern countries such as Norway or Sweden have tried to achieve all three goals by promoting public ECEC, providing well-paid and long parental leave with a

[11] I use day-care and childcare center as synonymous.

proportion of this leave that is exclusive for fathers, and creating part-time and good quality jobs for mothers. In the case of Chile, the goals underpinning the recent changes in early childhood development policies are primarily fostering child development and secondarily, increasing the female employment rate, bearing in mind that the ultimate goal is to overcome economic inequities.

### *2.4.1. Maternity Leave Policy*[12]

In general, governments establish maternity leave with the aim of protecting mothers and children's health, and protecting women from discrimination in the labour market. In 1952, the ILO recommended that governments ensure that workers have access to 12 weeks of paid maternity leave, and this was expanded to 14 weeks in 2000 (ILO, 2000). Out of a universe of 172 countries, 128 have some type of statutory maternity leave. In OECD countries, the average duration of maternity leave (post-natal leave) is 14 to 16 weeks and most countries cover between 60 to 100 per cent of earning-related payments (Moss, 2013). Every country has its own particular regulations and the differences among them are significant (See Appendix 2.2).

In Latin American countries the modal length is 12 weeks, the minimum paid maternity leave is 10 weeks (Honduras) and the maximum is 25 weeks (in Brazil). In Cuba and Venezuela, childbirth-related leave is 18 weeks. In 2010, Brazil increased its maternity leave from 120 to 180 days (See Appendix 2.3). In most countries, the leave is compulsory. It pays 100 per cent of mothers' previous compensation, and is funded by the countries' social security systems. Some countries provide additional leave time under special circumstances: multiple births (Cuba and Peru), children with Down syndrome (Argentina), child illness until their first year of life (Chile), and maternal illness (e.g. Chile, Mexico, Uruguay, and Venezuela) (Cabezas, 2006; Pautassi & Rico, 2011).

<u>The case of Chile: from maternity leave to parental leave</u>

Until 2010, maternity leave in Chile lasted six weeks of prenatal and 12 weeks of postnatal leave and women received a government subsidy of 100 per cent of their pre-birth salary

[12] This section refers only to maternity leave because although Latin American countries usually have days of paternity leave, the focus of their policy is maternity leave. Although most OECD countries use the term parental leave in Latin America this concept was rarely seen in legislations before 2010. In Chile in 2011, with the extension of maternity leave, the government started using the term and the concept of parental leave.

up to a maximum subsidy of £1,450 (the average monthly salary in Chile is £300 approx.). In addition, there was in place a similar subsidy for mothers with a child younger than one year who had a serious illness, and employment protection for one year after childbirth.

In 2009, only 36 per cent of the 235,365 mothers living in Chile who gave birth had access to maternity leave. A low proportion of mothers were eligible for maternity leave in Chile because women had to meet several conditions. First, it is relevant to have in mind that, in 2009 only 43 per cent of women in Chile participated in the labour market (OCDE, 2011). Second, a physician must prescribe maternity rest to a female worker. Third, those female workers who had a contract must demonstrate at least a six-month affiliation with a pension plan and must have contributed to the plan in at least three of the six months before the medical prescription for maternity rest. Independent workers must have had a twelve-month affiliation with a pension plan before the medical prescription and were required to have contributed to their pension fund in at least six of the prior twelve months.

In the early 1990s, working mothers requested, on average, nine days of medical leave for a child's serious illness (Rodríguez & Tokman, 2003). However, during 2007, on average, eligible mothers in Chile had two months and three days of child serious illness leave subsidy. Adding the maternity leave subsidy days and the subsidy for child serious illness leave, mothers had, approximately five months of post-delivery leave per child (Dussaillant, 2009b). Hence, de facto, eligible women took five months of post-birth leave (even though the maternity leave itself was of only three months at that time). This implies that the child serious illness leave subsidy was increasingly used to extend the postnatal period. Mothers asked their doctor for a (typically fraudulent) leave to prolong their child-related leave. Between 1991–2002 there was an increase of 569 per cent in the use of child serious illness leave (Rodríguez & Tokman, 2003).

The discussion about a potential extension of maternity leave in Chile was partly driven by the desire to regularise the overuse of the child serious illness leave[13]. The discussion about the maternity leave extension started during the first administration of President Bachelet (2006-2010). However, it was President Piñera (2010–2014) who implemented the

[13] In fact, the take up rate of the child serious illness leave in 2012—after the introduction of the maternity leave extension in 2011—decreased in a 92 per cent relative to the same take up rate in 2010. This implies that a 30 per cent of the monthly average spending on the additional parental leave subsidy has been funded with savings from the decrease on the subsidy of the child-serious-illness leave (Superintendencia de Seguridad Social, 2013).

maternity leave extension. During Chile's presidential election in 2009, the maternity leave extension was a key element in almost all of the candidates' discourse because they saw the maternity leave extension as a way to gain women's votes.

Piñera's administration (2010-2014) centred their efforts in proposing an extension of the maternity leave that would try to avoid decreasing the female employment rate. Two key elements of the proposed change were as follows. First, policymakers believed that under the new law, employers would have more certainty about when working mothers would return to their jobs because they would know in advance the exact extension of the maternity leave. Second, to avoid a pay gap and to not introducing a disincentive to employers to employ women, the government would fully fund the maternity leave (extended) subsidy.

Finally, the Chilean government extended the mandatory maternity leave from three to six months (post-natal leave) in 2011 and established changes to the benefit coverage and medical leaves associated with maternity. The project did not change the subsidy for the current pre- and postnatal rights. During six weeks of prenatal and the first 12 weeks of postnatal leave, women continue to receive 100 per cent of their pre-birth salary with a cap on £1,450 monthly subsidy. After the first three months after delivery, working mothers take their leave full- or part-time. Women can choose to extend their maternal leave at full time for 12 weeks or part time for 18 weeks[14]. This created a parental leave lasting between 24 and 30 weeks, below the OECD countries average of 48 weeks paid leave (Moss, 2012; Thévenon & Solaz, 2013). During this period, working mothers would continue receiving their full pre-birth salary. After the first three months of maternity leave, either fathers or mothers can take the parental leave receiving the mother's pre-birth salary in both cases. Given that most fathers earn higher salaries than mothers, this aspect of the law disincentives the take-up rate by fathers. In addition, fathers are allowed to take only six weeks of the additional 12 weeks. This special feature was designed to increase women's ability to participate in the labour market. This is probably the first Chilean policy in early childhood development whose goal is to improve gender equality in the responsibility for childcare. Naturally, laws do not change the culture immediately. In Chile, since 2011, only 0.3 per cent of fathers took the parental leave (Superintendencia de Seguridad Social,

[14] Between 2011 and 2013, only 2.1 per cent of mothers took the maternity leave in part-time mode (Superintendencia de Seguridad Social, 2013).

2013). This is even lower than in the EU15 countries, where 84 per cent of men declare they had not taken parental leave (Fox, Pascall, & Warren, 2009).

As I explained previously, the main stated aim of ECEC policies in Chile are to improve child outcomes and to decrease inequalities. For supporting parents and enhancing child well-being, early childhood development policies such as parental leave and ECEC need to be coordinated. In the case of Chile, once the parental leave is over, the poorest 60 per cent of the population has free access to public ECEC programs. In the next subsection, I discuss Chile's ECEC policies. I then explore in detail some of the strengths and weaknesses of Chilean ECEC services that expand and limit their capacity to support child development, especially for the youngest children (under three years old).

### *2.4.2. Early Childhood Education and Care Policies (ECEC) in Chile*

National comprehensive policies for ECEC require a strong commitment on the part of political leaders. In Latin America, Chile has demonstrated the strongest political support for early childhood development (Vegas & Santibanez, 2010). In Mexico, Colombia, and Chile, new approaches are being used in an attempt to implement comprehensive ECEC polies with the goals of poverty reduction and national development (Vargas-Barón, 2009).

In 2006, the Chilean government established an early childhood development policy as a key priority to address persistent economic inequality. The goal was to provide all children living in Chile with a high quality early childhood education, levelling the field in terms of opportunities for poorer and wealthier children. The main goals of the Chilean government were to provide full coverage of early childhood education for children up to four years old for the 40 per cent most vulnerable households (Ministerio de Educacion de Chile, 2010).[15] In 2009, the Chilean government enacted a law to create an intersectoral comprehensive childhood protection system called *Chile Crece Contigo* (Chile Grows with You, hereafter CCC). The aim of CCC is to foster the development of children from zero to four years of age via an integrated system of benefits, interventions and social services that support the child and her family. The CCC system accompanies parents/guardians in their children's development from the prenatal period until children enter preschool at four years old. The system focuses on health, but it also guarantees free access to centre-based care for

[15] Recently, the Chilean government extended the coverage of CCC to the most vulnerable 60 per cent of the population.

children (UNESCO, 2010). Chile's Presidency, the Ministry of Social Protection and the Ministry of Finance are leading the CCC multisectoral approach that includes the Ministry of Education, Ministry of Health, and all the public early childhood education and care providers (these are explained below). The CCC system obtained significant international loans and support for its innovative, intersectoral, and multidisciplinary approach to overcome the intergenerational transmission of poverty and foster early childhood development (Vargas-Barón, 2009).

In 2010, early childhood education for children preschool education in Chile was not mandatory and served children from birth until they entered primary education at six years old. In 2013, the Chilean government enacted a law committing to achieve free public universal coverage in pre-kindergarten and kindergarten. Moreover, the law states that the kindergarten preschool level is mandatory (Ministerio de Educacion de Chile, 2014). This new law will be implemented gradually. The Chilean government must promote and ensure access to the first and second transition levels (pre-kindergarten and kindergarten) for all children and must ensure access to the lower preschool levels (nursery and day care) for those who come from families belonging to the 60 per cent most vulnerable households in the country. (Ministerio de Educacion de Chile, 2014). Hence, by enacting the CCC, the Chilean government committed to provide free public childcare for the 60 per cent most vulnerable Chilean population.

Chile's early childhood education is structured in three levels according to the age of the children. Each of these three levels, in turn, are subdivided into two sub-levels. The levels are nursery (sala cuna), day care (middle level) and pre-school (transition level) (see Table 2.2.). This thesis focuses on nursery and the first year of day care level (children under three years old)

**Table 2.2. Chilean early childhood education structure**

| Level | Subdivision level | Child's age |
|---|---|---|
| Nursery | First year of nursery (*sala cuna menor*) | 0 to 11 months old |
| | Second year of nursery (*sala cuna mayor*) | 1 year to 1 year, 11 months old |
| Day care | First year of day care (*medio menor*) | 2 years to 2 years, 11 months old |
| | Second year of day care (*medio mayor*) | 3 years to 3 years 11 months old |
| Preschool | Pre-kindergarten (*primer nivel de transición*) | 4 years to 4 years 11 months old |
| | Kindergarten (*segundo nivel de transición*) | 5 years to 5 years 11 months old |

In the rest of this subsection, I present a synthesis of Chile's childcare provisions with a focus on children under three years of age. Chile has lower childcare coverage for children under three years of age compared to the average coverage in OECD countries (OECD, 2014). Even though the expenditure on early childhood education as a proportion of GDP is equal to the average of OECD countries, given that Chile has a lower income level than this group of reference, the expenditure per child in purchasing power parity is lower (OECD, 2012). The ratio of children per adult in Chile is higher than the same average ratio in OECD countries. Regarding the average teachers' wages, these are lower in Chile compared to the average wage of teachers in OECD countries (Ministerio de Educacion de Chile, 2014). The rest of this subsection shows figures and numbers that illustrate my previous statements.

**Institutions**

In Chile, three organizations are the main administrators of publicly funded early childhood education. First, the *Junta Nacional de Jardines Infantiles*, or JUNJI ('National Board of Day Care Centres'), is an institution that depends on the Ministry of Education. Second, Integra Foundation is a private, not-for-profit organisation funded and controlled by the Chilean Government through the Sociocultural Directorate at the Government's Presidency. Both Integra Foundation and JUNJI focus on the care and development of children between zero and four years old. The third main provider of publicly funded early education is Chile's Ministry of Education. The Ministry of Education provides most preschool coverage in the country for children between four and five years old (Rolla, Leal, & Torres, 2011).

Thus, the main public early childhood education providers for children under three are JUNJI and the Integra Foundation, created in the 1970s and 1990s respectively (Araujo, López-boo, & Puyana, 2013). Table 2.3. contains information about child enrolment in JUNJI, the Integra Foundation, and also the coverage of schools (municipal, private subsidized and private[16]) and those that teach special education[17] early childhood education. Unfortunately, there are no official statistics about the enrolment of children in private preschool institutions because these institutions are not mandated to send enrolment information to the Ministry of Education. Together, JUNJI and Integra have a share in the enrolment of public institutions higher than 98 per cent in nursery and 70 per cent in day care levels. The Integra Foundation and JUNJI operate some centres directly and also subsidise the operation of centres run by NGOs. In 2012, 715,578 children between the ages of zero and five were registered in the Minister of Education's preschool registry. However, the Chilean government does not have an estimation of how many children are in private preschool institutions.

**Table 2.3. Child enrolment by level of preschool education and type of institution (according the Minister of Education's registration)**

| Institutions | Nursery | Day care | Pre-kindergarten | Kindergarten | Total |
|---|---|---|---|---|---|
| JUNJI | 77,9% | 49,5% | 6,4% | 1% | 24,8% |
| Integra | 20.9% | 20,7% | 4.3% | 0,5% | 9,6% |
| Schools | | | | | |
| Municipal | 0% | 0% | 24,5% | 31,9% | 17,1% |
| Private subsidized | 0.22% | 0,84% | 39% | 48,8% | 26,9% |
| Private | 0.53% | 3,4% | 6,3% | 6,9% | 5% |
| Special education | 0.47% | 25,5% | 19,7% | 10,9% | 16,6% |
| TOTAL | 75,285 | 208,419 | 206.601 | 225.273 | 715.578 |

Source: Ministerio de Educacion de Chile (2014). The data comes from Chile's Ministry of Education registration of preschool education and datasets from JUNJI and Integra Foundation. No data on early childhood private institutions is included. Those in the category of special education may be municipal (public), subsidized private or private schools.

[16] Municipal schools are tuition-free school, funded by the Government. Private subsidised schools are subsidised by the Government and families also pay a fee which cannot exceed £20 per month. Private schools are not subsidized by the Government, so are financed solely by students' families. While 45.2 per cent of the Chilean schools' students attend at Municipal Schools, 46.5 per cent attend subsidised private schools, and only 6.8 per cent attend private schools (MINEDUC 2007).

[17] Special education means an institution for children who present physical, sensory, or mental disabilities, diagnosed by competent professionals (Ministerio de Educacion de Chile, 2014).

Each of the previously mentioned three main public institutions has its own programs, curricula, assessment tools, and mechanisms for obtaining public resources. These three institutions have shown a great lack of coordination between them.

The criteria under which the different providers of publicly funded early education in Chile operate are complex and unequal across institutions. On the one hand, JUNJI and Integra Foundation receive annually an amount of resources that is not based on the same criteria for both institutions. In addition, both institutions allocate these funds between their own programs and those administered by third parties unevenly, not transferring the same per capita funding in both cases. The amount spent per child on the educational services offered by JUNJI and INTEGRA are different from one another and there are no assessments to infer whether higher spending is related to higher needs or quality. Moreover, the allocation of resource for each institution is based on historical reasons rather than strategic ones (World Bank, 2009 cited by Rolla, Leal & Torres, 2011). Hence, children with the same characteristics (same social status) living in the same neighbourhood receive different amounts for their early education depending on the institution in which they are enrolled (Ministerio de Educacion de Chile, 2014).

**Table 2.4. Government per capita subsidy by preschool institution and age group in 2012**

| | JUNJI | Voucher centre-based care via JUNJI | Integra | Voucher centre-based care via Integra |
|---|---|---|---|---|
| Nurseries | £180 | £127 | £150 | £88 |
| Day cares and preschools | £115 | £66 | £116 | £64 |

Source: Ministerio de Educacion de Chile (2014). The subsidies assume full-time attendance (that is, from 8:30 to 16:30 Monday through Friday).

According to Faverio, Rivera and Cortazar (2013) more than 70 per cent of the NGOs and private institutions that operate under a voucher subsidy (of JUNJI or INTEGRA) should get additional funding for extra costs. The extra costs could imply higher salaries to the best performing teachers, training for teachers, or after-school activities.

Recent reports from the World Bank and the Inter-American Development Bank (IDB) conclude that clarifying the roles and functions of the different institutions providing publicly-funded early childhood education services is one of the most relevant issues for improving the quality of early childhood education in Chile (Rolla et al., 2011). For example, JUNJI has the role to inspect and regulate non-governmental centre-based care providers; however, JUNJI has no concrete ways to penalize providers that do not meet the standards such as adult–child ratio or space-per-child requirements. Moreover, JUNJI is also a provider of centre-based care (Ministerio de Educacion de Chile, 2014).

Other worrying aspects in the way early childhood education in Chile is structured is the lack of control and supervision of private providers. The reason behind the latter aspect is that private early childhood educational institutions (e.g. nurseries or childcares centres) are not required to have a special educational permit to function unless they receive funds from JUNJI or Integra. The only requirement for such private early childhood education providers is a municipal permit related to infrastructure requirements (Bedregal, González, Kotliarenco, & Raczynski, 2007).

The Ministry of Education does offer a voluntary official recognition to the institutions that provide early childhood education and care. The official recognition establishes certain requirements associated with staff, infrastructure, equipment, materials, funding, and curriculum. Unfortunately, few institutions choose to register in this way (Ministerio de Educacion de Chile, 2014).

**Coverage**

Due to the existence of various institutions that provide publicly funded preschool education and the lack of information about the coverage of private or informal preschool providers, the analysis of early childhood education coverage in Chile is a challenging task. Additionally, the fact that there is not a mandatory preschool attendance limits the ability to obtain accurate attendance information. In many cases, a child may be enrolled in a nursery or kindergarten but not necessarily attend it.

According to Chile's socioeconomic survey CASEN (2011), the enrolment rate in early childhood education has increased considerably from 16 per cent in 1990 to 44.5 per cent in 2011. In 2005, the Chilean government passed a law subsidizing childcare coverage. Between 2005 and 2007 there was an increase of 240 per cent in the number of day care centres (Medrano, 2009; UNESCO, 2012). The number of publicly-funded childcare centres increased almost five times since 2005 (from 692 to 3,902 childcare centres). In 2010, publicly funded childcare coverage in Chile reached 57,000 children, a twofold increase from the coverage in 2005 (Mineduc, 2010).

There is huge heterogeneity in the scale of the expansion depending on the initial level of coverage according to the children's age range. While, in 2011 the coverage for five-year-old children was 93.6 per cent, coverage for children under one-year-old was only 4.4 per cent. However, in percentage terms, the expansion of childcare coverage was much larger for children three and under than for older ones. For example, Table 2.5 shows that childcare coverage between 1990 and 2011 for one and five year olds increased 1580 per cent and 77 per cent respectively. As can be seen in Table 2.5, in 2011, Chile had almost universal preschool education coverage in kindergarten and more than 70 per cent in prekindergarten (CASEN, 2011).

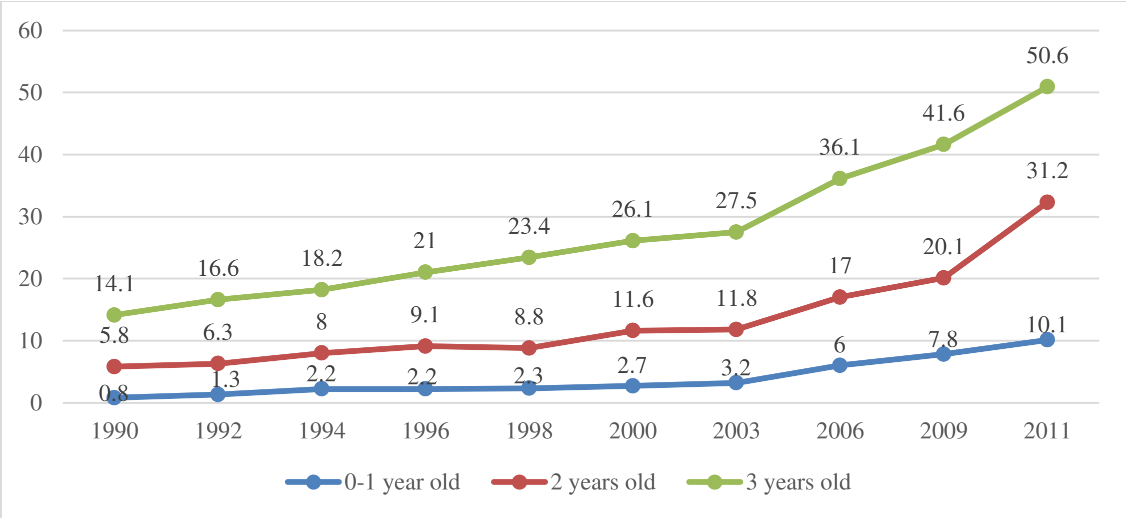
**Table 2.5. Proportion of children from zero to five years old who attended at early childhood education programs in Chile 1990-2011**

| Children's age | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1990 | 0.6 | 1.0 | 5.8 | 14.1 | 28.6 | 53.0 |
| 2011 | 4.4 | 16.8 | 31.2 | 50.6 | 73.2 | 93.6 |
| Total Increase | 630% | 1580% | 438% | 259% | 156% | 76.6% |

Source: Author's elaboration from CASEN 1990 and 2011

In contrast, the childcare coverage for children under three years of age in Chile is only 17.6 per cent, much lower than the 32.6 per cent in OECD countries (OECD, 2014a). Figure 2.1 shows that, in 2011, while only 10.7 per cent of infants (less than two-years-old) attended nursery, 31.2 per cent of children aged two and 50.6 per cent of children aged three attended day care (CASEN, 2011).

**Figure 2.1 Percentage of children from 0 to 3 years old attending childcare centres in Chile, 1990-2011**




Source: Author's elaboration from CASEN 1990, 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009 and 2011

The levels of preschool participation are highly unequal across income levels. For example, while in 2009 only 16.1 per cent of infants in households within the poorest income quintile attended nursery, the same proportion for infants in households within the wealthiest income quintile was 33.7 per cent. In 2011, this inequality in preschool coverage was reduced. While 24.1 per cent of infants in households within the poorest income quintile attended nursery, the same proportion for households within the wealthiest quintile was 29.4 per cent. This shows a narrowing in the socioeconomic gap in coverage driven by the explosive increase of coverage of publicly funded childcare centres.

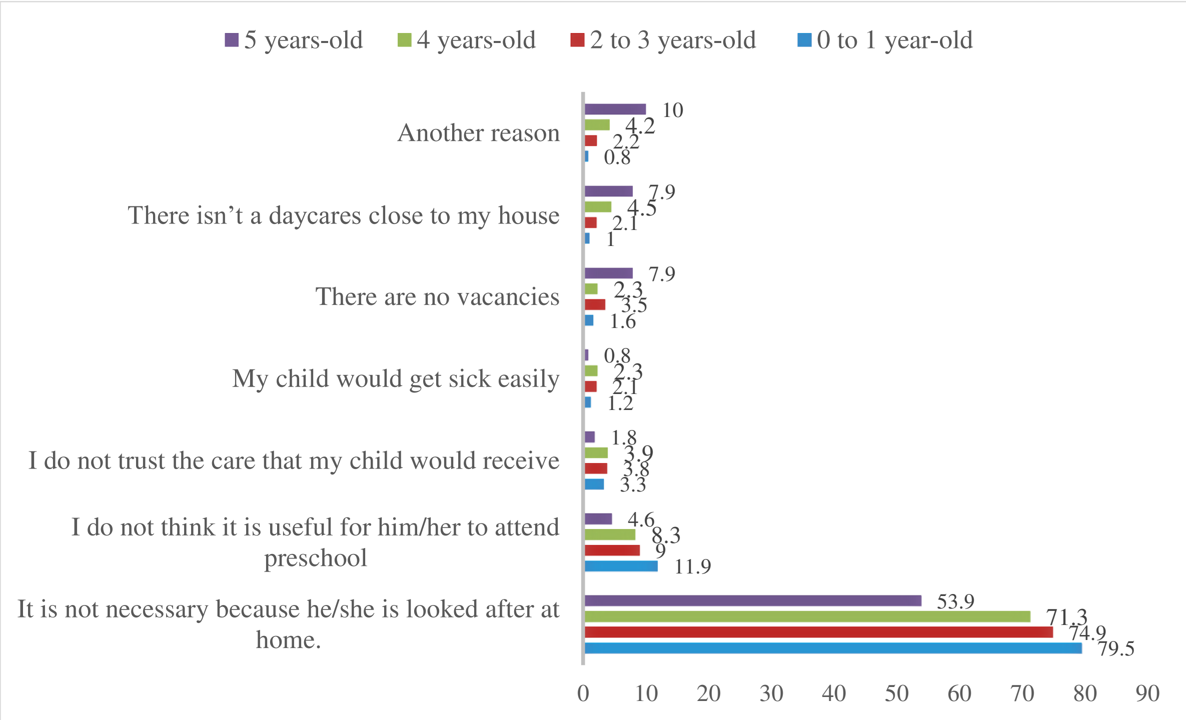
**Table 2.6. Childcare attendance of children 0 to 3 years old by income quintiles**

| Year | Household income quintiles | | | | | |
|---|---|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** | **V** | Average |
| 1990 | 4.2 | 3.4 | 5.5 | 6.5 | 12.5 | 5.5 |
| 1996 | 5.9 | 6.7 | 8.0 | 12.2 | 23.0 | 9.2 |
| 2003 | 9.0 | 10.7 | 12.3 | 11.3 | 22.2 | 11.8 |
| 2006 | 14.0 | 12.7 | 17.6 | 19.5 | 25.0 | 16.4 |
| 2009 | 16.1 | 17.2 | 18.6 | 19.3 | 33.7 | 19.2 |
| 2011 | 24.1 | 25.0 | 27.6 | 28.6 | 29.4 | 26.1 |

Source: Author's elaboration from CASEN 1990, 1996, 2003, 2006, 2009 and 2011

In relation to the supply and demand for early childhood education, there is excess supply of publicly-funded centre-based care (Ministerio de Educacion de Chile, 2014). This could be due to geographic mismatch as well as preferences of many parents to care for their children under three years of age at home, or to have them cared for by a relative. In 2011, the main reasons provided by mothers to explain why they did not send their infant (between 0 and 1 year old) to nursery were that they think nursery is not necessary because children are cared for at home (79.5 per cent) and they think that nursery is not useful (11.9 per cent) (CASEN, 2011). The prevalence of these two reasons diminishes as the child grows.

**Figure 2.2. Main reasons why mothers/guardians of children under six years old do not use childcare services by child's age**



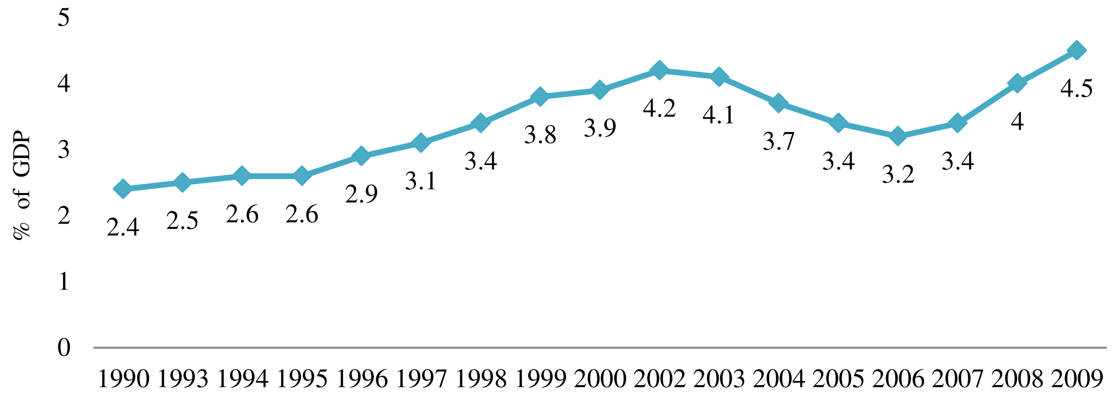

Source: CASEN 2011

**Financing**

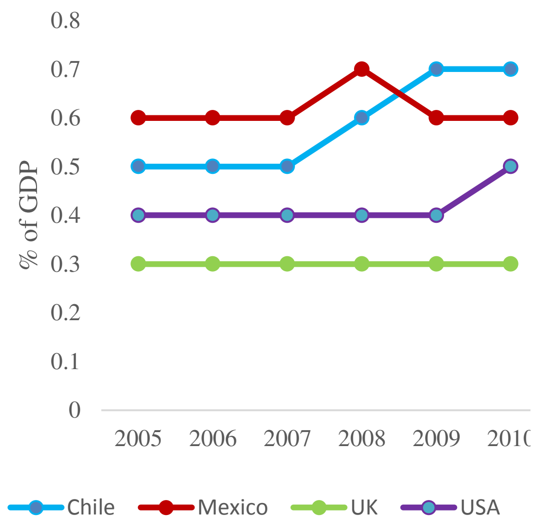
Between 2005 and 2009, Chile increased its expenditure on education by 1.1 GDP pp (from 3.4 to 4.5 per cent of the country's GDP) (World Bank Data, 2014[18]). During the same period, expenditure on education as a percentage of the country's GDP increased on average by nearly 0.4 pp in OECD countries (OECD, 2012). However, Chile's investment in education is still much lower than the OECD average. In 2010, Chilean expenditure on early childhood education was US$3,151 per student per year, just 58 per cent of the OECD countries' average of US$5,378 (OECD, 2012).

[18] Retrieved from http://data.worldbank.org/ (23/03/2014).

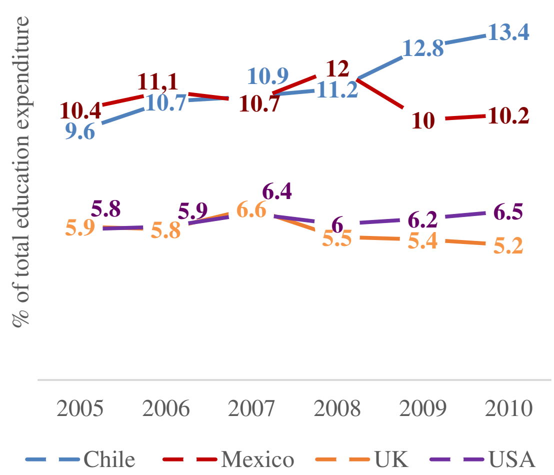
**Figure 2.3. Education expenditure in education and pre-primary education in Chile.**




Note: author's estimate based on World Bank Data, 2014
Panel A Education expenditure in Chile as a proportion of the country's GDP, 1990-2009.




Panel B: Total expenditure on pre-primary educational institutions as a % of GDP

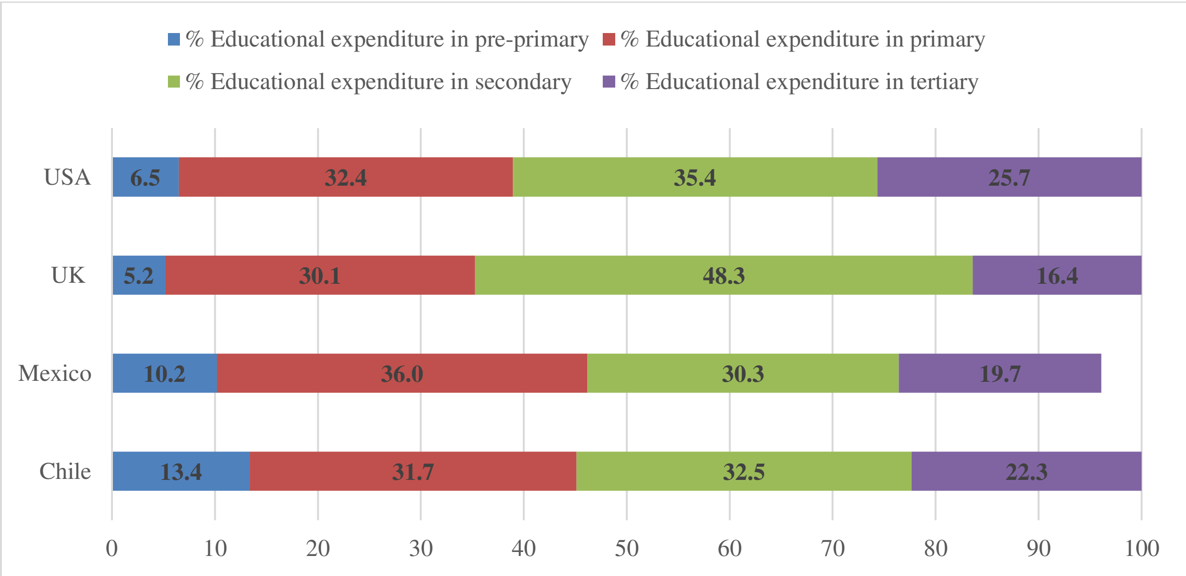



Panel C: Educational expenditure in pre-primary as % of a total educational expenditure

Chile's public expenditure on education is one of lowest within OECD countries in terms of total public expenditure on education as a percentage of GDP. However, Chile's public expenditure on education as a percentage of total public expenditure is the highest within OECD countries. In 2011, while OECD countries spent 13 per cent of total public spending on education, Chile spent 19.1 per cent. (OECD, 2012).

The expenditure of Chile in pre-primary education is large relative to the same expenditure in other countries. In Chile, the total expenditure on pre-primary educational institutions as a percentage of GDP has increased from 0.5 to 0.7 per cent of the GDP from 2005 to 2010. In addition, while OECD countries' average public expenditure on preschool education is 8 per cent of the total public expenditure, the same proportion in Chile is 13.4 per cent (OECD, 2012). In particular, this proportion in Chile is higher than the one in the UK (5.5 per cent) and the USA (6.5 per cent). These different proportions of investment in pre-primary education by countries may reflect different approaches on funding education (see Figure 2.4).

**Figure 2.4. Educational expenditure by educational level as percentage of total educational expenditure in the USA, UK, Mexico and Chile**




Note: Author's estimates are from Work Bank, 2014.

### Quality of ECEC in Chile

While there is no single definition of the requisites of a high-quality ECEC program, it is possible to identify certain characteristics that have been associated with better developmental outcomes. Espinosa (2002) distinguishes between 'structural' and 'process' dimensions of ECEC programs. A high-quality ECEC program has several structural factors. First, it has ample outdoor and indoor space and stimulating teaching materials available. Second, the program has highly skilled, adequately trained, and well compensated teachers and staff (Blau, 2000) with good opportunities for professional growth (Espinosa, 2002). Third, structural characteristics of high-quality programs are small group sizes and high adult–child ratio (Blau, 2000). These indicators are easy to observe and regulate. In addition, these structural characteristics provide the necessary conditions to develop high-quality adult-child interactions.

On the other hand, the ‘process’ dimension of a high-quality ECEC program reflects the actual experience that the children have in the program. Some of the process elements are: positive relationships between teachers and children, frequent conversations between them with mutual listening and back and forth exchanges, and a variety of stimulating instructional modalities and materials (Espinosa, 2002). The quality of instructional processes has important effects on children’s development. Teachers’ instructional interactions are a good predictor of children’s academic and language skills development. The more the caregiver speaks with the child, the better results the child has in cognitive and language development (NICHD Early Child Care Research Network, 2000; Shonkoff & Phillips, 2000). In addition, the quality of classrooms’ socio-emotional climates is also a good predictor of children’s social skills development. High-quality teacher–child interactions can facilitate children’s school readiness (Mashburn et al., 2008). The closeness of the teacher-child relationship is linked to both cognitive and social skills development, with a stronger effect on the latter (Peisner-Feinberg et al., 2001). Hence, a quality program in the dimension of processes is one in which children have close and positive relationships with teachers and peers; have access to different learning experiences relevant to their culture and appropriate to their developmental level and needs, and where families are involved and actively participate in children’s cognitive and socio-emotional development.

The indices of classroom quality differ for different age groups (Phillips, Mekos, Scarr, McCartney, & Abbott–Shim, 2000). In the case of children under three, for Donoso et al. (2009) the definition of quality should be based on an integrated model of development, with a crucial emphasis on the relationships between children and caregiver and the integration of emotional and cognitive skills. Regarding the relationship between the child and the caregiver, Dalli et al. (2011) state that for fostering development of children under three it is essential to maintain high ratios of adults to infants, that caregivers have specific training in infant pedagogy, and that the setting facilitates low levels of stress. In addition, Phillips et al. (2000) specify that the adult–child ratios for infants and group size for toddlers are key predictors of high-quality adult–child interactions for younger children.

Chilean standards are far from ideal. Chile’s quality standards for children under three years of age in the structural dimension are below international standards. In nurseries (for children up to two years of age) and in day care (children between two and four years of age) the adult–child ratios (teachers or teaching assistants) are 1:7 and 1:25 respectively (Ministerio de Educacion de Chile, 2014). The same standard in most OECD countries varies between 1:3 and 1:9 for children under three years of age with some exceptions such as Spain (1:13 for children between 12 to 24 months and 1:20 for children 24 to 35 months) and the USA (1:4 to 1:13 for children aged 27 months) (Munton et al., 2002). In addition, the Chilean regulation establishes that the teacher–child ratio is 1:42 for children under one year of age and 1:32 for children under three years of age (Ministerio de Educacion de Chile, 2014)

In addition, group sizes are also larger in the Chilean relative to the OECD countries standard. According to Chilean regulations, the maximum size of groups for infants, toddlers aged one and toddlers aged two are 7, 14, and 32 children respectively (Ministerio de Educacion de Chile, 2014). According to each country's regulations, the maximum size of a group for children under three years old in OECD countries varies between 10 to 14 children per group (CESifo DICE Report, 2010).

Preschool teachers who work in childcare centres in Chile must hold a degree from a four-year university or vocational institution. In addition, preschool teaching assistants must hold a vocational diploma whose courses last two years (Ministerio de Educacion de Chile, 2014). Although the preschool teachers and teaching assistants study courses that last between two and four years, the quality of this training is generally poor. Most current preschool teachers in Chile have obtained low scores in the standardised university selection test (*Prueba de Seleccion Universitaria*, or PSU for the acronym in Spanish) relative to graduates from other majors (Rolla et al., 2011). Moreover, admission to preschool teacher training is one of the least selective within university degrees in Chile (Tokman, 2010). Unfortunately, there are no specific studies describing the qualifications of Chile's preschool teachers that work with children under the age of three. Due to the large increase in ECEC program coverage since 2006, the number of graduates from the degree on early childhood education between 1999 and 2010 has increased more than twofold (113 per cent) (Ministerio de Educacion de Chile, 2014).

The results in Chile's INICIA test, which is a voluntary test that measures disciplinary and pedagogical knowledge of recent graduate preschool teachers, indicates that more than 60 per cent of recently graduated preschool teachers obtained poor results in 2012 (INICIA, 2012). Poor results in the INICIA test means that preschool teachers do not have the knowledge or skills necessary to exercise their profession. In addition, results from the evaluation of teachers who work in the public sector show that preschool teachers obtained lower scores compared to teachers in all other educational levels (Ministerio de Educacion de Chile, 2014).

It is worrying that the preschool education career in Chile does not attract the most talented students and that graduates who earn a preschool education degree do not have the necessary knowledge and skills to exercise their profession. There is a broad consensus among researchers, practitioners, and policymakers that the quality of early childhood services depends on well-educated, experienced, and competent staff (Urban, Vandenbroeck, Van Laere, Lazzari, & Peeters, 2012). The qualification level and training of teachers matter for child development (CESifo DICE Report, 2010; Munton et al., 2002). In particular, teachers of children under three years of age must have a nuanced understanding of how to foster child development at that age (Dalli et al., 2011).

Finally, the salaries of Chilean preschool teachers are lower compared to salaries of elementary and secondary school teachers and are duplicated by salaries obtained by graduates of related careers. Chilean preschool teachers earn lower salaries compared to the average salary of preschool teachers in the other OECD countries (Ministerio de Educacion de Chile, 2014). While the annual average salary of preschool teachers in Chile in 2012 was US$32,728 the average in England is US$43,949 and in the USA it is US$48,985 in (OECD, 2014b).

The fact that Chilean preschool teacher salaries are low relative to graduates from other degrees and compared to the salaries of preschool teachers in other countries is relevant because low salaries are associated with high turnover rates (Huntsman, 2008). Given that a stable relation with an adult is crucial for the development of children under three years of age, high turnover rates are especially negative for children in this age range. On the other hand, competitive salaries are a necessary condition for the preschool teaching profession to be able to attract the most talented students.

Some observational studies conclude that preschool programs in Chile are of low quality. Most of these studies analyse preschool levels of children older than the focus age of this study (children aged zero to three years old). However, these studies help to provide contextual information about the quality of the early childhood education in Chile. With respect to preschool teachers, Seguel, Edwards, Hurtado, Covarrubias, and Wormald (2007) found that only 21 per cent of preschool teachers carried out high-quality classroom practices that promote child development. A Chilean study at the preschool level (four to five years old) found that children attending at centre-based care have limited access to learning activities and individual stimulation (M. O. Herrera, Mathiesen, Merino, & Recart, 2005). In addition, a study conducted by the Chilean Ministry of Education found that preschool teachers devoted only 25 per cent of class time to educational activities, and 25 per cent was outdoor recreational time, with little adult supervision. Teachers spent the other 50 per cent of the time in daily care routines or just waiting. The study also found that preschool teachers do not take advantage of children's daily experiences as a mean for learning and development skills (MINEDUC, 1998 cited in Villalon, Suzuki, Herrera, & Mathiesen, 2002). Similarly, Strasser, Lissi, and Silva (2009) found that the distribution of instructional time by Chilean preschool teachers is highly deficient. They spend more than half of the time in non-instructional activities such as recesses, snack, and managing children's behaviour.

Villalón et al. (2002) report that Chilean preschool programs' quality is low. Personal care routines achieved the highest score, while creative activities and social development scored lowest. In addition, Chilean children are exposed to less literacy experiences than children in developed countries (Strasser & Lissi, 2009). Valenzuela (2005) concludes that Chilean preschool teachers use conversation as the main mean to develop children's language skills (cited in Strasser & Lissi, 2009). In addition, Eyzaguirre and Fontaine, (2008) conclude that language stimulation in kindergarten is deficient and the children's contact with reading is poor.

### 2.5. Conclusions: What has been achieved and what needs to be done?

The recent expansion of ECEC policies, the extension of parental leave, and the comprehensiveness of the CCC (Chile Grows with You) program, places Chile as one of the most advanced countries in the implementation of early childhood development policies in Latin America (Vegas & Santibanez, 2010). However, Chile has important challenges to overcome in order to guarantee that its early childhood policies actually have a positive impact on child development and, hence, tackle inequality from birth.

ECEC and parental leave policies in Chile theoretically match well to foster child well-being. The parental leave and the childcare coverage expansion complement each other well. Although regressive in distributional terms, the fact that the Chilean government provides a parental leave subsidy equivalent to the pre-birth salary implies that all new parents (mainly mothers) take the whole six months of post-birth leave. In addition, full-time childcare provision either begins during or immediately at the end of the maternal leave entitlement (depending on whether the parents choose full-time or part-time parental leave) and the 60 per cent most vulnerable households have free access to publicly-funded centre-based care. Moss (2012) stated that the previous complementation is relevant because an integrated approach to early childhood policies provides parents and children a smooth transition from full-time parental care to a shared care between parents and professional caregivers. Hence, integrated early childhood education and care policies may reduce the stress on parents and have a positive impact on child well-being.

One of the goals of the Chilean government is to increase childcare coverage for children under three years of age. At least two factors impede an increase in centre-based coverage in Chile for children under three years of age. First, there is a cultural conceptualization that the care of younger children is the family's responsibility. A large proportion of mothers in Chile believe that children under three years of age are better off with their mother or grandmother than in centre-based care. Continuing the increase in publicly-funded childcare coverage for children under three years of age is a big challenge because it involves the shifting of responsibility, power, and control from families to the government (Williams, 2010).

Second, the only type of care currently offered by the Chilean government to children under three years of age is centre-based care. There are no subsidies or certification schemes for childminders or other types of non-maternal care. To date, the Chilean government's main strategy to increase non-maternal care for children under three years of age is by expanding publicly funded centre-based care provision. Chile's current President Bachelet (2014–2018) promised to increase centre-based care coverage for children up to two years old in 90,000 places (50% of the current coverage in this age range). As I stated before, the current bottle neck for increasing coverage for children under three years of age is not necessarily in the supply of centre-based care (because some centres have idle capacity) but mostly in the demand for centre-based care. One way of increasing non-maternal care to facilitate female employment would be to foster other types of non-maternal care. There is no evidence in Chile about the effect of other types of non-maternal care that are not centre-based such as grandparent care, non-relative care or childminders. Other types of care might enable the Chilean government to increase non-maternal coverage while ensuring high-quality care. On the other hand, a key action to convince parents to send their children under three years age to centre-based care would be to show them that this type of care is beneficial for their children.

If the final goal is to foster child development, the mere increase in the coverage of centre-based care is not enough. Chile's early centre-based care provision must improve in structural characteristics and institutional setting. Some elements in the quality of centre-based care provision that indicate that this type of care is not helping to unleash children's full cognitive and socio-emotional potential. Some quality indicators of publicly funded childcare in Chile such as child ratios, group size, and teaching staff skills and training are below the standards of most OECD countries. As West (2006) concludes in the UK context, greater enrolment rates have not necessarily implied higher quality; this could also be applicable to Chile. The increase in ECEC enrolment has increased the total amount of resources spent, but not the per-capita expenditure necessary to maintain high-quality practices (Pacheco et al., 2005). In the case of Chile, the government has prioritised resources for increasing coverage of early education services rather than improving the quality of the existing services. The current ECD policies for children under the age of three are particularly worrying. The structural indicators of quality such as adult–child ratios, group size, and teacher training are particularly important to foster younger children's development. Small groups and specific training in early education (specifically in infant development for example) in centre-based care are key factors that facilitate the teaching staff to respond adequately to the specific necessities of each child. In addition, sensitive and responsive adults and a high-quality environment are key elements for centre-based care to have a positive impact in younger children's development and future learning (Dalli et al., 2011)

In a context of change and implementation of important early childhood policies in Chile, this thesis wants to shed light on how the type of care affects the development of children under the age of three in Chile. It is worth noting that in this thesis I do not evaluate the actual effect of the extension of parental leave in Chile or the expansion of publicly-funded

ECEC services, but provide results that could help to understand the possible effect of those policies. To evaluate the actual impact of the previously mentioned policies, further work needs to be done using new sources of data.

In a context in which Chile is increasing parental leave, there is no evidence about how the timing of maternal employment affects child development. During the first years of life mothers are often the main caregivers, this being one of the reasons they do not choose to use childcare services. Most of the mothers stayed home with their children one or more years after giving birth. Little is known about whether or how the length of time that mothers stay home with their children affects child development. In this context, this thesis would like to fill the knowledge gap and to provide information about the effects on child development of mothers delaying their return to work during their child's first year of life (See Chapter 4).

As we shall see in Chapter 5, during the first year of their children's lives, parents prefer to use informal care (grandparent and relative care) rather formal care. Unfortunately, there is no information about the enrolment or effects of alternative types of care ('informal care') on child development. This thesis will provide information about enrolment and effects of informal types of care relative to maternal care for children under three years of age in Chile. This will help inform policymakers about alternative types of care such as grandparent, relative, and non-relative care that are widely used by the population. These types of care have been under-researched in studies using both Chilean and international data.

At two years old, centre-based care becomes a more prevalent alternative of care. At that stage, more parents start to believe that attendance at this type of care is beneficial for child development. In Chapter 6, this thesis focuses on the association between attendance at centre-based care at two years old and child development.

Overall, this thesis would like to help inform the debate about which type of care and which timing during their three first years of life is better for child development in a middle-income country. In the next chapter, I describe the data source and methods used to answer these questions.

## 2.6. Appendices

### Appendix 2.1. Chilean demographic, economic and social indicators

| | Unit | Chile | OECD |
|---|---|---|---|
| **Demographic indicators** | | | |
| Population | 1,000 inhabitants | 17,403 | |
| Fertility rate (2011) | Children | 1.91 | 1.7 |
| Youth population aged less than 15 in 2010 | % of population | 22.3 | 18 |
| Infant mortality in 2010 | Per 1,000 people | 7.9 | 4.3 |
| Estimated life expectancy | Years | 78.3 | 80.1 |
| **Economic indicators** | | | |
| Real GDP growth | Annual growth (%) | 5.6 | |
| Annual median equivalised disposable household income in 2010 | 2010 USD (purchasing power parity) | 8.300 | 20.400 |
| Public social expenditure | % of GDP | 10.2 | 21.9 |
| Expenditure on pre-primary education in 2011 | % of GDP | 0.6 | 0.6 |
| Public expenditure per student per year in pre-primary in 2010 | USD $ | 3,151 | 5.378 |
| **Labour market indicators** | | | |
| Employment rate in population aged 15-64 in 2013 | % | 62.3 | 66.2 |
| Female employment in 2013 | % | 50 | 60 |
| Proportion of part-time employment in 2010 | % | 17.4 | 16.6 |
| Unemployment rate in whole economically active population (2013) | % | 6.2 | 9.1 |
| Unemployment rate in female economically active population (2013) | % | 7.1 | 9.3 |
| **Poverty and Inequality** | | | |
| Percentage of persons living with less than 50% of median equivalised household income | % | 18 | 11.3 |
| Gini coefficient | | 0.50 | 0.31 |

Source: OECD, 2013a, 2013b, 2014c

## Appendix 2.2. Maternity, Paternity, and Parental Leaves in OECD Countries

| Country | Type of Leave provided | Payment Rate | Total duration of leave (in months)[19] |
|---|---|---|---|
| Australia | 52 weeks of parental leave (and a right to request up to an additional 52 weeks per employed couple. | Unpaid. | 24 |
| Austria | 16 weeks maternity leave.<br>Parental leave until the child's second birthday. | 100% of prior earnings.<br>Unpaid. However, parents who earn less than €14,600 per year are paid at a rate of €14.53 per day, or €20.59 in the case of families with low incomes and single parents. | 24 |
| Belgium | 15 weeks of maternity leave plus 10 days of paternity leave.<br>4 months of parental leave for each parent. | In the private sector: first month at 82% of earnings and 75% for the remaining weeks, with a ceiling of €82.99 per day. Public sector: statutory civil servants receive full salary.<br>Flat rate of €707.08 per month | 12.3 |
| Canada (except province of Québec) | On average, 17 weeks of maternity leave.[20]<br>4 days paternity leave.<br>On average, 37 weeks of parental leave (for one parent or shared between two parents) | 15 weeks at 55% of prior earnings (ceiling of €375 per week)<br>55% of prior earnings. Low-income families are eligible to a family supplement to raise the payment. | 12 |
| Québec | 18 weeks of maternity leave.<br>5 weeks of paternity leave.<br>32 weeks of parental leave. | 70% of prior earnings.<br>70-75% of prior earnings.<br>Seven weeks of 70 % of prior income and 25 weeks of 55% of prior earnings | |
| Denmark | 18 weeks of maternity leave.<br>2 weeks of paternity leave.<br>32 weeks of parental leave to be divided between both parents[21] | Daily cash benefits based on former earnings up to a ceiling of €537 weekly | 12 |
| Finland | 18 weeks of maternity leave.<br>9 weeks of paternity leave.<br>26 weeks of parental leave.<br>Childrearing leave until child is three years old. | During the first 56 days of leave, the payment is equal to 90% of prior earnings<br>70% prior earnings<br>70% prior earnings<br>Flat rate | 36 |

[19] Maternal and parental leave.
[20] Length of leave and entitlement vary across provinces and territories.
[21] Parents can prolong the 32 weeks leave to 40 weeks.

| Country | Type of Leave provided | Payment Rate | Total duration of leave (in months)[19] |
|---|---|---|---|
| France | 16 weeks of maternity leave.<br>Two weeks of paternity leave.<br>Parental leave until the child is three years old. | 100% prior earnings<br><br>Unpaid for one child, paid at flat rate (income-tested) for two or more | 36 |
| Germany | 14 weeks of maternity leave<br>Three years of parental leave | 100% prior earnings<br>Flat rate (income-tested) for 2 years, unpaid during the third year. | 36 |
| Italy | 20 weeks of maternity leave.<br>One day of paternity leave.<br>Six months of parental leave for each parent with a maximum of 11 months. | 80% prior earnings<br><br>30% of prior earnings | 14.6 |
| Norway | Nine weeks of maternity leave.<br>Two weeks of paternity leave<br>47 or 57 weeks of parental leave.<br>Two years of childrearing leave. | 100%-80% of earnings<br><br>47 weeks at 100% of earnings or 57 weeks at 80%of earnings, up to a ceiling of six times the basic national insurance benefit payment<br>Unpaid | 12.6 |
| Portugal | 17–21 weeks of maternity leave.<br>20 days of paternity leave.<br>Parental leave of three months per parent. | 17 weeks at 100% prior earnings or 21 weeks at 80% of earnings<br><br>25% of average earnings | 12 |
| Spain | 16 weeks of maternity leave.<br>15 days of paternity leave.<br>Parental leave until the child turns three years old. | 100% of prior earnings<br><br>Unpaid. | 36 |
| Sweden | 18 months of parental leave. | 12 months at 80% of prior earnings, 3 months flat rate, 3 months unpaid | 18 |
| United Kingdom | 52 weeks of maternity leave.<br>Two weeks of paternity leave.<br>18 weeks of parental leave per parent per child[22] | 90% during first six weeks and flat rate of €160 during the next 33 weeks. The remaining 13 weeks are unpaid.<br>Unpaid. | 12 |
| United States | 12 weeks of family leave | Unpaid. | 2.8 |

Source: Kamerman, 2000; Moss & Wall, 2007; Moss, 2013; Ray, 2008

[22] Up to the child's fifth birthday, with a maximum of four weeks leave to be taken in any one calendar year.

**Appendix 2.3. Childbirth Related Policies in 12 Latin American Countries**

| Country | Type of Leave provided | Months | Payment Rate | Source of funding | Day care | Paternity leave |
|---|---|---|---|---|---|---|
| Argentina | 90 days of maternity leave: 45 days before birth and 45 days after birth. | 2.9 | 100% full wage replaced | Social security | | Two days of paternity leave |
| Bolivia | 90 days of maternity leave, 45 days before birth and 45 days after birth. | 2.9 | 100% for workers earning the minimum wage; 70% if salary is higher than the minimum wage. | 90% Social security and 10% employer | | Not included |
| Brazil | 120 days extended to 180 days in the private sector<br>180 days in the public sector<br>Five days paternity leave in private sector and<br>10 days in public sector | four or six | 100% wage replaced until 120 days. The next 60 days are compulsory to the public sector and optional to the private sector | Social security | Right to day care centre in enterprises with 29 or more women | Five days paternity leave |
| Chile | 18 weeks of maternity leave (six weeks before birth and 12 weeks after) (before 2011) | 4.2 | 100% wage replaced with a cap of £1,800 monthly salary | Social security | Right to day care centre in enterprises with 20 or more women | Five days paternity leave |
| Colombia | 12 weeks of maternity leave (six of them mandated after birth) | 2.8 | 100% wage replaced | Social security | | Eight days paternity leave (if both parents contribute to the social security system) If not four days |
| Costa Rica | 16 weeks of maternity leave | 3.7 | 100% wage replaced | Mixed (50% social security; 50% employer) | | Not included |

| Country | Type of Leave provided | Months | Payment Rate | Source of funding | Day care | Paternity leave |
|---|---|---|---|---|---|---|
| Cuba | 18 weeks, six weeks before and 12 weeks after birth. " extra weeks in case of multiple birth[23] | 4.2 | 100% wage replaced | Social security | | Parents can decide that either the mother or the father takes some of the post natal leave |
| Ecuador | 12 weeks, 2 weeks before and 10 weeks after birth. | 2.8 | 75% wage replaced | 75% social security system and 25% employer | Right to day care centre in enterprises with 50 or more women | 10 days paternity leave |
| Honduras | 10 weeks | 2.3 | 100% wage replaced for 84 days | Social security | | Not included |
| Mexico | 12 weeks of maternity leave, six weeks before and six weeks after birth | 2.8 | 100% wage replaced | Social security. Employer covers 100% if social security contributions absent | Right to day care centre of mothers who contribute to social security | Not included |
| Paraguay | 12 weeks of maternity leave | 2.8 | 50% for nine weeks | Social security | | Two days of paternity leave |
| Peru | 90 days, the days before birth cannot exceed the 45 days. 30 more days for a multiple birth | 2.9 | 100% wage replaced | Social security | | Four days of paternity leave |
| Uruguay | 12 weeks of maternity leave, six weeks before and six weeks after. 13 weeks for public sector | 2.8 | 100% wage replaced | Social security | | 10 days paternity leave for public sector. Three days private sector |
| Venezuela | 18 weeks of maternity leave, six weeks before and 12 weeks after | 4.2 | 100% wage replaced | Social security | Right to day care centre in enterprises with 20 or more women. | |

Source: ILO, 2010; Moss, 2013; Pautassi & Rico, 2011.

[23] Six weeks post natal leave in case that the child dies at birth or during the first four weeks.

# Chapter 3

# Methods and data source

## 3.1. Introduction

My aim in this thesis is to bring new evidence about the association between attendance at different types of care during the first three years of life and child development in Chile. This question is complex because the relation between type of care, timing and child development could be mediated by several variables such as the quality of centre-based care, the characteristics of mothers and families, and the children's experiences.

To conduct this research, I choose the empirical approach, the methods and data that enable me to obtain the most rigorous association between type of care, timing of early maternal employment, and child development. By using the term association I account for the fact that the absence of an exogenous shock to the type of care and timing of early maternal employment weakens the researcher's capacity to infer causality. This study is a quantitative non-experimental research that uses fixed effects models, propensity score matching and multivariate OLS regressions to analyse a novel Chilean longitudinal survey—the *Encuesta Longitudinal de la Primera Infancia* (Longitudinal Survey of Early Childhood, in Spanish, *ELPI*). In each empirical chapter I discuss with greater detail the variables and the specific analysis. The present chapter is focused on discussing the dataset, the instruments used to measure child development, and the method.

The current chapter is organised as follows. In the second section of this chapter I describe the ELPI panel dataset. I use this dataset in all the empirical chapters. As part of the previous description, I explain the instruments used in the ELPI dataset to measure child development. In section 3.5, I provide an overview of this thesis' methods. Finally, section 3.6 concludes this chapter by presenting some reflections from my fieldwork in Chile and the use of longitudinal surveys.

## 3.2 Data source: Encuesta Longitudinal de la Primera Infancia (ELPI)

The ELPI is a longitudinal household survey whose first two waves took place in 2010 and 2012. The ELPI survey responded to the necessity of having an instrument to evaluate the impacts of the new early childhood policies in Chile implemented since 2006. The ELPI's initial objective was to increase available information and to create data to track early childhood development in Chile (*Centro de Microdatos*, 2013a). A longitudinal survey provides information about the same sample of individuals at different points in time. The repeated measures of the same children and household members facilitate identification of the impact of specific policies on child development. The ELPI’s first wave was funded by Chile's Ministry of Education and the second wave, by Chile's Ministry of Labour and Social Security. Both waves were conducted by *Universidad de Chile*’s *Centro de Microdatos*. The data for ELPI's first wave in 2010 was collected between March and June.

I use ELPI 2010 for conducting the analyses in chapters 4 and 5. I use both ELPI 2010 and 2012 for conducting the analysis in Chapter 6. The main reason why I did not use the 2012 wave in chapters 4 and 5 is that these are two stand-alone papers that I wrote before the ELPI 2012 was available. However, there are also other reasons related to the methods that I discuss in subsection 3.5.

### *3.2.1 ELPI’s sampling, sample size, attrition and weights*

<u>Sampling</u>

The selection of units of analyses were performed using systematic random sampling and the distribution of the sample was made in proportion to the population of each stratum (Levy & Lemeshow, 1999) considering the 15 administrative regions in Chile. To obtain a representative sample of children, the *Centro de Microdatos* (2012) used a two-stage design stratified by clusters. The two-stage sample design ensures that every eligible boy or girl in Chile has a similar probability of being selected and provides a more efficient way of grouping the sample. (*Centro de Microdatos,* 2012)

ELPI's sampling design is a multi-stage stratified sampling. In the first stage, the researchers in charge of the ELPI survey selected the municipalities using both the 2002 Census and the

2006 CASEN survey (a national representative household survey). Out of 346 municipalities in Chile, the 83 most populous municipalities in Chile--which account for 74 per cent of the country's population--were selected with probability one. Out of the remaining 263 municipalities, 33 were selected in the first selection stage. To select these 33 municipalities, the *Centro de Microdatos* stratified the 263 remaining municipalities by region, and groups of per capita income and population of children between six months and five years old. The second stage consisted of randomly selecting the children within each selected municipality using systematic sampling, which is a simple way to implement a random sampling *(Centro de Microdatos*, 2010).

Sample size

The sample size of the baseline survey (ELPI 2010) was 15,000 children aged six months to five years old at the time of the first wave. Given the relatively large sample size, the ELPI 2010 survey enables the researcher to obtain sufficient power for each age group (*Centro de Microdatos*, 2010). Given that in this study the group of interest is only a subset of the whole sample--children younger than three years old--ELPI's sample size is appropriate to address my research questions. ELPI 2012 included 3,000 new children born between September 2009 and December 2011. Hence ELPI 2012 has a sample size of approximately 18,000 children. (This new children are not included in the analyses of this thesis).

Attrition and survey weights

Given that the ELPI survey has cross-sectional and longitudinal weights, each wave of the survey and both waves used together as a panel are representative at a national level. While in Chapter 4 and Chapter 5 I use the cross-section weights of ELPI 2010, in Chapter six I use the survey's longitudinal weights to adjust for attrition (Mcdonald & Ketende, 2010; Kalton, 1986).

**Table 3.1. Sample size in ELPI 2010 and 2012**

| | **ELPI 2010** | **ELPI 2012** |
|---|---|---|
| Longitudinal | 15,175 | 12,898 |
| Cross-sectional | 0 | 3,135 |
| Total | 15,175 | 16,023 |

Source: *Centro de Microdatos*, 2011, 2013b.

Given that 2,277 children were not in ELPI 2012, the attrition level[24] was 15.3 per cent, (Bravo, 2012). For longitudinal surveys in developing countries, this percentage of attrition is within expected ranges. Alderman, Behrman, Watkins, Kohler, and Maluccio (2001) show that the attrition rate of longitudinal surveys from developing countries differs largely from six to 50 per cent between two survey waves. Plewis (2007) describes the attrition rate between waves 1 and 2 in the Millennium Cohort Study (MCS) as 21 per cent. The attrition between waves 1 and 2 rate of the 1970 British Cohort Study (BCS70) was 19 per cent and in the National Child Development Study (NCDS) was 9 per cent (Plewis, Calderwood, Hawkes, & Nathan, 2004).

### *3.2.2. The type of information ELPI collects*

The survey has two main components: a questionnaire and an application of a battery of cognitive, socio-emotional and anthropometric assessments to the caregiver and child. To collect this information, ELPI conducted two home visits to each household. During the first visit, surveyors collected background information about the household. During the second visit, a trained professional assessed children and caregiver at home.

#### The ELPI Questionnaire[25]

The ELPI questionnaire has 188 questions divided into 11 categories.

[24] Attrition takes place when a unit drops out of the study at one wave and remains out after that (Mcdonald & Ketende, 2010)
[25] For access to the whole questionnaire, see www.elpi.cl.

**Table 3.2 ELPI's survey categories**

| | Categories | Content | Number of items |
|---|---|---|---|
| A | Household composition | Relationships, sex, age, marital status and whether descendant of indigenous peoples. | 23 |
| B | Household members' level of education | Years of schooling and level of education of each household member. Perception about adequacy of nearby centre-based care. | 4 |
| C | Employment | Current employment status of each working-age (15 years and older) household member. | 16 |
| D | Household income | Labour earnings from the main and secondary occupation and other earnings (government subsidies, pensions, interest and rent, among others). | 11 |
| E | Welfare | Social security system (pensions) and health insurance system used. | 3 |
| F | Assets | Appliances, public utilities and internet connection available to household members. Housing quality: predominant material, number of rooms and housing tenure. | 8 |
| G | Pregnancy | Pregnancy checks, diseases, medical conditions and nutritional status. Birth: type of delivery, complications during pregnancy and delivery and use of sick leave. | 42 |
| H | *Chile Crece Contigo* Program (Chile Grows with You) | Activities, games, learning materials and milk provided by the Program. Participation in the Program. | 30 |
| I | Immunization | Vaccinations. | 9 |
| J | Childcare | History of the child's type of care. | 35 |
| K | Father situation | Information about the child's biological father in case the father is not a member of the child's household (otherwise, the father's information is recorded in modules A through D). | 7 |

<u>Development outcomes in ELPI</u>

Child development is a complex and multidimensional progression characterized by a series of incremental and continuous learning processes. Child development is multidimensional because it encompasses different dimensions that cannot be understood in isolation. Each of these dimensions takes a leading role depending on the age and developmental level of the child. Within child development, we can distinguish at least five key areas: physical, motor, cognitive, psycho-emotional and social (Observatorio Social, 2009). Given that all dimensions are linked to each other, the division of child development into different areas is arbitrary and subject to different interpretations.

The ELPI survey divides child development into two domains: psychomotor and socio-emotional. Hence, the survey collapses motor and cognitive skills into the psychomotor learning category. However, some instruments for development outcomes in the ELPI survey do not measure motor development. For example, while the Battelle, EEDP and TEPSI tests evaluate psychomotor and cognitive development, the PPVT test only measures cognitive development (specifically, language). On the other hand, the CBCL and ASQ tests collapse both emotional and social domains into socio-emotional development. (Please note that all acronyms are defined below.)

The battery of instruments for children in 2010 had four instruments for cognitive development, two for socio-emotional development and three anthropometric measures. The type and number of instruments used depended on the age of the children.

**Table 3.3. Instruments that assess child development in ELPI 2010**

| Area | Child's age | Instruments |
|---|---|---|
| Cognitive | Children between Six and 23 months | • *Escala Evaluación Desarrollo Psicomotor* (EEDP, in English, Psychomotor Development Evaluation Scale)<br>• The Battelle Developmental Inventory |
| | Children Between 24 and 60 months | • *Test de Desarrollo Psicomotor* (TEPSI, in English, Psychomotor Development Test) |
| | Children between 30 and 60 months | • Peabody Picture Vocabulary Test |
| Socio-emotional | Children between Six and 17 months | • Age and Stages Questionnaires (ASQ: Social Emotional). A Parent-Completed, Child-Monitoring System for Social-Emotional Behaviours There are three versions six months, 12 months and 18 months, which were applied to children aged 6–8 months, 9–14 months and 15–17 months respectively. |
| | Children Between 18 and 36 months | • Child Behaviour Checklist |
| Anthropometric | Children between Six and 59 months | • Height |
| | Children between Six and 59 months | • Weight |
| | Children between Six and 59 months | • Cranial circumference |

**Child motor and cognitive outcomes**

The ELPI survey assesses the cognitive and non-cognitive skills of children between six months and five years old. To evaluate cognitive skills, it uses four instruments depending on the child's age[26].

*Escala Evaluación Desarrollo Psicomotor* (EEDP): EEDP is an instrument developed in Chile during the 1970s. This instrument is widely used in the country's public health centres and health research for measuring cognitive skills development (Bedregal, 2008). EEDP is a standardized psychomotor development test for Chilean infants between 0 and 24 months old. The test has 75 items in total and it assesses four domains: (a) Motor domain, where the EEDP evaluates gross motor skills, body coordination, and postural reactions. (b) Language domain, which evaluates both verbal and nonverbal reactions to sound, soliloquy, vocalization, comprehension and utterances. (c) Social domain, which evaluates the child's ability to react to people and to learn through imitation. (d) Coordination domain, which evaluates the child's ability to coordinate different movements. (Rodriguez, Arancibia, & Undurraga, 2008). The EEDP shows high test-retest reliability[27] and validity[28] (Martinez & Urdangarin, 2005).

The Battelle Developmental Inventory (BDI): This is a semi-structured assessment that involves observation of the child, interviews with parents and caregivers and interaction with the child using toys, questionnaires, and tasks. The Battelle assesses five domains of development: adaptive behaviour, personal /social skills, communication; gross and fine motor ability, and cognitive skills. The BDI's test-retest reliability is between .90 and .99 depending on the child's age range and it has a well-documented high validity (Berls & McEwen, 1999).

*Test de Desarrollo Psicomotor* (TEPSI). TEPSI is the first standardised psychomotor development test made in Chile for children between 24 and 60 months old. The TEPSI test is a well-known instrument in Chile for measuring cognitive skills and it is used in all Chilean public primary health care centres. This test measures the psychomotor development,

[26] In each empirical chapter I use the results of different development tests depending on the research question, and the children's targeted age.
[27] Test-retest reliability is used to assess the consistency of repeated measures to the same child during a specific period of time.
[28] *Validity*: refers to the extent to which the instrument actually measures the variable it claims to measure (Berls & McEwen, 1999).

determining whether the child has normal or lower-than-expected performance. The TEPSI test has 52 items in total and assesses three domains. First, the TEPSI test evaluates the motor domain, which includes body coordination and postural reactions. Second, this test evaluates the language domain, which includes the ability to understand and execute certain commands, the management of basic concepts, mastery of a certain amount of vocabulary, and the ability to describe and verbalize. Third, the TEPSI test evaluates the coordination domain, which includes fine motor skills development. Each subtest and the total score have a pre-calibrated standard to detect the existence of any delay in the child's psychomotor development in some particular aspect or in general (Marchant & Haeussler, 2007).

Peabody Picture Vocabulary Test (PPVT). The PPVT measures verbal ability. It can be used with children aged two years and upwards. In this test, the child is asked to point to one of four pictures on a page that corresponds to the word spoken by the examiner. The sequence of words progresses from easy to more complex. Performance is measured by comparison with other children in the same age group, and test results are expressed as a percentile ranking and an equivalent educational age. PPVT's reliability is high (.95) (Observatorio Social, 2009).

**Children's socio-emotional outcomes**

Ages & Stages Questionnaires: Social-Emotional (ASQ–SE). The ASQ-SE are questionnaires completed by parents or caregivers. These questionnaires evaluate children's social and emotional behaviour through self-regulation, compliance, communication, adaptive functioning, autonomy, affect, and interaction with people. The ASQ-SE is an instrument widely used in international studies. It has a high test-retest reliability (.94). In addition, both its concurrent and predictive validity are also high (Ringwalt, 2008).

Child Behaviour Checklist (CBCL). The CBCL has been one of the most widely-used standardized measures in child psychology for evaluating behavioural and emotional problems (Ivanova et al., 2007). In this test, mothers report child behaviour. The CBCL assesses two broad socio-emotional domains: internalizing (anxious, depressive, and over controlled) and externalizing (aggressive, hyperactive) behaviour problems. In addition, this test measures several subdomains including social withdrawal, somatic complaints, anxiety and depression, destructive behaviour, social problems, sleeping problems, attention problems and aggressive behaviour (Achenbach & Ruffle, 2000). The CBCL has 100 items that are rated on a three point scale from 0 (not true about the child) to 2 (very true about the child). CBCL has a good validity of .77 (Observatorio Social, 2009).

The ELPI 2012 wave included new instruments to measure the children's executive function. Table 3.4 shows the list of instruments used in this wave. Given that in Chapter 6 I exploit the longitudinal aspect of the ELPI survey, I only used the tests included or that had equivalents in both ELPI's 2010 and 2012 waves. The CBCL test appears in both 2010 and 2012 waves. Although the Battelle Inventory Developmental Screening and the TADI tests were new measures that appear only in ELPI 2012, the Centro de Microdatos included them as follow-up tests of the Battelle and EEDP tests respectively that were passed in 2010.

The Battelle Inventory Developmental Screening Test (BDIST). The BDIST is a short version of the BDI. The BDIST has 96 items organized in the following domains: language, motor, adaptive, personal/social, and cognitive. This test uses a combination of direct assessment, observation and parental interview. The BDIST's retest reliability and concurrent validity are high (Ringwalt, 2008). The average correlation between the BDI test taken in 2010 and the BDIST taken in 2012 to the same children was .32.

*Test de Aprendizaje de Desarrollo Infantil* (TADI): The TADI is a recently developed test in Chile for children from three months to six years old. One of the goals of the authors of this test was to have a valid, reliable and pertinent instrument for the current Chilean context. The test evaluates four dimensions: motor, language, cognitive, and social-emotional. The TADI is applied individually to children and requires the presence of a significant adult to the child. The TADI has items divided into three formats: direct measurement of the child, observations by the test-taker, and joint tasks between the caregiver and the observed child. Each item has a dichotomous score relative to the achievement of each assessed aspect (*Centro de Microdatos*, 2013a). Both TADI's retest reliability and validity are high (.90) (Pardo, Gomez, & Edwards, 2012). The TADI was conceived as an updated version of the EEDP test. ELPI's 2012 wave included the TADI instead of the EEDP test. Therefore, in Chapter 6 I use the TADI as a cognitive follow-up test of the EEDP test. The average correlation between the EEDP test taken in 2010 and the TADI taken in 2012 to the same children was .22.

**Table 3.4. Battery of instruments for children assessment ELPI 2012**

| Area | Child's age | Instruments |
|---|---|---|
| Cognitive | Between six and 83 months | Test de Aprendizaje de Desarrollo Infantil (TADI), in English Child Development Cognitive Test) |
| | Between 24 and 60 months | The Battelle Inventory Developmental Screening test (BDIST) |
| | Between 30 and 83 months | Peabody Picture Vocabulary Test |
| Socio-emotional | Between six and 17 months | ASQ: Social Emotional (A Parent-Completed, Child-Monitoring System for Social-Emotional Behaviours) There are three version 6 months, 12 months and 18 months. |
| | Between 18 and 71 months | Child Behaviour Checklist (CBCL) I |
| | Between 72 and 83 months | Child Behaviour Checklist (CBCL) II |
| Executive Function | Between 24 and 35 months | Snack Delay Task (SDT) |
| | Between 24 and 35 months | Pencil Tapping Task (PTT) |
| | Between 36 and 83 months | Backward Digit Span Task (BDS) |
| | Between 36 and 83 months | Head Toes Knees Shoulders Task (HTKS) |
| Anthropometric | Between six and 84 months | Height |
| | Between six and 84 months | Weight |
| | Between six and 84 months | Cranial circumference |

**Caregivers' measures**

The ELPI 2010 wave has cognitive, socio-emotional and health (height and weight) outcomes of the main caregivers (most of them, the children's mothers) that I included as covariates in the models.

Wechsler Adults Intelligence Scale (henceforth, WAIS) measures caregivers' cognitive skills. The WAIS test assesses adult global intelligence using the individual's IQ as a proxy for intelligence. The main measured variables in the WAIS test are verbal IQ, performance IQ, and full scale IQ. The test has seven verbal subtests and seven performance subtests (Kaplan & Saccuzzo, 2009). The ELPI 2010 wave used only two out of 14 subtests: vocabulary and digit span. The WAIS vocabulary subtest assesses the caregiver's cultural level, especially the caring environment and the caregiver's schooling level. In addition, the WAIS vocabulary subtest also assesses the caregiver's ability to properly receive, store and use new information.

This subtest also measures the caregiver's sorting and conceptualization capacity. On the other hand, the WAIS digit span subscale evaluates the caregiver's working memory and processing speed. Additionally, it measures short-term memory, sequencing under distractors, facility with numbers, and mental alertness. A high score in the WAIS digit span subtest suggests rapid adaptation to stimuli, from which could be inferred flexibility of the cognitive adaptation capacity (Kaplan & Saccuzzo, 2009).

The Spanish Big Five Inventory (henceforth, BFI) measures the caregivers' personality traits. The BFI is a questionnaire of 44 items that assesses personality in the following dimensions: extraversion, agreeableness, conscientiousness, neuroticism, and openness (John, Naumann, & Soto, 2008). Extraversion assesses the ability to communicate with other people, to be assertive. Agreeableness evaluates the person's altruism and capacity to establish personal links with others. Conscientiousness is the ability to control impulses, plan, organise, and implement projects and ideas, and having purposes or clear goals. Neuroticism indicates the presence of features such as emotional instability and the tendency to experience negative emotions such as fear, guilt, sadness or anger. Finally, openness evaluates the presence of active imagination, aesthetic sensitivity, capacity for introspection, and intellectual curiosity (John et al., 2008).

The WAIS and the BFI provide important information about mothers' cognitive abilities and personality. These are associated with maternal outcomes such as educational attainment and labour market outcomes (Almlund, Duckworth, Heckman, & Kautz, 2011; Duckworth et al., 2008).

**Household Measures in ELPI 2010**

<u>Home Observation for Measurement of the Environment (HOME).</u> In this instrument a trained surveyor (psychologists) observes and interview the primary caregiver (mainly mothers) to assess the quality and quantity of stimulation and support available to a child at home. The HOME test has been used to measure the effect of the home environment on child development in several studies (for a list of studies using the HOME test see Totsika and Sylva, 2004). This test assesses four aspects of family environment: 1) emotional and verbal response of the mother / caregiver, 2) restriction and punishment, 3) maternal commitment to

the child, and 4) the home environment. Unfortunately, the ELPI survey only included a subset of the questions within each dimension of this instrument. The non-standard selection of questions does not permit to have a standardised final score fully comparable with other studies. (See table 3.5 for more information about the instrument).

**Table 3.5. HOME inventory subscale**

| Name of subscale | Description | Example item |
|---|---|---|
| Learning materials | Toys and activities directed towards the intellectual development of the child | Child has toys that teach colours, sizes and shapes. Child has three or more puzzles. |
| Language stimulation | Verbal communication between child and caregiver that is intended to help language development. | Child has toys that help teach names of animals. Child is encouraged to learn the alphabet. |
| Physical environment | The household's dwelling safety. | Building appears safe and free of hazards. Outside play environment appears safe. |
| Responsivity | The quality of verbal interactions between the caregiver and the child. | Parent holds child close for 10-15 minutes per day. Parent converses with child at least twice during visit. |
| Academic stimulation | Encouragement of the child's intellectual development. | Child is encouraged to learn colours. Child is encouraged to learn patterned speech. |
| Modelling | Use of boundaries in the caregiver-child relationship | Some delay in food gratification is expected. TV is used judiciously. |
| Variety | Indoors and outdoors activities of the child | Child has real or toy musical instrument. Child is taken on outing by a family member at least every other week. |
| Acceptance | The way the caregiver disciplines the child | No more than one instance of physical punishment occurred during the past week. Parent does not scold or yell at the child more than once. |

Source: Totsika & Sylva, 2004

### 3.3. Strengths and limitations of the ELPI dataset

The ELPI dataset has several features that make it an excellent match with the objectives of this research. First, the ELPI dataset is the first representative sample at Chile's national level with early childhood development outcomes. Before the ELPI dataset, research on early childhood was based on small samples not nationally representative (for some examples, see Cortazar, 2011; Noboa-Hidalgo & Urzua, 2012; Seguel, Edwards, Hurtado, & Chadwick, 2009). Second, the ELPI was designed to evaluate early childhood development. Hence, it has extremely detailed information about the childcare history (e.g. every three months during the child's first year of life), maternal employment history (before and after childbirth) and a battery of child outcomes in different domains (cognitive, socio-emotional, and health domains). In addition, the ELPI has a complete set of variables that are associated with child development such as maternal cognitive abilities, maternal personality, maternal mental health or learning environment. Moreover, the ELPI has data about the child's mother's pregnancy and the household's socio-economic status which are relevant covariates in my models. Third, the ELPI dataset has a large sample size of children between the ages of zero and five (15,000 children) and a multi-cohort design that allows simultaneous analyses for children of different ages with sufficient power to detect low levels of association. In addition, the previously mentioned sample size and the detailed covariates enable me to allow for a heterogeneous association between type of care and child development depending on the child's household vulnerability or type of maternal job. To my best knowledge, the previously mentioned features of the ELPI are unique in the context of a middle-income country.

Using the ELPI dataset also entailed some difficulties and limitations. First, after the release of the data of the first wave in February of 2011, the *Centro de Microdatos* released a revised version of the dataset in July 2013 with corrections in standardised tests and including 300 new development outcomes of children (previously with missing data in their development outcomes). This meant that I had to re-write Chapter 4 and 5 using the revised version of the data set.

Second, it was not possible for me to obtain a merged dataset of the ELPI with administrative datasets. This limited my work in two ways. First, I could not confirm the reliability of some declared information with administrative sources. For example, in the case of family income this could be relevant because while higher income individuals tend to under-report their income, lower-income individuals tend to over-report it. In addition, I could have checked the reports of timing of early maternal employment against the child-related leaves dataset to detect miss-reported timing information. Second, due to confidentiality issues, I was not allowed access to the (existing) georeferenced location of children's addresses and centre-based care institutions. This information would have enabled me to use an alternative way to identify the impact of centre-based care (relative to maternal care) on child development. Specifically, I could have used the distance of the children to the nearest centre-based care as an instrument for estimating attendance at centre-based care. Possibly, children living nearer a centre-based care are more likely to attend to it relative to children living farther from a centre-based care institution. If distance to centre-based care only affects children's development outcomes through attendance to day care, the proxy would be a valid one (Hill, Waldfogel, Brooks-Gunn, & Han, 2005).

Third, it would have been useful if the ELPI dataset were more detailed. For example, I did not have access to the results of the sub-areas in the EDDP test. This impeded me from calculating and analysing the correlation between the different sub-areas of this test and the association between the sub-areas of the EEDP and other cognitive tests such as the Battelle test.

### 3.4. Methods

Using the ELPI dataset with its strengths and limitations, I chose the best methods that would allow me to identify a careful association between type of care or early maternal work and child development. In what follows, given I use these methods in my empirical chapters (Chapter 4, Chapter 5, and Chapter 6), I briefly explain what propensity score matching ('PSM') methods and fixed effects models are and how they are estimated.

*3.4.1. Propensity Score Matching*

PSM was designed to assess program effects in the absence of a control group. The aim of PSM is to select a group of individuals who received a treatment[29] with a comparable group, according to observable features, which did not receive the treatment (Rosenbaum & Rubin, 1983).

The advantage of PSM over OLS is that the former is more robust to misspecification bias than the latter. Misspecification refers to assuming an incorrect functional form in the relation between the covariates and the outcome variable (Drake, 1993). In the particular case of OLS regressions, misspecification refers to assuming wrongly that the independent variables are related in a linear and additive way with the dependent variable.

In Chapter 4, PSM enables me to compare the development outcomes of children whose mothers start working between zero and three, three and six, six and 12 and 12 and 18 months after delivery (the treatment group) with children who share similar socio-demographic characteristics whose mothers did not start working during this period (the control group). In Chapter 5, PSM enables me to compare the development outcomes of children who attended different types of non-maternal care during the first year with children who share similar socio-demographic characteristics and were cared for exclusively by their mothers (this is the control group). The different types of non-maternal care are relative, grandparent, centre-based and non-relative care; all these categories form the treatment groups in Chapter 5. Finally, in Chapter 6, PSM allows me to compare children who attended centre-based care at age two (my treatment group) with children who share similar socio-demographic characteristics and were cared for exclusively by their mothers (my control group).

When running a PSM analysis, the first step is to select the variables that predict the treatment. In the context of this study, I choose all the covariates used in my regression analysis. Hence, these are variables that, according to previous evidence may be correlated both with the type

[29] Acknowledging that the variation in the key variable (type of care in Chapter 4, early maternal employment timing in Chapter 5 and centre-based care in Chapter 6) is not exogenous or random relative to the characteristics of the children, in line with most of the program evaluation literature, I use the word 'treatment' to denote the status of individuals experiencing a specific policy or experience (e.g. attendance at centre-based care or early maternal employment).

of care or the timing of early maternal employment (my key explanatory variables) and children's development outcomes (my outcome variables).

In a first stage, the PSM model calculates the predicted probability (propensity score) that each child is treated. In a second stage, each treated individual is matched to an untreated individual with the most similar propensity score. The propensity score range is between zero and one (excluding both lower and upper limits). To create a matched comparison group I implemented a one-to-one, nearest-neighbour PSM with replacement. In this type of matching, each treated unit is matched to the control unit with the nearest propensity score (Blundell & Costas Dias, 2009). For each couple of treatment and control groups, I calculate how balanced the matched groups are using a t-test of difference in means for each variable used for predicting the propensity score. In this balance check, the smaller the t score, the greater the balance between groups is.

In my analyses I prefer to estimate the average treatment on the treated effect (ATT) parameter rather than the average treatment effect (ATE) parameter for at least two reasons. First, the calculation of the ATT parameter requires a weaker set of assumptions. Calculating the ATE is equivalent to calculating the average difference in child outcomes for the treatment group and the control group once every individual in the both groups is matched with an individual in the other group. Hence, the calculation of an unbiased ATE parameter requires the assumption that the control (treatment) group would have experienced the same average outcome as the treatment (control) group should the control (treatment) group have been treated. On the other hand, the ATT parameter is the average difference in child outcomes for the treatment group once every individual in this group is matched with an individual in the control group. Hence, the calculation of an unbiased ATT parameter only requires the assumption that the control group would have experienced the same average outcome as the treatment group should the control group have been treated (Blundell & Costas Dias, 2009). In the context of this study, the ATE would be biased if there are children in the control groups (those who were always cared exclusively by their mothers or that did not attend non-maternal care) who do not have an equivalent child in terms of their propensity to be treated in the treated groups. This could happen, if, for example, there are children whose mother has an extremely low employability (in the case of the maternal employment chapter) or lives too far away from centre based care programs and potential informal carers (in the case of the type of care chapters).

A second reason why I opt for the calculation of the ATT parameter is its target population. Given that both attendance to non-maternal care and early maternal employment are (to a certain extent) optional, I think it is more interesting to estimate the effect on the population of children whose parents are willing to either enrol their child in non-maternal care or engage in early maternal employment.

For information more specific to each chapter, please refer to the methods section in each empirical chapter.

### *3.4.2. Individual Fixed Effects*

To control for potentially unobserved characteristics of children and their families who could be inducing selection on unobservables into centre-based care, in my third empirical chapter I use an individual fixed effects approach. By running the analysis in first differences, fixed effects methods enable the researcher to control for unobserved individual characteristics that do not change over time. Given that individual fixed effects models exploit changes in individual covariates over time (not the cross-sectional variation in the data), coefficients are typically less precise (larger standard errors) and fail to control for time-varying selection factors. Given that I work with only two periods, my identifying assumption is that there are no time-varying factors between the first and second measurement that are causing selection on unobservables into different types of care. In other words, I presume there are no differential trends in child development outcomes between the children in different types of care that are driving my results.

In Chapter 4, I use cross-sectional analyses. The question that motivates this chapter is whether the association between maternal employment and child outcomes in the first year of life differs according to the maternal employment timing (between zero and three, three and six, six and 12, or 12 and 18 months). The reason for using cross-sectional analysis in the referred Chapter (as opposed to individual fixed effects) is due to data limitations. Given that the focus is on children's first year of life and that the earliest measurements of child development in the ELPI dataset are for six-month old children, it is not possible to have children's baseline development outcomes for children younger than six months. Hence, the individual fixed effects model exploiting variation in type of care during the first year was not a feasible method. Another approach to control for unobserved fixed effects could be controlling for family fixed effects. However, the ELPI dataset centres on the development outcomes of only one child per household. Hence, there is no information about the development outcomes of twins or siblings. In Chapter 5, the main question was whether non-maternal care affects children's cognitive and socio-emotional development in their first year of life. Hence, a similar logic of unavailability of baseline development outcomes applies to this Chapter.

Finally, Chapter 6 explores what the effects are of entering into centre-based care (relative to maternal care) at two years old on child cognitive and socio-emotional development. In this case, having measures of child development before the children turned two and after they turned three years of age is extremely useful. In Chapter 6 it is possible to control for unobserved fixed effects of the child such as innate cognitive or socio-emotional ability or motivation to learn to obtain a careful measure of the association between attendance at centre-based care and child development.

Each empirical chapter has a detailed description of my key variables and my model specification.

### *3.4.3. Mediation and moderation*

In my empirical chapters, I analyse the role of potential mechanisms—also called mediators — influencing child development and also how some key variables have an association with child development of a larger magnitude in specific populations—usually called moderating variables. For studying the mechanism and moderation effects, in line with McCartney, Burchinal and Bub (2006), I use the change in the key coefficient when including a potential mechanism to test mediation and I focus on the magnitude of the interaction term between the key and moderating variables to test moderation.

## 3.5. Insights from fieldwork in Chile

When a study uses secondary analysis, it is difficult for the researcher to fully understand the nuances of the data set and to know the quality of the data (Bryman, 2004). With the purpose of deeply understanding the dataset's subtleties, I visited Chile twice during my PhD. In 2011, I visited Chile's Ministry of Education and discussed my research proposal with experts on child development in Chile. In 2013, I discussed my questions about the ELPI dataset with researchers at Chile's *Centro de Microdatos*, the Chilean institution in charge of the design and data collection of the ELPI survey.

In 2012, I worked as a consultant for Chile's Ministry of Education and Ministry of Labour on the elaboration and implementation of the 2012 wave of the ELPI survey. Even though the Ministry of Education funded the first ELPI wave (2010), the Ministry of Labour funded the second wave (2012). This, in turn involved a substantial change in both the surveys and the instruments to be used. I was actively involved in the discussions about which new questions and instruments to measure child development should be included while keeping the longitudinal aspect of the survey.

My visits sharpened my understanding about the ELPI survey implementation. Given my involvement in the discussion of the instruments for assessing child development that would be included in the 2012 wave of the ELPI survey, I got to deeply understand the criteria behind and the content of this survey's second wave. This second wave includes new instruments for assessing child development such as executive function measures, maternal depression tests and parenting stress measures. In addition, the questions in the ELPI's second wave ask for more details about the maternal history of employment such as the intensity of maternal work (part-time or full-time) during the different stages of children's early childhood. This knowledge enabled me to understand that I could include some data that was not included in ELPI's first wave but was present in ELPI's second wave such as the previously explained intensity of work of mothers during different periods of their child's lives.

### 3.6. Summary and Conclusions

This chapter describes the dataset and method used in this thesis. The description of the key variables are in each of the empirical chapters where these variables are included. Given that each chapter has a specific empirical specification depending on the motivating question and data available, I discuss these specifications in each empirical chapter.

Given this thesis works with a secondary dataset, understanding the ELPI dataset's strengths and limitations is crucial. The ELPI dataset provides a unique opportunity to address the research questions of this thesis in the context of a middle-income country. Given the ELPI is a survey especially designed to assess child development, it provides a rich set of child development outcomes (cognitive and socio-emotional outcomes) and covariates that permit controlling for omitted variable bias. In addition, the ELPI dataset has extensive information about children's type of care and maternal employment history; this enables me to carefully define the key variables in each empirical chapter. For Chapter 4, the ELPI dataset provides detailed information about the timing of maternal employment after childbirth within the first year of life (zero, three, six, and 12 months). This is quite unique. For Chapter 5, the ELPI dataset provides a detailed description about the children's type of care during their first years of life (grandparent, relatives, nanny, and centre-based care). Finally for Chapter 6, the ELPI dataset provides panel data that enables me to control for unobserved individual fixed effects that could be biasing cross-sectional results.

# Chapter 4

# Early Maternal Employment and Child Development: Does Timing Matter?

## 4.1. Introduction

The labour market participation of mothers with young children has been steadily increasing. This has increased the number of mothers who need to combine childbearing with paid work. The percentage of women that initiated employment during the first year after childbirth is 61 per cent in the USA (Dye, 2010) and 59 per cent in the UK (Department for Work & Pensions, 2013). Even though in Chile the share of working mothers with children under one year is not as high as in developed countries, it is gradually increasing. While in 2002, 31 per cent of women with children under one year old worked (*Instituto Nacional de Estadísticas* (INE), 2002) in 2006 34 per cent worked (CASEN 2006). In this context, the effect of early maternal employment[30] on child development is of great social concern and is crucial for calculating the cost effectiveness of policies that have the aim of boosting maternal employment.

The maternal employment effect on child development is not the same when mothers initiated employment before or after their child's first year of life. For example, in a meta-analysis, Lucas-Thompson, Goldberg and Prause (2010) found that maternal employment during the first year of a child's life is detrimental for child development. However, maternal employment during the second and third years of the children's life is associated with higher future achievement (Lucas-Thompson et al., 2010; Waldfogel, Han, & Brooks-Gunn, 2002). Moreover, Ruhm (2004) argues that the positive effects on maternal employment during the child's second and third years would offset negative effects on the child during the child's first year.

[30] In this thesis, early maternal employment refers to mothers who initiate employment within the first twelve months after childbirth. It is worth noting that in the literature early maternal employment is also used to refer to the first three years of a child's life.

Due the evidence that maternal employment during the child's first year of life has a small detrimental impact on child development[31]. (Baum II, 2003; Han et al., 2001; Hill et al., 2005; James-Burdumy, 2005; Ruhm, 2004), this chapter would like to explore this association in a middle income country as Chile that is implementing a recent increase in the maternal leave length.

This small detrimental effect of maternal employment during infancy in child development could be explained because not being with their mothers during infancy –because mother is working– could be a risk factor for insecure attachment (Belsky & Rovine, 1988) and for behavioural problems (Fearon, Bakermans-Kranenburg, van Ijzendoorn, Lapsley, & Roisman, 2010). In addition, the amount of time that children spent with their mothers may account for this detrimental effect, as time that mothers spend with their infants is an indicator of positive mothering and quality of home environment (Huston & Aronson, 2005). Working mothers had fewer positive mother-child interactions and their mothers read less frequently with the child (Cawley & Liu, 2007; Nomaguchi, 2006).

Due that some studies suggest that the effect of early maternal employment varies depending on when mothers initiate their work during the first year after childbirth (Baydar & Brooks-Gunn, 1991; Han et al., 2001), it is relevant to explore in detail whether timing of maternal employment initiation *within* the child's first year of life affects child development. There are few studies that explore this association *within* the first year. For example, Baydar & Brooks-Gunn (1991) argue that the effect of the timing of maternal employment during the first year could be not linear, they found that initiating employment during the last quarter of the first year after childbirth is more beneficial for cognitive and behavioural development relative to initiate employment during the first three quarters. One of the hypothesis for this result is that at that stage (last quarter of first year of life) children have more mature cognitive conceptions of object permanence (Harris, 1983), that they permit to deal better with separation from their

[31] However, in a recent study, Brooks-Gunn, Han and Waldfogel (2010) conclude that the overall effect of early maternal employment on child development is neutral. They found a negative main effect of maternal employment during the first year on child cognitive outcomes, but after running structural equation (SEM) models found offsetting positive indirect effects. Hence, considering the positive effect of early maternal employment on child development through higher maternal earnings and a richer home environment, and the negative effect of early maternal employment on child development through childcare they conclude that the effect is neutral.

mothers. Might we expect that children of mothers who initiate employment early during the first year have more detrimental effect relative to children whose mothers initiate employment later.

In addition, the evidence shows that there are several variables that are relevant moderators in the association between early maternal employment and child development. First, some studies have concluded that the adverse effects of early maternal employment are focused in children whose mothers initiated employment full-time (as opposed to part-time) and during the first year after childbirth (Brooks-Gunn et al., 2010; Gregg et al., 2005). For example, full-time employment during the first 12 months of life is associated with lower cognitive scores than the ones of children whose mothers do not work; however, part-time employment is not associated with such a negative effect (Brooks-Gunn, Han & Waldfogel, 2010).

Second, the level of vulnerability of the child's household and characteristics of the child have been found to have an important moderating role in the association between maternal employment and child development (Goldberg et al., 2008). Third, other researchers have studied the child’s gender and type of care as moderators in the association between maternal employment and child development. There is some evidence that the association between early maternal employment and child socio-emotional development is more negative for boys than for girls (Brooks-Gunn et al., 2002; Desai, Chase-Lansdale, & Michael, 1989) Finally, Baydar and Brooks-Gunn, (1991) find that the effect of early maternal employment on child development depends on the type of care received by the child during that time. Hence, in this chapter I analyse whether these sub-groups moderate the association between early maternal employment and child development.

While there is a vast literature exploring the association between maternal employment and child development, the evidence about the effect of timing of maternal employment initiation during the child’s first year on child development is extremely thin. In addition, most studies have been conducted in developed countries (especially in the USA and the UK) and there is no evidence about such association in the context of middle-income countries. Regarding the differences between middle-income and developed countries, working conditions, parental background, and the duration of maternity leave differs in both contexts and these differences could interact with the effect of early maternal employment on child development.

One of the contributions of this chapter is the fine, policy-relevant categories within the first year used for the analysis—maternal employment initiation between zero and three, three and six, six and 12 or 12 and 18 months after childbirth. In 2011, the Chilean government increased post childbirth maternity leave from 3 to 6 months. Hence, understanding the effects of maternal employment timing during the first year after childbirth on infant development will help to illuminate current and future social policy both in Chile and other middle-income countries. Finally, this chapter examines whether the association between maternal employment and child outcomes differs depending on maternal job intensity (part-time or full-time), maternal education, family structure (single versus two-parent families), child's gender, and type of care.

In this chapter, I analyse three research questions:

- Does the association between early maternal employment and child outcomes differ according to the timing of maternal employment initiation (between zero and three, three and six, six and 12, and 12 and 18 months after childbirth)?
- Do maternal employment intensity (full versus part-time), maternal education, family structure (single versus two-parent family), child characteristics (gender) and type of care moderate the association between early maternal employment and child development?
- Is the child’s environment (home environment, household income, and maternal depression) the mechanisms that underpin the association between maternal employment and child outcomes during the child’s first year of life?

To deal with selection bias, I analyse these questions using multivariate regressions and propensity score matching (PSM) techniques. In both approaches, I control for a rich set of child, mother and family characteristics. I use data from the 2010 wave of ELPI survey. (For more information see Chapter 3).

This chapter is organised as follows. In section 4.2, I review the results from previous relevant studies about early maternal employment and child development, state key hypotheses and identify the gaps in the literature. In section 4.3, I describe the data, the key variable and provide an explanation of the estimation method. In section 4.4, I present the results and in section 4.5, I summarise my results, discuss them and conclude.

## 4.2. Evidence about the relation between early maternal employment and child development

In this section, firstly, I summarise the main studies about the association between maternal employment during the first year after childbirth and child development emphasising the relevance of the timing within the first year. Secondly, I examine the role of maternal employment characteristics such as intensity of employment or mother, child and family characteristics in moderating the relation between maternal employment and child development. Finally, I examine the role of a set of potential mediators (family income, home environment and maternal depression) that could explain how maternal employment during the first year of a child's life might affect child development.

### *4.2.1. Early maternal employment and child cognitive and socio-emotional development*

The present study is focused on the association between maternal employment during the first year after childbirth and child cognitive and socio-emotional outcomes. Several studies report that early maternal employment has a minor negative effect on child cognitive development (relative to mothers who did not work during that early period) (Berger et al., 2008; Bernal, 2008; Brooks-Gunn et al., 2002; Han et al., 2001; James-Burdumy, 2005; Ruhm, 2004). In a recent study with data from the USA and structural equation modelling, Brooks-Gunn et al. (2010) found not effect between maternal employment during the first year of life and child cognitive development. This is their preferred specification. However, when they analyse their data using OLS regressions, they observe that—controlling for an extensive set of covariates—the effect of early maternal employment is negative for non-Hispanic white children in some cognitive outcomes at ages three, four and half, and in first grade.

In contrast, the evidence about the impact of early maternal employment on child socio-emotional development is mixed. Some studies find no relation between early maternal employment and child socio-emotional development. Brooks-Gunn et al. (2010) using data from the NICHD Study of Early Child Care in the USA, do not find a significant association between first-year maternal employment and child socio-emotional outcomes at ages three, four and half, and in first grade. In addition, McMunn et al. (2011) using the UK Millennium Cohort Study and multivariate logistic regression models, do not find detrimental effects of early maternal employment on child socio-emotional behaviour at five years old. However other studies find a negative association between maternal employment and child socio-emotional development (Berger et al., 2005; Huerta et al., 2011).

In summary, studies find different effects of early maternal employment depending on the child development domain. The next sub-section analyses whether the timing when mothers initiate employment matters for child development.

### *4.2.2. Timing of early maternal employment*

While several previous studies have studied the effects of maternal employment in the first year of a child's life, only a few studies have focused on whether timing of early maternal employment *within* the first years after childbirth affects child development.

In the context of the USA, where a large number of mothers initiate employment when their child is under the age of one, using data from the National Longitudinal Survey of Youth (NLSY), Berger, Hill and Waldfogel (2005) report that children whose mothers initiated employment within 12 weeks after childbirth present more externalising behavioural problems at age three relative to children whose mothers initiated employment after 12 weeks. This observational study uses OLS estimators and propensity score matching models to deal with selection on observables. In addition, Baum II, (2003) using the same dataset and OLS regressions, conclude that children whose mothers initiated employment at or before three months after childbirth have lower cognitive development (measured by the PPVT score) at ages three and four, relative to children whose mothers initiated employment three months after childbirth.

In addition, using longitudinal birth cohort datasets from five OECD countries (Australia, Canada, Denmark, UK, and USA), Huerta et al. (2011) conclude that children whose mothers initiated employment within six months after childbirth present a small negative effect on their cognitive outcomes at four years old in the USA and five years old in the UK relative to children whose mothers initiated employment later than six months after childbirth. Huerta et al. (2011) also find that children in the UK whose mother initiated employment within six months after childbirth presented more behavioural problems at ages five and seven relative to children whose mothers initiated employment later than six months after childbirth. To perform the previously explained analysis, this study uses OLS and logistic regressions.

Using data from the National Institute of Child Health and Human Development (NICHD-SECC) in the USA, Brooks-Gunn et al. (2002), find that children of mothers who initiated employment before nine months after childbirth presented a worse school readiness score at 36 months relative to children whose mothers initiated employment at least nine months after childbirth. This analysis uses OLS regressions.

Using data from the UK, Verropoulou and Joshi (2009) find a negative association between maternal employment during the last quarter of a child’s first year of life only in one of four dimensions of child development. They find this in the reading dimension at five to seventeen years old. Verropoulou and Joshi (2009) used second generation study of the National Child Development Study (NCDS), a British cohort born in 1958, and analysed their data using multilevel analysis. In addition, Cooksey, Joshi, and Verropoulou, (2009), do not find a significant association between early maternal employment during the last quarter of a child’s first year of life and child development in the British data. In addition, using data from the US, Cooksey, Joshi and Verropoulou (2009) find a significantly negative association only between early maternal employment and reading comprehension and a significantly positive association only with behavioural problems for children 4–14 years old. To reach to their findings, Cooksey, Joshi and Verropoulou (2009) use the 1970 British Birth Cohort Study and the US 1979 National Longitudinal Study of Youth and carry out their analyses using multi-level modelling.

From the previous evidence, first, I conclude that when mothers initiate employment during the first year of their child's life, this has a small detrimental effect on child development relative to mothers who stay at home. Second, the earlier the mother starts work within the first year after childbirth, the larger is the negative impact on her child.

However, there are only few studies analysing the effects of timing of maternal employment during the first year after childbirth on child development, and all these studies use data from the UK and the USA. In addition, to my knowledge, there are also few studies exploring the potentially heterogeneous impact of early maternal employment on child development for mothers who initiate employment between zero and three, three and six, or six and twelve months after childbirth. Baydar and Brooks-Gunn (1991) find that maternal employment initiation during the last quarter of the child's first year is associated with less detrimental effect on child outcomes relative to initiating employment earlier. In a related result, Han et al. (2001) find that the association between maternal employment initiation during the last quarter of the child's first year and child development is not significant.

### *4.2.3. Moderators between early maternal employment and child outcomes*

The second objective of this study is to analyse whether the impact of maternal employment during the child's first year of life on child development is heterogeneous depending on characteristics of the mother's job, child vulnerability (maternal education and family structure), and child characteristics. Previous studies have found that mothers' employment intensity (part-time or full-time), maternal education, family structure (single or two parent family), the child's gender, or type of childcare are relevant moderators in the association between maternal employment and child development. In this subsection I test whether these are relevant moderators of the previously described association in the Chilean context.

#### Maternal work intensity

Based on previous findings, I hypothesise that the association between early maternal employment and child development is heterogeneous depending on the mother's *work intensity* (part-time vs. full-time) (Brooks-Gunn, Han, & Waldfogel, 2002; Brooks-Gunn, Han, & Waldfogel, 2010). Studies using data from the USA and the UK conclude that full-time employment during the first year of a child's life is associated with poorer child cognitive development (Brooks-Gunn et al., 2002; Gregg et al., 2005). For example, controlling for an extensive set of covariates, the effect of full-time early maternal employment (relative to no employment) on cognitive development has been found to be negative. However, the effect of part-time early maternal employment on cognitive development has been found to be neutral (Brooks-Gunn, Han & Waldfogel, 2010). In addition, full-time early maternal employment (relative to economic inactivity) is associated with more behavioural problems such as aggression or impulsivity (Berger et al., 2005; Hill et al., 2005; Waldfogel, 2006). In contrast, part-time early maternal employment is associated with positive or neutral child development outcomes (Gregg et al., 2005; Waldfogel, 2006, 2007).

The amount of hours per week spent by a mother at work could have a different impact on child development. Brooks-Gunn et al. (2002), divided children into three groups: those whose mothers were not employed, those whose mothers were employed part-time (working less than 30 hours per week), and those whose mothers were employed full-time (working more than 30 hours per week). They found that maternal employment during the first nine months was not related with children's cognitive abilities at 15 or 24 months; however, when mothers worked 30 or more hours per week at some point during their child's first nine months, their children got lower scores on a cognitive measure at 36 months relative to children whose mothers did not work at all during the same period. In addition, Harvey (1999) found that an increase of ten hours per week was associated with a 1 to 1.5pp decrease in Peabody Picture Vocabulary Test (PPVT-R) standard scores.

Chile's labour market differs from the USA and UK's labour markets. This casts doubts about the direct applicability of the previously described findings to the Chilean context. First, in Chile half of all part-time workers are on short-term contracts and do not contribute to the insurance and pension systems in the country (Lee, McCann, & Messenger, 2007; Leiva, 2000). On the other hand, on average, Chilean workers work 2,029 hours per year, far more than the 1,765 hours worked on average in OECD countries (OECD, 2012). These differences in labour market contexts could affect workers' mental health and life satisfaction factors that could, in turn, affect child development. Despite the differences in the labour market contexts of Chile, the USA and the UK, I expect that the effect of full-time early maternal employment on child development in Chile is of larger magnitude than the effect of part-time early maternal employment on child development.

<u>Child vulnerability: maternal level of education and family structure</u>

I use maternal level of education and family structure (whether single or two-parent families) as proxies for child vulnerability. I hypothesise that maternal level of education is a relevant moderator in the association between early maternal employment and child development based on Gregg, Washbrook, and Team ALSPAC Study (2003), who find that the association between maternal employment and child development for children with mothers with low level of education is positive and large policy-wise.

In addition, I examine whether family structure is a relevant moderator in the association between early maternal employment and child development because the evidence supports that the previously stated association for children in two-parent families is different relative to the same association for children in single-parent families. The magnitude of the negative association for children in two-parent families is larger than the magnitude of the association for children in one-parent families (Brooks-Gunn et al., 2002; Han et al., 2001).

Harvey (1999), using the NLSY dataset from the USA, finds a positive association between early maternal employment and child development for children in single-parent families. Similarly, a meta-analysis of 68 studies concludes that the association between early maternal employment and child cognitive development is more positive for single-parent than for two-parent families (Goldberg et al. 2008). In this study, the overall association between early maternal employment and child cognitive development was non-significant. In contrast, Gregg et al (2005) did not find a heterogeneous association between maternal employment and child development depending on the family structure.

<u>Child's gender</u>

Several studies report that the effect of early maternal employment on male and female infant development is heterogeneous. For example, Brooks-Gunn, Han and Waldfogel (2002) find that maternal employment when children are nine months old is associated with a lower

Bracken School Readiness score at 36 months with the effect being larger for males than females. Other studies find an adverse effect of early maternal employment on child cognitive development only for males (Desai et al., 1989). In addition, a meta-analysis of 68 studies concludes that early maternal employment has more positive effects on female relative to male development (Goldberg et al., 2008).

Type of care

Maternal employment implies that the child necessarily needs non-maternal care. Hence, the type of care is an essential aspect in the effect of early maternal employment on child development. In this chapter I include formal (centre-based care) and informal care as moderators in the association between early maternal employment and child development[32]. For example, Gregg et al. (2005) using data from the UK, find that there is no association between full-time maternal employment at 18 months and child development for children who attended centre-based care. However, these same authors find that there is a negative association between early maternal employment and child development for children who attended informal care. These authors used data from the Avon Longitudinal Study of Parents and Children and used OLS as method of analysis. Gregg et al. (2003) suggest that the negative effect of maternal employment on child development is compensated by the positive effect of centre-based care.

### *4.2.4. Mediators between early maternal employment and child outcomes*

Finally, I examine the role of mechanisms that, according to the evidence, may explain the impact of maternal employment on child development. The previously mentioned potential mediators include family income, the quality of home environment, and maternal depression during pregnancy.

[32] In Chapter 5, I analyse in detail the relationship between different types of care and child development during the child's first year of life. Hence, in this chapter I do not analyse the moderating effect of each type of care in the association between early maternal employment and child development.

## Family income

Early maternal employment could have a positive effect on child development because it might increase family income, which in turn could imply a better quality of family environment (Votruba-Drzal, 2012). In addition, there is abundant evidence that income has a positive impact on child cognitive development (Clark-Kauffman, Duncan, & Morris, 2002; Cooper & Stewart, 2013; Votruba-Drzal, 2006).

## Home environment

The effects of early maternal employment on child development could depend on the quality of children's home environment. Families who have more books and play materials, and those who take part in enhancing experiences such as going to the library or to the park have children who are more advanced in their social and cognitive development (NICHD Early Child Care Research Network, 1999; 2001). Given the additional income coming from employment, mothers who engage in early maternal employment could be more likely to provide a stimulating home environment. At the same time, working mothers may spend less time with their children and, hence, stimulate them less. Huston and Aronson (2005) conclude that mothers who work have less available time to spend with their children with respect to those ones that do not work; however, they also found that mothers compensate such decrease in available time with their children by decreasing time in other activities. Another hypothesis behind the effect of early maternal employment on child development is that working mothers provide less sensitive care relative to non-working mothers. Clark, Hyde, Essex and Klein (1997) find that women who returned to employment soon after childbirth (four months after childbirth) displayed more negative affection and attitudes towards their infant relative to those mothers who did not engage in paid work during the four first months after childbirth. In a complementary study, Symons (1998) finds that mothers of children in extensive hours of child care were less sensitive to their child's needs relative to mothers with children in fewer hours of care. However, Symons (1998) is not able to determine the direction of causality in the previous relation. In contrast, Parcel and Menaghan (1994) conclude that mothers who spent more time at work had slightly higher quality home environments. Maternal employment may improve family environment through increased income or mothers' increased intellectual and social stimulation.

Maternal depression

Maternal depression during pregnancy also seems to be a mediator in the impact of maternal employment on child development. Maternal depression during pregnancy affects the child's brain build-up and future child outcomes (Baker-Henningham, Powell, Walker, & Grantham-McGregor, 2005; Danese, Pariante, Caspi, Taylor, & Poulton, 2007; NICHD Early Child Care Research Network, 1999). It is worth mentioning that the average maternal depression prevalence rate is higher in developing than in developed countries (Walker et al., 2007). Similarly to what has been found in developed countries, in developing countries, maternal depression is associated with a reduction in children's cognitive performance, a delay in social development (Galler, Harrison, Ramsey, Forde & Butler, 2000), and child mental health problems (Patel, DeSouza, & Rodrigues, 2003).

One of the mechanisms through which maternal employment could affect child development is that maternal employment could have a positive effect on child development because working mothers present less depression symptoms than those who do not work (Coley, Lohman, Votruba-Drzal, Pittman, & Chase-Lansdale, 2007; Gyamfi, Brooks-Gunn, & Jackson, 2005). Low-income mothers who entered the labour market and left welfare reported significantly fewer symptoms of depression relative to those who did not work (Gyamfi et al., 2005). Gyamfi et al. (2005) finds that women who worked, or who combined welfare and work, were more likely to have reduced levels of depressive symptoms relative to women who only received welfare. Similarly, Coley, Lohman, Votruba-Drzal, Pittman and Chase-Lansdale (2007) find that becoming employed is associated with a decrease in mothers' depressive symptoms.

Identifying the mechanisms through which early maternal employment is associated with children' outcomes is key for understanding this chapter's results and their validity in other contexts. However, given that reverse causality may bias the estimates, identifying these mechanisms with cross-section data is difficult. For example, it is hard to know whether maternal depression or home environment are the effect or the cause of employment decisions.

According to the previously cited evidence, the timing of maternal employment initiation could matter for child development. However, there is little evidence about the effect of timing of early maternal employment on child development, especially in middle-income countries. Given most studies in this topic have been conducted in the UK, the USA, or other developed countries, we need to be cautious when generalising these findings to middle-income countries like Chile. The differences in the length of maternity leave, and the availability of part-time work in Chile relative to the UK and the USA might imply a different association between early maternal employment and child development in Chile relative to the same association in the UK and the USA. This chapter contributes to filling the gap of knowledge about the impact of timing of early maternal employment on child outcomes in a middle-income country. This chapter uses robust statistical methods to address some of the selection bias and causality issues. Below, I describe this chapter's data and method used to answer this chapter's research questions.

### 4.3. Data and Methods

The data used in this study comes from the *Encuesta Longitudinal de la Primera Infancia* (ELPI, or in English, Longitudinal Survey of Early Childhood). The ELPI is a panel survey whose aim is to increase knowledge about development outcomes of early childhood in Chile. The first wave of this panel was available in December 2010 and included children between six months and five years old (born between 1$^{st}$ January, 2006 and 31$^{st}$ August, 2009). The collection of information was between June and October 2010.

Table 4.1 shows that out of the 7,472 mothers with children between 12 and 36 months old in ELPI 2010, 44% engaged in early maternal employment. While seven per cent of mothers initiated employment immediately after childbirth, 12, 14, and 11 per cent initiated employment by three, six and twelve months after childbirth respectively.

**Table 4.1. Timing of early maternal employment**
**(Mothers with children aged 12 to 36 months old)**

| Timing of early maternal employment initiation | Number | Percentage |
|---|---|---|
| Between zero and three after childbirth | 547 | 7 |
| Between three and six months after childbirth | 931 | 12 |
| Between six and 12 months after childbirth | 1,078 | 14 |
| Between 12 and 18 months after child birth | 798 | 11 |
| Mothers who engaged in early maternal employment | 3,280 | 44 |
| Mothers who did not engage in early maternal employment | 4,116 | 56.10 |
| Total number of mothers | 7,472 | 100.00 |

Notes: Maternal employment timing is divided into 5 groups: 1) Mothers who initiated employment between zero and three months after childbirth ('immediately or 0'); 2) mothers who initiated employment between three and six months after childbirth ('Three months'). 3) mothers who initiated employment between six and 12 months after childbirth ('Six months'); 4) mothers who initiated employment between 12 and 18 months after childbirth ('Twelve months'), 5) mothers who did not engage in early maternal employment during those periods. The sample is restricted to mothers with children aged 12 to 36 months old.

In the analyses I compare children whose mothers engaged in early maternal employment (immediately, three, six, or twelve months after childbirth) with children of mothers who did not engage in early maternal employment and were in one of the two cohorts I used from the ELPI sample: children aged 12 (inclusive) to 24 months (not inclusive) and children aged 24 (inclusive) to 36 months (not inclusive). Each cohort had 3,605 and 3,867 children respectively. For more information about the ELPI survey, see Chapter 3.

### *4.3.1. Measures*

Key variable: Maternal employment timing within the first year after childbirth

This chapter analyses whether the timing of early maternal employment is associated with child development using ELPI 2010's question about the timing of maternal employment initiation. The exact question was whether mothers were working between zero and three months; three and six months; six and 12 months, and 12 and 18 months after childbirth. Taking into account the minimum time that mothers could have been within each period with their children and when they said initiated their work, I divided mothers in the following five groups. 1) Mothers who initiated employment between zero and three months after childbirth (this is, who were working between zero and three months after childbirth); 2) mothers who initiated employment three months after childbirth (this is, who initiated employment during the period three to six months after childbirth); 3) mothers who initiated employment six months after childbirth (who initiated employment during the period six to 12 months after childbirth); 4) mothers who initiated employment 12 months after childbirth (who initiated employment during the period 12 to 18 months after childbirth); and 5) mothers who did not engage in maternal employment within 12 months after childbirth (who did not initiate employment in any of the previously mentioned periods). This sample is restricted to mothers with children aged 12 to 36 months old in 2010. Most studies use mothers who are not working as a reference group. To facilitate the comparison of my results with the results of previous studies, I also used mothers who did not engage in early maternal employment as the reference group (this is, mothers in category number 5).

Dependent variables: Children's cognitive and socio-emotional outcomes

The present study uses the two cognitive outcome measures available in the ELPI survey for the cohort of children aged 12 to 24 months at the moment of the survey: the Battelle Developmental Inventory and the *Escala Evaluación Desarrollo Psicomotor* (Psychomotor Development Evaluation Scale or 'EEDP', for its acronym in Spanish). While the former test is widely used in international studies, the latter is a well-known Chilean instrument. In addition, the present study uses the two cognitive outcomes measures available in the ELPI survey for the cohort of children aged 24 to 36 months at the moment of the survey: the Peabody Picture Vocabulary Test[33] and the Psychomotor Development Test (*Test de Desarrollo Psicomotor,* or 'TEPSI' for its acronym in Spanish). While the former test is widely used in international studies, the latter is an instrument developed in Chile.

To facilitate comparisons between the results using both tests and with the previous literature, I standardised all cognitive tests (mean of zero and a standard deviation of one). In addition, to account for differences in children's age at the time of the test, the Centro Microdatos rescaled all tests scores. Lower scores indicate lower cognitive development. (For more information about the test see chapter 3 of methods)

[33] This test initiates its measure with children at 30 months.

**Table 4.2. Instruments of children' cognitive outcomes**

| Age | Cognitive Skills |
|---|---|
| Children between 12 and 23 months and 30 days | • Psychomotor Development Evaluation Scale (*Escala Evaluación Desarrollo Psicomotor* (EEDP,)<br>• The Battelle Developmental Inventory |
| Children between 24 and 36 months | • Psychomotor Development Test (*Test de Desarrollo Psicomotor* (TEPSI)) |
| Children between 30 and 36 months | • Peabody Picture Vocabulary Test |

The present study uses *The Child Behavior Checklist* scores from the ELPI 2010 to measure the socio-emotional development of children aged 18 to 36 months. In these analyses I do not include children aged 12 to 18 months because the CBCL test only enables to evaluate children aged 18 months old or older. Following the same procedure carried in the cognitive tests, the Centro de Microdatos rescaled the socio-emotional test scores to account for differences in children's age and I standardised these socio-emotional assessment scores into Z scores (with a mean of zero and a standard deviation of one). Higher scores indicate more behavioural problems.

<u>Control variables: Child, mother and family characteristics</u>

Mothers who initiate employment earlier after childbirth may have unobserved (to the researcher) characteristics that could bias simple associations (Hill et al., 2005; James-Burdumy, 2005). For avoiding possible confounders in the relation between maternal employment and child development, I controlled for an extensive set of child, mother and family characteristics.

Children's characteristics include: the child's age, whether child was the first born in the family, child's gender and whether the child had low birth weight (less than 2,500g) (The United Nations Children's Fund & World Health Organization, 2004) and whether the child was born prematurely. I include prematurity and child low birth weight as regressors in my analyses because of omitted variable bias concerns. Regarding the correlation with the dependent variable preterm or low birth weight children have lower academic performance and also present more attention and behavioural problems (Aarnoudse-Moens, Weisglas-Kuperus, van Goudoever, & Oosterlaan, 2009) relative to full term and/or normal birth weight children. Later in life, low birth weight children perform worse in school readiness (Reichman, 2005) and preterm children have lower math performance in preschool (Aarnoudse-Moens, Oosterlaan, Duivenvoorden, van Goudoever, & Weisglas-Kuperus, 2011).

Maternal characteristics include the mother's age, whether the mother was married, and the mother's education. I select the previous variable because maternal education is a strong predictor of child outcomes (Duncan, Brooks-Gunn, & Klebanov, 1994) and could have an effect on the timing of maternal employment (e.g. highly educated mothers could face higher incentives for returning earlier to the job market after childbirth relative to less educated mothers). In addition, I control for the Wechsler Adults Intelligence Scale ('WAIS') that measures that measures mothers' vocabulary and quantitative skills. In addition, I also controlled for maternal personality characteristics measured by the 'Spanish Big Five Inventory' (henceforth, BFI). I also include covariates regarding the mother's pregnancy of the child in the sample such as whether the mother drank alcohol during pregnancy or presented mental health problems. I also control for whether the mother worked before pregnancy, maternal pre-pregnancy income (linear and quadratic terms) and whether the mother was married when she gave birth. I do this, because children born to single-parent families have more negative outcomes and lower household income relative to children born to two-parent families (McLanahan, 1997). Finally, I control for the child's type of care in the period when the child's mother initiated employment after childbirth.

Theoretically, household income could be correlated with both the key variable (timing of early maternal employment) and the outcome variables (child development indicators). Hence, I should control for household income in all my regressions. However, household income before the child's birth was not asked in the ELPI survey. Fortunately, pre-birth maternal income was included in ELPI 2012.[34] As a proxy for pre-birth non-maternal income I constructed the variable non-maternal income in 2010. This is non-maternal income some months after the children's birth. I constructed this variable by subtracting household income at the 2010 survey minus maternal income during the same period. When using non-maternal income in 2010 as a proxy for pre-birth non-maternal income I assume that non-maternal

[34] For all my analyses in this chapter I used ELPI 2010. However, given that only ELPI 2012 asked for the maternal work history, I used this latter wave to construct the non-maternal income variable.

income—that is mainly paternal income—is relatively stable between the child's birth (between 2008 and 2009) and the survey in 2010. When running the regression analyses and PSM models with and without non-maternal income as a covariate, the results are similar (results not shown but available on request).

Potential moderators: employment intensity, child vulnerability and type of care

This study tests whether some variables previously identified as relevant moderators in the association between the timing of early maternal employment and child development are relevant moderators in the Chilean context. These potential moderators are maternal employment intensity, child vulnerability (low maternal education, family structure) and child characteristics (gender) and type of care).

According to the 'employment intensity' variable, working mothers do so in either a full-time or part-time mode. To create the intensity-of-work variable, I used the information about the maternal work intensity when mothers initiated employment after childbirth. While 82 per cent of mothers worked full-time, 18 per cent worked part-time. I got this information from the ELPI 2012 wave, because the ELPI 2010 wave (in which I base this chapter's analysis) did not ask mothers their intensity of work when they initiated employment after childbirth.

**Table 4.3. Maternal work intensity at employment initiation after childbirth by timing of maternal employment**

| Maternal work intensity | Between 0 and 3 months after childbirth | Between 3 and 6 months after childbirth | Between 6 and 12 months after childbirth | Between 12 and 18 months after childbirth | Total number of mothers | Percentage of mothers |
|---|---|---|---|---|---|---|
| Full-time | 241 | 518 | 507 | 280 | 1,546 | 82.3 |
| Part-time | 80 | 100 | 89 | 63 | 332 | 17.7 |
| Total | 321 | 618 | 596 | 343 | 1,878 | |

Note: This table shows the number and proportion of mothers depending on their work intensity and timing of early maternal employment initiation. Source: ELPI 2010 and 2012.

'Low maternal education' refers to mothers with less than 12 years of education (i.e. who did not achieve a high school degree). According to this criterion, 35 per cent of mothers in the ELPI survey have a low level of education.

The 'type of care' variable refers to the value of this variable when the mother initiated employment after childbirth. The type of care variable has two categories: informal care (relative, grandparent and non-relative) and formal care (centre-based care). The downside of this variable is that the type of care variable changes frequently during early childhood[35].

<u>Potential mediators that could have been affected by timing of maternal employment: household income and home environment</u>

Household income and the home environment are two potential confounders that could have been affected by the timing of maternal employment initiation. If maternal employment initiation (my key variable) influenced household income or home environment, including these variables could bias the coefficient on early maternal employment because the latter variables could pick up part of the association between early maternal employment and child development. Hence, I do not include household income or home environment as covariates. Instead of including them as covariates, I test whether these variables are relevant mediators in the association between early maternal employment and child development.

Family income is measured by several questions in the ELPI survey. In the analysis, I used the average household income over the last twelve months from all sources of income. The child environment in the ELPI survey was measured by the Home Observation for Measurement of the Environment ('HOME') test. The HOME test was designed to measure the quality and quantity of stimulation and support in children's homes. Unfortunately, the ELPI survey only included a subset of the items that could be observed by the interviewer within each dimension of the EC-HOME instrument. I created a HOME final score adding all the items. Given a maximum potential score of 15 (the amount of items in the ELPI version of the HOME test), the mean score in the sample was 9.84 (SD=2.7).

When confronted with the decision of including a potential confounding variable that could be non-predetermined, the researcher must judge using her knowledge from previous evidence whether the potential confounder is affected by the key variable (in this case, the timing of maternal employment). Based on the existing evidence, I assume that both household income

[35] In the next chapter, I analyse the association between type of care and child development.

and the home environment at the moment of the survey were affected by the timing of early maternal employment. Hence, I do not include these variables as covariates in my analyses. However, I expect that the inclusion of non-maternal income or child's learning environment at home are mediators in the association between timing of early maternal employment and child development. In sub-section 4.4.5 I test the relevance of these potential mediators in the previously mentioned association.

*4.3.2. Missing Data*

Missing data is an issue in many survey data-sets and the ELPI survey is not an exception. There are a variety of strategies to deal with this problem. Some of them are complete case analyses, dummy variable indicators for missing data, and nonresponse weighting (Little & Rubin, 2002). In this study, I use complete case analyses and nonresponse weighting provided by the ELPI survey. For more information about the number of missing values in all covariates, see Appendix 4.1.

*4.3.3. Data Analysis*

I conduct two main sets of analyses. Firstly, I analyse the development outcomes of children whose mothers initiated employment immediately, three, six, or 12 months after childbirth.

$$D_i = X_i'\beta + \sum_t \gamma_t E_{t,i} + \varepsilon_i \qquad i = 1,..,N\ ;\ t = 6,12 \tag{1}$$

Where

$D_i$ = Child i's development outcome at the moment of the interview. This is the dependent variable. It varies depending on the indicator used to measure child development (Battelle Inventory, EEDP, Tepsi, or PPVT scores).

The independent variables are:

$X_i'$ = Mother and children i's observable characteristics.

$E_{t,i}$ = Dummy variables for timing of maternal employment. Equals 1 if the mother initiated employment by period t, 0 otherwise (t=0, 3, 6, 12 months because t=13 months is the reference category. i.e. the coefficients on between zero and three months ('immediately or 0'), between three and six months ('3 months'), between six and 12 months ('6 months') and between 12 and 18 months ('12 months') represent the child's developmental difference with respect to children whose mothers did not initiate employment during those periods controlling for all other covariates).

$\varepsilon_i$ = Child i's development outcome error term (i.e. factors determining the child's development outcome that are unobserved to the researcher).

The coefficients of interest are the $\gamma_t$ for $t = 0, 3,6, 12$. These coefficients may be interpreted as the association between child development and maternal employment initiation between zero and three or three and six or six and 12 or 12 and 18 months after childbirth relative to mothers who did not engage in early maternal employment.

Secondly, I test whether the intensity of maternal work (part-time or full-time), child vulnerability (low maternal education and family structure), child characteristics (gender) or type of care have an heterogeneous association between early maternal employment and child development.

$$D_i \;=\; X_i'\beta + \sum_t \sum_s \delta_{t,s}\, E_{t,i}\, M_{s,i} + \varepsilon_i \qquad i = 1, .., N; = 0, 3, 6, 12\ ; s = 1,2 \qquad (2)$$

Where the independent variable not previously described is:

$M_{s,i}$ = Dummy variables for the different subgroups. For work intensity, equals 1 if the mother worked part-time $(s = 1)$ or if she worked full-time $(s = 2)$. For work type, equals 1 if the mother had a low level education $(s = 1)$ or high level of education $(s = 2)$ . For family structure, equals 1 if the child lives in a two-parent family $(s = 1)$, or single-parent family $(s = 2)$. For child gender, equals 1 if the child was a boy $(s = 1)$, or girl $(s = 2)$. For type of care, equals 1 if the child was in formal care at the point of the interview $(s = 1)$, or informal care $(s = 2)$,.

In all cases, the coefficient of interest is the effect of timing of maternal employment on child development for the different subgroups, $\delta_{t,s}$. To explore whether the differences in he magnitude of the coefficient between sub-groups is statistically significant, I run an ad-hoc post-test estimation comparing the coefficients within each pair (subgroups). To allow for correlation between the latter coefficients, I use Stata's seemingly unrelated estimation command ('Suest').

To infer causal implications of maternal employment on child development, I need to address a possible selection bias. Mothers who initiated employment earlier might be different from the ones who started later along observable variables. Hence, the method must enable a proper comparison between treated and non-treated women.

*Addressing selection bias*. I estimate both OLS and PSM models. The reason for including PSM models is that these models deal better than OLS regressions with misspecification bias. In Chapter 3, I explain PSM estimators in general and the way I implemented them in this chapter.

The aim of PSM is to select a group of individuals that might resemble the outcomes of the treated group had that group not been treated (Blundell & Costas Dias, 2009). In the context of this study, the treatment is maternal employment initiation between zero and three, three and six, six and 12, or 12 and 18 months after childbirth. Hence, the comparison group (referred to as *control* group) is the group of children whose mothers did not engage in early maternal employment.

The first step when applying PSM is to select the variables that predict the treatment. In the context of this chapter, I choose all the covariates used in our regression analysis. In line with the literature review, all these variables could affect maternal employment timing after childbirth. As in the other empirical chapters, I check whether treated and control groups are balanced in the mean of covariates. Treated and control samples were reasonably balanced. The detail of the balance checks is in Appendices 4.2 through 4.5.

To test whether the potential moderators (intensity of job, maternal education, family structure, child gender and type of care) are relevant, I estimate sub-groups of OLS regressions and I estimated a post-hoc test to analyse the potentially heterogeneous associations between the key and dependent variables along the moderating variables.

## 4.4. Results

### *4.4.1. Differences between mothers who initiate employment immediately, three, six, and 12 months after childbirth and those who do not engage in early maternal employment*

Mothers who did not engage in early maternal employment are more vulnerable than those mothers who initiated employment earlier. More specifically, mothers who did no work during the first year after childbirth had more negative (i.e. negatively correlated with child development) indicators in some dimensions relative to mothers who initiated employment between zero and three, three and six, six and 12, or 12 and 18 months after childbirth (lower WAIS test scores and lower levels of education). Additionally, mothers who did not work during the first year after childbirth were more likely to have a premature child relative to mothers who initiated employment between three and six or six and 12 months after childbirth. In contrast, mothers who did not engage in early maternal employment have certain characteristics that are positively correlated with child development relative to mothers who engaged in early maternal employment. For example, the former were more likely to be married, have fewer mental problems during pregnancy, and drank less alcohol during pregnancy relative to the latter group of mothers.

In addition, mothers who did not engage in early maternal employment differ in personality characteristics from mothers who engaged in early maternal employment. The former group of mothers show less extraversion, conscientiousness, and openness to new experiences than mothers who started to work during the first years after childbirth. In addition, mothers who did not work during the first year after childbirth presented more neuroticism at the moment of the ELPI survey.

A key difference between the previously defined groups of mothers is that mothers who did not initiate employment during the first year after childbirth were less likely to work before pregnancy (18% of them worked) relative to mothers who always worked (71%) or mothers who initiated employment three, six or 12 months after childbirth (81%, 68% and 45% of them worked respectively).

In addition, mothers who did not work during the first year after childbirth had lower income before pregnancy (a monthly salary of £39) relative to mothers who always worked (£218) or mothers who initiated employment between three and six, six and 12, or 12 and 18 months after childbirth (monthly salary of £310, £261 or £153 respectively). Similarly, mothers who did not work during the first year after childbirth are from lower income households and present a lower score in the quality of parenting and the home environment according to the HOME test relative to mothers who engaged in early maternal employment. All these factors may influence the women's decision about the timing of early maternal employment. Hence, to avoid selection bias, these variables must be included as covariates in the analyses.

Finally, children whose mothers did not engage in early maternal employment exhibit more socio-emotional problems and lower cognitive development (measured by the EEDP and Tepsi tests) relative to children whose mothers initiated employment between three and six or six and 12 months after childbirth. In addition, children whose mothers did not engage in early maternal employment exhibited lower cognitive development (measured by the Battelle and PPVT tests) relative to children whose mothers initiated employment between 12 and 18 months after childbirth.

In sum, the data displayed in Table 4.4 shows that children whose mothers did not engage in early maternal employment had lower cognitive development and more socio-emotional problems relative to those whose mothers initiated employment between three and six, six and 12, or 12 and 18 months after childbirth. The descriptive statistics suggest that there are relevant differences in key maternal, pregnancy, child and family characteristics between mothers who did not work during the first year and those who engaged in early maternal employment at different stages within the first year after childbirth. This implies that I should control for these observable variables in the regression analysis.

**Table 4.4. Mother, pregnancy, children and family characteristics by mothers' employment timing during the first year after childbirth for children between 12 and 36 months old**

| | (1) Not worked by first year N=4116 | (2) Worked between 0 and 3 months N=547 | (3) Worked between 3 and 6 months N= 931 | (4) Worked between 6 and 12 months N=1,078 | (5) Worked between 12 and 18 moths N=798 | (6) Significan t test between (1) and (2) | (7) Significan t test between (1) and (3) | (8) Significan t test between (1) and (4) | (9) Significan t test between (1) and (5) |
|---|---|---|---|---|---|---|---|---|---|
| **Maternal characteristics** | | | | | | | | | |
| Work before pregnancy (%) | 18.2 (0.6) | 71.3 (2.2) | 81.2 (1.5) | 68.4 (1.6) | 45.1 (1.9) | *** | *** | *** | *** |
| Maternal age | 29.2 (0.09) | 31.0 (0.3) | 30.5 (0.2) | 29.6 (0.2) | 27.9 (0.3) | *** | *** | | *** |
| Mother married**(%) | 74.2 (0.01) | 66.4 (0.01) | 70.3 (0.6) | 67.7 (0.02) | 63.6 (0.02) | *** | ** | *** | *** |
| Maternal years of education | 10.9 (0.04) | 11.9 (0.2) | 12.9 (0.1) | 12.9 (0.1) | 12.3 (0.03) | *** | *** | *** | *** |
| Mother's WAIS digit score | 6.7 (0.03) | 7.1 (0.1) | 7.7 (0.1) | 7.6 (0.09) | 7.2 (0.1) | ** | *** | *** | *** |
| Mother's WAIS vocabulary score | 7.7 (0.04) | 8.4 (0.2) | 9.3 (0.1) | 9.4 (0.1) | 8.6 (0.1) | *** | *** | *** | *** |
| Extraversion | 3.47 (0.01) | 3.59 (0.02) | 3.64 (0.19) | 3.63 (0.02) | 3.65 (0.02) | *** | *** | *** | *** |
| Agreeableness | 3.81 (0.01) | 3.85 (0.02) | 3.88 (0.02) | 3.85 (0.01) | 3.83 (0.02) | ** | *** | ** | |
| Conscientiousness | 3.96 (0.01) | 4.04 (0.02) | 4.08 (0.02) | 4.09 (0.02) | 4.01 (0.02) | *** | *** | *** | *** |
| Neuroticism | 3.08 (0.01) | 2.98 (0.03) | 2.93 (0.02) | 2.92 (0.02) | 3.03 (0.03) | *** | *** | *** | ** |
| Openness | 3.77 (0.01) | 3.86 (0.02) | 3.85 (0.02) | 3.88 (0.02) | 3.84 (0.02) | *** | *** | *** | *** |
| **Pregnancy Characteristics** | | | | | | | | | |
| Teenager pregnancy | 11.5 (0.09) | 5.7 (1.0) | 3.4 (0.5) | 8.5 (0.8) | 14.5 (1.3) | *** | *** | ** | ** |
| Mental problems during pregnancy (%) | 12.7 (0.4) | 18.3 (0.6) | 14.9 (1.2) | 17.7 (1.2) | 18.0 (1.4) | *** | | *** | *** |
| Mother drank alcohol during pregnancy (%) | 6.3 (0.3) | 12.2 (1.5) | 12.0 (1.2) | 8.1 (0.9) | 6.4 (0.8) | *** | *** | * | |
| Difficulties during pregnancy (%) | 41.2 (0.6) | 42.7 (0.2) | 47.9 (1.8) | 46.4 (1.7) | 46.6 (0.5) | | *** | ** | ** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Child characteristics** | | | | | | | | | |
| Child gender, male (%) | 50.2 (0.6) | 53.4 (2.2) | 53.0 (1.7) | 50.2 (1.7) | 49.5 (1.9) | | | | |
| Having older sibling (%) | 54.2 (0.6) | 61.9 (1.5) | 52.9 (1.8) | 44.9 (1.3) | 43.4 (1.8) | *** | | *** | *** |
| Premature (%) | 7.3 (0.3) | 6.2 (1.0) | 5.5 (0.9) | 4.9 (0.7) | 7.3 (0.9) | | * | *** | |
| Child low weight (%) | 3.8 (0.2) | 2.7 (0.8) | 3.4 (0.7) | 3.3 (0.6) | 5.1 (0.8) | | | | |
| CBCL test score , 18-36 months+ | 0.050 (0.018) | -0.028 (0.053) | -0.114 (0.040) | -0.160 (0.037) | -0.008 (0.039) | | *** | *** | |
| EEDP test score, 12-24 months | -0.113 (0.024) | -0.043 (0.068) | -0.014 (0.046) | 0.086 (0.044) | -0.046 (0.049) | | * | *** | |
| Batelle total Score, 12-24 months | -0.114 (0.024). | -0.126 (0.060) | -0.094 (0.045) | 0.018 (0.042) | 0.0003 (0.055) | | | *** | * |
| Tepsi test score, 24-36 months | -0.052 (0.014) | -0.013 (0.066) | 0.030 (0.049) | 0.096 (0.050) | 0.030 (0.050) | | | ** | |
| PPVT test score, 30-36 months | -0.049 (0.016) | -0.095 (0.062) | 0.098 (0.065) | 0.003 (0.062) | 0.055 (0.061) | | ** | | * |
| **Family characteristics** | | | | | | | | | |
| Maternal income before childbirth in pounds | 39,31 (2.23) | 218.72 (13.58) | 310.83 (14.71) | 261.02 (11.62) | 153.31 (10,29) | *** | *** | *** | *** |
| Monthly non-maternal income in pounds | 433.568 (13.23) | 458.760 (37.91) | 551.767 (40.62) | 557.578 (36.88) | 443.881 (39.79) | | *** | *** | |
| HOME Score | 14.64 (0.05) | 15.20 (0.15) | 15.40 (0.11) | 15.49 (0.09) | 15.05 (0.11) | *** | *** | *** | *** |

Notes: Maternal employment timing is divided into 5 groups: 1) Mothers who initiated employment between zero and three months after childbirth (*'immediately*); 2) mothers who initiated employment between three and six months after childbirth ('three months'). 3) mothers who initiated employment between six and 12 months after childbirth ('six months'); 4) mothers who initiated employment between 12 and 18 months after childbirth ('12 months'), 5) mothers who did not engage in early maternal employment during those periods. The sample is restricted to mothers with children aged 12 to 36 months old. Columns (1) through (5) show percentages or mean values with standard deviation in parentheses. *$p$<.05, **$p$<.01, ***$p$<.001. **Married or living with a partner. **+** The CBCL test is a socio-emotional test where a higher score means more socio-emotional problems.

*4.4.2. Maternal employment timing and child cognitive and socio-emotional development*

In this subsection I explore whether the previously described differences in child outcomes persist or become starker once I control for maternal and child characteristics. My aim doing this is to explore whether the association between maternal employment and child outcomes in the first year of life differs according to the timing of maternal employment (between zero and three, three and six, six and 12, or 12 and 18 months after childbirth). I present the results of multivariate regressions models that analyse the associations between the timing of maternal employment and child cognitive and socio-emotional development. The regression models are estimated using ordinary least squares and regress different measures of child cognitive outcomes on child, mother and family background characteristics.

<u>Association between timing of maternal employment and child cognitive outcomes</u>

Controlling for maternal, family and child characteristics, children whose mothers initiate employment between three and six months after childbirth present slightly worse cognitive outcomes at 12–24 months old and 24–36 months old relative to children whose mothers did not engage in early maternal employment. In addition, children whose mothers initiated employment between six and 12 months after childbirth present worse cognitive outcomes in one out of six of the Battelle test sub-areas at 12–24 months old relative to children whose mothers did not engage in early maternal employment. The inclusion of maternal and child characteristics makes the magnitude of the coefficient larger. For a detailed table showing the size of the coefficients with and without control variables see appendices 4.6 and 4.7.

First, Table 4.5. presents the coefficients on the association between timing of early maternal employment and child cognitive outcomes measured by the Battelle Inventory and the EDDP test at age **12–24 months old**. The results in Table 4.5. show that, controlling for all usual covariates, children whose mothers initiated employment between three and six months after childbirth presented significantly lower cognitive outcomes relative to children whose mothers did not engage in early maternal employment. These significant differences in cognitive outcomes appear in the cognitive

(13 per cent of one standard deviation), communication (13 per cent of one standard deviation) and motor (13 per cent of one standard deviation) domains in the Battelle Inventory test. Although children whose mothers initiated employment between three and six months after childbirth present lower cognitive development measured by the EEDP test relative to children whose mothers did not engage in early maternal employment, this difference is not statistically significant. Unfortunately, it is not possible to analyse the correlation between the sub-areas of EEDP and Battelle instruments because the ELPI data-set did not provide information about the EDDP sub-scale scores. Nevertheless, the correlation between the EEDP test final score and the Battelle test is moderate (0.45).

**Table 4.5. The association between timing of maternal employment and child cognitive outcomes (according to the Battelle Inventory and EEDP tests) at 12–24 months old: OLS regressions**

| Maternal Employment Timing | (1) Battelle Total | (2) Cognitive Battelle | (3) Communication Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal /Social Battelle | (7) EDDP Total |
|---|---|---|---|---|---|---|---|
| (A) Between 0-3 months | -0.101<br>(0.078) | -0.088<br>(0.086) | -0.054<br>(0.080) | -0.116<br>(0.080) | -0.032<br>(0.075) | -0.050<br>(0.073) | 0.013<br>(0.084) |
| (B) Between 3-6 months | -0.128*<br>(0.066) | -0.128*<br>(0.071) | -0.128*<br>(0.068) | -0.128*<br>(0.071) | 0.014<br>(0.065) | -0.093<br>(0.062) | -0.051<br>(0.070) |
| (C) Between 6-12 months | -0.015<br>(0.060) | 0.097<br>(0.064) | -0.033<br>(0.060) | -0.114*<br>(0.063) | 0.029<br>(0.057) | 0.016<br>(0.055) | 0.065<br>(0.062) |
| (D) Between 12-18 months | -0.006<br>(0.072) | -0.011<br>(0.074) | -0.071<br>(0.070) | 0.054<br>(0.071) | -0.023<br>(0.066) | -0.002<br>(0.060) | -0.046<br>(0.063) |
| (E) Difference between (A) and (B) | ns | ns | ns | ns | ns | ns | ns |
| (F) Difference between (B) and (C ) | ns | *** | ns | ns | ns | * | ns |
| (G) Difference between (C) and (D) | ns | ns | ns | ** | ns | ns | ns |
| Obs. | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,666 |

Notes: The reference group is mothers who did not engage in early maternal employment. Each model controls for children’s characteristics (gender, age, prematurity, low weight at birth and whether the child has an older sibling) and maternal characteristics (WAIS vocabulary score, WAIS digit score, Big Five Inventory dimensions score, marital status, years of education, age, mental health problems during pregnancy and maternal income pre-pregnancy. Rows (A), (B), (C) and (D) show mean values for dummy coefficients with standard deviation in parentheses are shown. **p*<.05, ***p*<.01, ****p*<.001.

In addition, Table 4.5 suggests that, controlling for all usual covariates, children whose mothers initiated employment between six and 12 months after childbirth presented better cognitive outcomes at age 12 to 24 months old relative to children whose mothers initiated employment between three and six months after childbirth. Row (F), Columns (2) and (6) in Table 4.5 indicates that children whose mothers initiated employment between six and 12 months (versus between three and six months) after childbirth got higher cognitive test scores in the Battelle test in the cognitive and personal/social domains. In addition, row (G) and column (4) shows in Table 4.5. show that motors skills of children whose mothers initiated employment between 12 and 18 months after childbirth are significantly higher with respect to the same outcomes for children whose mothers initiated employment between six and 12 months after childbirth (measured by the Battelle test).

Hence, there is an association between the time after childbirth when mothers initiated employment and cognitive development measured by the Battelle test. Children whose mothers initiated employment between three and six months after childbirth presented significantly lower cognitive development indicators relative to children whose mothers did not engage in early maternal employment. In addition, a delay in employment initiation from three-six to six-12 months after childbirth and is associated with a slightly positive improvement in the child cognitive dimensions of cognitive[36] and personal skills. In addition, a delay in employment initiation from six-12 to 12-18 months after childbirth is associated with better child motor skills.

Second, looking at the association between the timing of maternal employment and child development in a cohort of older children (**24–36 months old**), I find that, in line with the findings in the younger cohort, children whose mothers initiated employment between three and six months after childbirth, present a significantly lower cognitive development in two out of three dimensions and in the total score of the Tepsi test relative to children whose mothers did not engage in early maternal employment. Specifically, row B, columns (1), (2) and (4) in Table 4.6—whose outcome variable is the Tepsi test score—shows that employment initiation between three and six months after childbirth is

[36] One of the dimensions of the Battelle cognitive test is the cognitive dimension.

negatively associated with child cognitive development (at 24 to 36 months old) relative to not engaging in early maternal employment. Table 4.6. shows that, controlling for all the usual covariates, children whose mothers initiated employment between three and six months after childbirth present lower motor skills (20 per cent of one standard deviation) and coordination skills (15 per cent of one standard deviation) relative to children whose mothers did not engage in early maternal employment. In addition, children whose mothers initiated employment between 12 and 18 months after childbirth presented better language skills according to the Tepsi test and better vocabulary according to the PPVT test relative to children whose mothers initiated employment three months after childbirth. (See Table 4.6's row (D) columns (3) and (5)).

**Table 4.6. The association between timing of maternal employment and child cognitive outcomes at 24–36 months old: OLS regressions**

| Maternal Employment Timing | (1) Tepsi Total | (2) Tepsi Coordination | (3) Tepsi Language | (4) Tepsi Motor | (5) PPVT |
|---|---|---|---|---|---|
| (A) Between 0-3 months | -0.044<br>(0.081) | -0.095<br>(0.088) | 0.026<br>(0.088) | -0.094<br>(0.084) | 0.037<br>(0.086) |
| (B) Between 3-6 months | -0.138**<br>(0.070) | -0.151*<br>(0.085) | -0.082<br>(0.072) | -0.199***<br>(0.069) | 0.005<br>(0.078) |
| (C) Between 6-12 months | -0.034<br>(0.070) | -0.072<br>(0.072) | -0.034<br>(0.071) | -0.017<br>(0.072) | 0.002<br>(0.073) |
| (D) Between 12-18 months | 0.077<br>(0.066) | 0.021<br>(0.069) | 0.123*<br>(0.072) | 0.031<br>(0.068) | 0.131*<br>(0.073) |
| (E) Difference between (A) and (B) | ns | ns | ns | ns | ns |
| (F) Difference between (B) and (C) | ns | ns | ns | ** | ns |
| (G) Difference between (C) and (D) | ns | ns | ns | * | ns |
| Observations | 2,798 | 2,798 | 2,808 | 2,798 | 1,436 |

Notes: The reference group is mothers who did not engage in early maternal employment. Each model are OLS regressions that control for children's characteristics (gender, prematurity, low weight at birth and whether the child has an older sibling) and maternal characteristics (WAIS vocabulary score, WAIS digit score, Big Five Inventory dimensions score, marital status, years of education, age, mental health problems during pregnancy and income pre pregnancy). Rows (A), (B), (C) and (D) show mean values for dummy coefficients with standard deviation in parentheses. 'ns' means not significant.*$p$<.05, **$p$<.01, ***$p$<.001.

In sum, children whose mothers initiated employment between three and six months after childbirth exhibited lower cognitive development at 12–24 months old and 24–36 months old. In addition there is some evidence that children whose mothers initiated employment between 12 and 18 months after childbirth exhibited higher cognitive development relative to children whose mothers initiated employment three months after childbirth at 24 to 36 months old.

Maternal employment timing and child socio-emotional outcomes

In a similar way to how I previously described child cognitive outcomes, I now present estimates for the association between timing of maternal employment initiation (between zero and three, three and six, six and 12, and 12 and 18 months after childbirth) and child social and emotional outcomes. The main instrument used for measuring child social and emotional outcomes was the *Child Behavior Checklist 1 ½-5* that considers patterns of socio-emotional problems (internalising or externalising problems).

The main findings are that children whose mothers initiated employment between zero and three, three and six or six and 12 months after childbirth present more socio-emotional problems at 18–36 months old relative to children whose mothers did not engage in early maternal employment.

Table 4.7 shows that children whose mothers initiated employment between zero and three and three and six months after childbirth present more socio-emotional problems at 18–36 months[37] relative to children whose mothers did not engage in early maternal employment. Row (A) in Table 4.7 shows that children whose mothers initiated employment between zero and three months after childbirth presented more general socio-emotional problems, externalising problems and internalising problems (16, 15 and 16 per cent of one standard deviation respectively), with respect to children whose mothers did not engage in early maternal employment. In addition, children whose mothers initiated employment between three and six months after childbirth presented more general socio-emotional and externalising problems (12 and 18 per cent of one standard deviation respectively) relative to children whose mothers did not engage in early maternal employment. Finally, children whose mothers initiated employment between six and 12 months after childbirth presented more externalising problems (9 per cent of one standard deviation) relative to children whose mothers did not engage in early

[37] The CBCL test can only be taken to children aged 18 months and older. Hence, the children from the cohort aged 12 to 24 months old who took the CBCL test were aged 18 to 24 months old.

maternal employment.

**Table 4.7. The association between timing of early maternal employment and child socio-emotional outcomes at 18–36 months old: OLS regressions**

| Maternal employment timing | (1) CBCL Total | (2) Externalising problems | (3) Internalising problems |
|---|---|---|---|
| (A) Between 0-3 months | 0.161** (0.064) | 0.151** (0.066) | 0.159** (0.062) |
| (B) Between 3-6 months | 0.120** (0.049) | 0.181*** (0.052) | 0.013 (0.055) |
| (C) Between 6-12 months | 0.014 (0.048) | 0.085* (0.050) | -0.046 (0.048) |
| (D) Between 12-18 months | 0.030 (0.048) | 0.035 (0.049) | 0.010 (0.050) |
| (E) Difference between (A) and (B) | ns | ns | ** |
| (F) Difference between (B) and (C) | ** | * | ns |
| (G) Difference between (C) and (D) | ns | * | ns |
| Observations | 4,249 | 4,249 | 4,249 |

Notes: Each model controls for children's characteristics (gender, prematurity, low weight at birth and whether the child has an older sibling) and maternal characteristics (WAIS vocabulary score, WAIS digit score, Big Five Inventory dimensions score, marital status, years of education, age, mental health problems during pregnancy and pre-pregnancy maternal income. Rows (A) through (D) show coefficients on dummy variables for different time periods where the reference group is mothers who did not engage in early maternal employment. Child socio-emotional outcomes measured by the Child Behavior Checklist 1 ½-5years old. *$p$<.05, **$p$<.01, ***$p$<.001

In sum, this section shows suggestive evidence that maternal employment initiation between three and six months after childbirth is worse for child cognitive development at ages 12–24 months and 24–36 months, and socio-emotional development at age 18–36 months relative to not engaging in early maternal employment. Interestingly, the signs of the association between timing of maternal employment and child development with controls are different. In the analysis without control variables, children whose mother initiated employment between three and six or six and 12 months present better development outcomes in some sub-areas relative to children whose mothers did not engage in early maternal employment.

In addition children whose mothers initiate their employment between six and 12 months after childbirth present some indicators of lower cognitive outcomes and more socio-emotional problems relative to children whose mothers did not engage in early maternal employment. Finally, controlling for all usual covariates, children whose mothers initiated employment between 12-18 months after childbirth present higher cognitive outcomes at 24 to 36 months old and no association with socio-emotional problems relative to children whose mothers did not engage in early maternal employment.

The following subsection explores the robustness of the previously described associations contrasting these findings with the ones obtained using propensity score matching.

### *4.4.3. Association between timing of early maternal employment and child outcomes using propensity score matching (PSM)*

This subsection presents results from the analyses that estimate the association between timing of early maternal employment and child development using propensity score matching. I expected that estimation of PSM models (instead of OLS regressions) improves my estimation because it gets rid of misspecification problems. In addition, as explained with more detail in the methods section, the estimation of the ATT parameter requires less assumptions than the ATE parameter and is more relevant to the nature of my research questions. While PSM enables to recover the ATT parameter, OLS regressions are only able to recover the ATE parameter.[38]

This subsection shows that the results using PSM analyses are to some extent consistent with the results using OLS analyses. The PSM estimates are larger and more statistically significant compared with the OLS estimates. These findings show that my conclusions in the previous subsection are robust to misspecification.

Why am I getting different results in PSM relative to OLS estimates? The larger and more significant negative effects in PSM's ATT could imply that some treated children (whose mother started working during the first year after childbirth) do not have an equivalent counterfactual in the untreated population, so these are not considered in the estimation. Second, PSM's ATT only considers the effect on the treated population. My

[38] I run also ATE analyses, which get the same results as my OLS analyses as it is expected because both calculate the average treatment effect of the population. For more information please see Appendix 4.12

results are consistent with the hypothesis that early maternal employment has a more negative effect on child development for children whose mother engaged in early maternal employment. This could happen if mothers who start working early, even though they are more advantaged in observables relative to mothers who did not engage in early maternal employment, could have unobservables that could be negatively correlated with child development. For example, mothers who engage in early maternal employment could be more work-oriented and less interested in the interaction with their child or could have less support networks and be in more need to work relative to mothers who do not engage in early maternal employment. For these reasons, my preferred results stem from PSM rather from OLS specifications.

Controlling for child, maternal and family characteristics, children whose mothers initiated employment during the first year after childbirth (between zero and three, three and six, six and 12, or 12 and 18 months) showed significantly lower cognitive development in the Battelle test total score at **12–24 months old** relative to children whose mothers did not engage in early maternal employment (see Table 4.8). In addition, children whose mothers initiated employment between six and 12 months after childbirth exhibited significantly higher cognitive development in two out of seven domains (Row (C) in Table 4.8 columns (6) and (7)) relative to children whose mothers did not engage in early maternal employment. This significant association only appears in the PSM analysis. In sum, the PSM analysis supports to some extent the OLS results presented in the subsection above.

**Table 4.8. The association between early maternal employment timing and child cognitive outcomes at 12–24 months old: OLS and PSM estimates**

| | Total Battelle (1) | | Personal/Social Battelle (2) | | Adaptive Battelle (3) | | Motor Battelle (4) | | Communication Battelle (5) | | Cognitive Battelle (6) | | EEDP (7) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PSM | OLS | PSM | OLS | PSM | OLS | PSM | OLS | PSM | OLS | PSM | OLS | PSM | OLS |
| (A) Between 0-3 months | -0.214*** | -0.101 | -0.168*** | -0.088 | -0.127** | -0.054 | -0.162*** | -0.116 | -0.150** | -0.032 | -0.085 | -0.050 | 0.030 | 0.013 |
| | (0.054) | (0.078) | (0.048) | (0.086) | (0.058) | (0.080) | (0.056) | (0.080) | (0.065) | (0.075) | (0.057) | (0.073) | (0.053) | (0.084) |
| N | 1,580 | 2,665 | 1,580 | 2,665 | 1,580 | 2,665 | 1,580 | 2,665 | 1,580 | 2,665 | 1,580 | 2,665 | 1580 | 2,666 |
| (B) Between 3-6 months | -0.239*** | -0.128* | -0.198*** | -0.128* | -0.130** | -0.128* | -0.135** | -0.128* | -0.210*** | 0.014 | -0.027 | -0.093 | -0.025 | -0.051 |
| | (0.057) | (0.066) | (0.050) | (0.071) | (0.060) | (0.068) | (0.065) | (0.071) | (0.062) | (0.065) | (0.077) | (0.062) | (0.069) | (0.070) |
| N | 1,750 | 2,665 | 1,750 | 2,665 | 1,750 | 2,665 | 1,750 | 2,665 | 1,750 | 2,665 | 1750 | 2,665 | 1,749 | 2,666 |
| (C) Between 6-12 months | -0.111** | -0.015 | -0.122*** | 0.097 | -0.082 | -0.033 | -0.113* | -0.114* | -0.055 | 0.029 | 0.172** | 0.016 | 0.119*** | 0.065 |
| | (0.046) | (0.060) | (0.038) | (0.064) | (0.055) | (0.060) | (0.060) | (0.063) | (0.052) | (0.057) | (0.071) | (0.055) | (0.043) | (0.062) |
| N | 1,818 | 2,665 | 1,818 | 2,665 | 1,821 | 2,665 | 1,818 | 2,665 | 1,818 | 2,665 | 1,818 | 2,665 | 1,819 | 2,666 |
| (D) Between 12-18 months | -0.157*** | 0.006 | -0.102*** | -0.011 | -0.157*** | -0.071 | -0.022 | 0.054 | -0.246*** | -0.023 | -0.044 | -0.002 | -0.151*** | -0.046 |
| | (0.049) | (0.072) | (0.039) | (0.074) | (0.054) | (0.070) | (0.051) | (0.071) | (0.049) | (0.066) | (0.058) | (0.060) | (0.044) | (0.063) |
| N | 1,688 | 2,665 | 1,688 | 2,665 | 1,688 | 2,665 | 1,688 | 2,665 | 1,688 | 2,665 | 1,688 | 2,665 | 1,689 | 2,666 |
| (E) Difference between (A) and (B) | ns | ns | ns | ns | *** | ns | ns | ns | ns | ns | ns | ns | *** | ns |
| (F) Difference Between (B) and (C) | ns | ns | ** | ** | ns | ns | ns | ns | ** | ns | ns | *** | ns | ns |
| (G) Difference Between (C) and (D) | ns | ns | ns | ns | ns | ns | *** | * | ns | ns | * | ns | ns | ns |

Notes: The reference group in rows (A) through (D) is mothers who did not engage in early maternal employment. The PSM analyses estimate the average treatment effect on the treated (ATT). The sample size in PSM comprises only the treated (each specific period of maternal employment initiation) and control (children whose mother did not engage in early maternal employment) subjects. By contrast, the sample size in OLS comprises all categories (all timings of early maternal employment initiation) in all regressions. Each model controls for child characteristics (age, age squared, gender, prematurity, low weight at birth and whether the child has an older sibling) and maternal characteristics (WAIS vocabulary score, WAIS digit score, Big Five Inventory dimensions score, marital status, years of education, age, mental health problems during pregnancy and maternal income pre- pregnancy). Columns (1), trough (7) show mean values for dummy coefficients with standard deviation in parentheses are shown.. *$p$<.05, **$p$<.01, ***$p$<.001.

In the cohort of children between **24 and 36 months old** at the moment of the 2010 ELPI survey, the results are also consistent with those using OLS analyses where children of mothers who initiated employment between three and six months after childbirth presented lower cognitive development relative to children whose mothers did not engage in early maternal employment. Additionally, children whose mothers initiated employment between zero and three, or six and 12 months after childbirth presented lower cognitive development compared to children whose mothers did not engage in early maternal employment.

However, two of the results using PSM analyses show outcomes that are more positive for children whose mothers engaged in early maternal. First, children whose mothers initiated employment between 12 and 18 months after childbirth presented better cognitive outcomes, especially in language and motor skills according to the Tepsi test and vocabulary skills according to the PPVT test (10, 10 and 22 per cent of one standard deviation respectively) relative to children whose mothers did not engage in employment at all during the first year. Second, children whose mother initiated employment between three and six, or six and 12 months after childbirth presented better vocabulary measured by the PPVT test relative to children whose mothers did not engage in early maternal employment. This is not consistent with the Tepsi test results where children whose mother initiated employment between three and six or six and 12 months after childbirth presented lower language skills compared to children whose mothers did not engage in early maternal employment. The correlation between the Tepsi test language domain and the PPVT test is moderate (.56). One explanation for this inconsistency between the results using the Tepsi test as cognitive outcome and the results using the PPVT as cognitive outcome could be that the children's sample who took the Tepsi test is slightly different from the sample of children who took the PPVT test because this latter test starts at 30 months old. I checked this hypothesis by running the analyses with the TEPSI test restricting the sample to those children who also took the PPVT test and the results did not change.

**Table 4.9. The association between timing of early maternal employment and child cognitive outcomes at 24–36 months old: OLS and PSM estimates.**

| Maternal employment timing | (1) Tepsi Total | | (2) Tepsi Coordination | | (3) Tepsi Language | | (4) Tepsi Motor | | (5) PPVT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PSM | OLS | PSM | OLS | PSM | OLS | PSM | OLS | PSM | OLS |
| (A) Between 0-3 months | -0.129** | -0.044 | -0.118** | -0.095 | -0.132* | 0.026 | -0.023 | -0.094 | -0.222*** | 0.037 |
| | (0.058) | (0.081) | (0.059) | (0.088) | (0.069) | (0.088) | (0.057) | (0.084) | (0.062) | (0.086) |
| | 1,887 | 2,798 | 1,887 | 2,798 | 1,893 | 2,808 | 1,887 | 2,798 | 974 | 1,436 |
| (B) Between 3-6 months | -0.168*** | -0.138** | -0.304*** | -0.151* | -0.111* | -0.082 | -0.094* | -0.199*** | 0.393*** | 0.005 |
| | (0.053) | (0.070) | (0.055) | (0.085) | (0.061) | (0.072) | (0.052) | (0.069) | (0.090) | (0.078) |
| | 2,015 | 2,798 | 2,015 | 2,798 | 2,022 | 2,808 | 2,014 | 2,798 | 1,064 | 1,436 |
| (C) Between 6-12 months | -0.131*** | -0.034 | -0.234*** | -0.072 | -0.129** | -0.034 | 0.028 | -0.017 | 0.117* | 0.002 |
| | (0.049) | (0.070) | (0.054) | (0.072) | (0.059) | (0.071) | (0.052) | (0.072) | (0.066) | (0.073) |
| | 2,034 | 2,798 | 2,034 | 2,798 | 2,040 | 2,808 | 2,034 | 2,798 | 1,059 | 1,436 |
| (D) Between 12-18 months | 0.088* | 0.077 | 0.0135 | 0.021 | 0.103** | 0.123* | 0.099* | 0.031 | 0.215*** | 0.131* |
| | (0.050) | (0.066) | (0.047) | (0.069) | (0.0514) | (0.072) | (0.056) | (0.068) | (0.060) | (0.073) |
| | 1,985 | 2,798 | 1,985 | 2,798 | 1,991 | 2,808 | 1,985 | 2,798 | 1,017 | 1,436 |
| (E) Difference between (A) and (B) | ns | ns | ns | ns | ns | ns | ns | ns | ns | ns |
| (F) Difference between (B) and (C) | *** | ns | ns | ns | * | ns | *** | *** | ns | ns |
| (G) Difference between (C) and (D) | ns | ns | ns | ns | ns | ns | ns | ns | *** | ns |

Notes: Each model controls for children's characteristics (gender, prematurity, low weight at birth and whether the child has an older sibling) and maternal characteristics (WAIS vocabulary score, WAIS digit score, Big Five Inventory dimensions score, marital status, years of education, age, mental health problems during pregnancy and pre-pregnancy maternal earnings). Rows (A), (B), (C) and (D) show mean values for dummy coefficients with standard deviation in parentheses. The reference group in these rows is mothers who did not engage in early maternal employment. The sample size in PSM comprises only the treated (each specific period of maternal employment initiation) and control (children whose mother did not engage in early maternal employment) subjects. By contrast, the sample size in OLS comprises all categories (all timings of early maternal employment initiation) in all regressions. *$p$<.05, **$p$<.01, ***$p$<.001.

In sum, the PSM analyses in general confirm the negative association between employment initiation between three and six months after childbirth and child cognitive development in the cohort aged 12 to 24 and 24 to 36 months old found using OLS regressions. Additionally, the PSM analyses also suggest that children whose mother initiated employment between zero and three or six and 12 months after childbirth also presented a negative association at 12 to 24 months and at 24 to 36 months old. Finally, employment initiation between 12 and 18 months after childbirth shows more mixed results: while the association between employment initiation between 12 and 18 months after childbirth and child cognitive development is negative in the cohort aged 12 to 24 months old, this same association is positive in the cohort aged 24 to 36 months old.

Table 4.10 shows the association between timing of maternal employment and child socio-emotional development using OLS and PSM estimators. This table shows evidence that both OLS and PSM estimates suggest that there is a negative association between employment initiation between zero and three months after childbirth (relative to no engagement in early maternal employment) and child socio-emotional development at 18–36 months old. In addition, children whose mothers initiated employment both between three and six or six and 12 months after childbirth presented more externalising problems and less internalising problems relative to children whose mothers did not engage in early maternal employment. Children whose mothers initiated employment between three and six months after childbirth presented 14 per cent of one standard deviation more externalising problems and 9 per cent of one standard deviation less internalising problems relative to children whose mothers did not engage in early maternal employment. Additionally, children whose mothers initiated employment between six and 12 months after childbirth present 15 per cent of one standard deviation more externalising problems and 14 per cent of one standard deviation less internalising problems relative to children whose mothers did not engage in early maternal employment. Finally, row (D) in Table 4.10 show that maternal initiation between 12 and 18 months after childbirth relative to not engaging in early maternal employment is not associated with child socio-emotional problems.

**Table 4.10. The association between timing of early maternal employment and child socio-emotional outcomes at 18–36 months old: OLS and PSM estimates**

| Maternal employment timing | CBCL Total (1) | | Externalising Problems (2) | | Internalising problems (3) | |
|---|---|---|---|---|---|---|
| | PSM | OLS | PSM | OLS | PSM | OLS |
| (A) Between 0-3 months | 0.116** (0.047) | 0.161** (0.064) | 0.153*** (0.050) | 0.151** (0.066) | 0.108** (0.045) | 0.159** (0.062) |
| Observations | 2,797 | 4,249 | 2,797 | 4,249 | 2,797 | 4,249 |
| (B) Between 3-6 months | 0.029 (0.045) | 0.120** (0.049) | 0.139*** (0.052) | 0.181*** (0.052) | -0.090** (0.045) | 0.013 (0.055) |
| Observations | 2,034 | 4,249 | 2,034 | 4,249 | 2,034 | 4,249 |
| (C) Between 6-12 months | 0.005 (0.044) | 0.014 (0.048) | 0.153*** (0.046) | 0.085* (0.050) | -0.143*** (0.046) | -0.046 (0.048) |
| Observations | 2,055 | 4,249 | 2,055 | 4,249 | 2,055 | 4,249 |
| (D) Between 12-18 months | 0.036 (0.041) | 0.030 (0.048) | 0.047 (0.048) | 0.035 (0.049) | 0.050 (0.041) | 0.010 (0.050) |
| Observations | 2,004 | 4,249 | 2,004 | 4,249 | 2,004 | 4,249 |
| (E) Difference between (A) and (B) | ns | ns | ns | ns | ns | * |
| (F) Difference between (B) and (C) | ns | ** | ns | ns | ns | ns |
| (G) Difference between (C) and (D) | ** | ns | *** | ns | ns | ns |

Notes: Each model controls for children's characteristics (age, age squared, gender, prematurity, low weight at birth and whether the child had an older sibling), maternal characteristics (WAIS vocabulary score, WAIS digit score, Big Five Inventory dimensions score, marital status, years of education, age, mental health problems during pregnancy and pre-pregnancy maternal income) . Cells show regression coefficients with standard errors in parentheses. The reference group in rows (A) through (D) is mothers who did not engage in early maternal employment. Child socio-emotional outcomes measured by the Child Behavior Checklist 1 ½-5 years old. The sample size in PSM comprises only the treated (each specific period of maternal employment initiation) and control (children whose mother did not engage in early maternal employment) subjects. By contrast, the sample size in OLS comprises all categories (all timings of early maternal employment initiation) in all regressions. *p<.05, **p<.01, ***p<.001.

In conclusion, the OLS and PSM analyses confirm a negative association between early maternal employment (especially immediately and three months after childbirth) and child cognitive and socio-emotional development.

### *4.4.4. Moderators in the association between early maternal employment and child development*

In this section, I test the degree to which several variables moderate a potentially heterogeneous association between timing of early maternal employment and child development. I grouped the moderators into three groups: maternal intensity of work, child vulnerability (maternal education and family structure) and child characteristics (gender and the child's type of care).

Test of potential moderator: intensity of maternal employment (part-time or full-time)

First, I estimate the association between timing of maternal employment and child cognitive and socio-emotional outcomes allowing for variations in such association according to maternal intensity of job (full-time versus part-time). To implement the previously mentioned associations, first, I estimate two separate groups of regressions restricting these two samples to children of full-time working mothers and part-time working mothers (the two groups of maternal job intensity[39]). Second, I run post-hoc t-test analyses to test whether the difference between the key coefficients on the different timings of early maternal employment for each of the two groups of regressions is statistically significant. If this difference is statistically significant, this means that the association between the specific timing comparison (e.g. between six and 12 months vs. did not engage in early maternal employment) and the specific child outcome (e.g. cognitive) differs depending on the value of the maternal intensity of job variable (e.g. for full-time vs. part-time).

Table 4.11 shows that the association between timing of early maternal employment and child cognitive development varies in some specific timings by intensity of mothers' work. While in Panel A children whose mothers initiated full-time employment during the first year after childbirth did not present any significant difference relative to children whose mothers did not engage in early maternal employment after childbirth, this association is statistically significant for children whose mother initiated part-time early employment.. In Panel B, children whose mothers initiated employment part-time between zero and three months after childbirth presented lower cognitive skills at age 12 to 24 months old relative to children whose mothers did not engage in early maternal employment. In addition, children whose mothers initiated employment part-time between six and 12 months after childbirth presented better motor skills at age 12 to 24 months relative to children whose mothers did not engage in early maternal employment. Finally, children whose mothers initiated employment part-time between 12 and 18 months after childbirth present higher cognitive outcomes in five out of seven outcomes relative to children whose mothers did not engage in early maternal employment

[39] The reference group in the job intensity variable is *full-time or part-time job* in panels A and B respectively.

Several post-hoc t-tests (not shown, but available on request) show that the association between early initiation of maternal employment and child cognitive development is more positive in three out of seven cognitive indicators (in the Battelle personal/social, communication skills, and  the Battelle total score) for children whose mothers worked part-time relative to children whose mothers worked full-time when mothers initiated employment between 12 and 18 months after childbirth. In addition, children whose mothers worked part-time presented better motor skills relative to children whose mothers worked full-time when mothers initiated employment between six and 12 months after childbirth.

**Table 4.11. The association between early maternal employment timing and child cognitive outcomes at age 12-24 months old analysing maternal intensity of work (full-time versus part-time), as moderators in such association: OLS regressions**

| Maternal employment timing | Battelle Total (1) | Personal/ Social Battelle (2) | Adaptive Battelle (3) | Motor Battelle (4) | Communication Battelle (5) | Cognitive Battelle (6) | EEDP (7) |
|---|---|---|---|---|---|---|---|
| **A. Full-time maternal work intensity** | | | | | | | |
| No early maternal employment (reference category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0-3 months / Full-time working mothers | -0.188 | -0.198 | 0.039 | -0.238 | -0.060 | -0.004 | 0.046 |
| | (0.212) | (0.184) | (0.193) | (0.211) | (0.210) | (0.197) | (0.183) |
| 3-6 months / Full-time working mothers | -0.341 | -0.292 | 0.062 | -0.259 | -0.280 | -0.119 | -0.092 |
| | (0.220) | (0.178) | (0.209) | (0.218) | (0.183) | (0.206) | (0.227) |
| 6-12 months / Full-time working mothers | -0.155 | -0.128 | 0.077 | **-0.211** | -0.059 | 0.118 | 0.024 |
| | (0.225) | (0.185) | (0.205) | (0.233) | (0.179) | (0.204) | (0.212) |
| 12-18 months / Full-time working mothers | **-0.025** | **-0.114** | 0.166 | 0.154 | **-0.048** | 0.210 | 0.051 |
| | (0.241) | (0.198) | (0.223) | (0.258) | (0.209) | (0.229) | (0.221) |
| Observations | 1,745 | 1,745 | 1,745 | 1,745 | 1,745 | 1,745 | 1,744 |
| R-squared | 0.066 | 0.098 | 0.079 | 0.118 | 0.055 | 0.059 | 0.069 |
| **B. Part time maternal work intensity** | | | | | | | |
| No early maternal employment (reference category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0-3 months / Part-time working mothers | -0.185 | -0.125 | 0.091 | 0.014 | -0.135 | -0.491** | 0.069 |
| | (0.258) | (0.267) | (0.254) | (0.261) | (0.262) | (0.213) | (0.246) |
| 3-6 months / Part-time working mothers | -0.186 | -0.190 | -0.174 | -0.290 | -0.166 | -0.257 | -0.319 |
| | (0.271) | (0.276) | (0.211) | (0.262) | (0.247) | (0.246) | (0.336) |
| 6-12 months / Part-time working mothers | 0.336 | 0.116 | 0.015 | **0.516**** | 0.315 | 0.381 | 0.123 |
| | (0.236) | (0.214) | (0.233) | (0.241) | (0.232) | (0.234) | (0.300) |
| 12-18 months / Part-time working mothers | **0.649**** | **0.402*** | 0.124 | 0.780** | **0.526*** | 0.480 | 0.451* |
| | (0.291) | (0.237) | (0.353) | (0.338) | (0.282) | (0.342) | (0.263) |
| Observations | 1,467 | 1,467 | 1,467 | 1,467 | 1,467 | 1,467 | 1,468 |
| R-squared | 0.080 | 0.100 | 0.086 | 0.153 | 0.055 | 0.062 | 0.070 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children of full-time working mothers and part-time working mothers respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1

Now we turn to look at socio-emotional outcomes. Overall, I present suggestive evidence that both full-time and part-time early maternal employment are negatively correlated with child socio-emotional development. Moreover, a post-hoc analysis shows that the association between part-time early maternal employment and child socio-emotional development is mixed depending on the timing where mothers start working during the first year after childbirth. In this analysis, I include the same set of control variables (mother, family and child characteristics) than in my previous analyses. All the child socio-emotional outcomes are measured by the Child Behavior Checklist 1½–5 test.

More specifically, Panel A of Table 4.12 shows that children whose mothers initiated full-time employment between three and six months after childbirth presented more externalising problems relative to children whose mothers did not engage in early maternal employment. Additionally, Panel B of Table 4.12 shows that children whose mothers initiated part-time employment between zero and three, three and six months, and 12 and 18 months after childbirth presented less socio-emotional, internalising and externalising problems respectively relative to children whose mothers did not engage in early maternal employment. In contrast, children whose mothers initiated part-time employment between six and 12 months after childbirth presented more socio-emotional and externalising problems relative to children whose mothers did not engage in early maternal employment.

Several post-hoc t-tests (not shown but available on request) show that the association between early initiation of maternal employment and child socio-emotional development is more detrimental for children whose mothers worked full-time relative to children whose mothers worked part-time when mothers initiated employment between zero and three or three and six months after childbirth. By contrast, children whose mother initiated employment part-time between six and 12 months after childbirth presented more socio-emotional problems at age 18 to 36 months relative to children whose mother initiated employment full-time in the same period.

**Table 4.12. Association between maternal employment timing and child socio-emotional outcomes analysing maternal intensity of work as a moderator in such association: OLS regressions**

| Maternal employment timing | CBCL Total (1) | Externalising problems (2) | Internalising problems (3) |
|---|---|---|---|
| **A. Full time maternal work intensity** | | | |
| No early maternal employment (reference category) | 0 | 0 | 0 |
| | (0) | (0) | (0) |
| 0-3 months / Full-time working mothers | 0.084 | 0.036 | 0.135 |
| | (0.122) | (0.118) | (0.122) |
| 3-6 months / Full-time working mothers | 0.114 | 0.225** | -0.032 |
| | (0.082) | (0.089) | (0.094) |
| 6-12 months / Full-time working mothers | 0.038 | 0.133 | -0.016 |
| | (0.085) | (0.093) | (0.088) |
| 12-18 months / Full-time working mothers | -0.033 | 0.056 | -0.076 |
| | (0.115) | (0.110) | (0.118) |
| Observations | 3,047 | 3,047 | 3,047 |
| R-squared | 0.200 | 0.156 | 0.191 |
| **B. Part time maternal work intensity** | | | |
| No early maternal employment (reference category) | 0 | 0 | 0 |
| | (0) | (0) | (0) |
| 0-3 months / Part-time working mothers | -0.346* | -0.164 | -0.202 |
| | (0.190) | (0.205) | (0.154) |
| 3-6 months / Part-time working mothers | -0.180 | -0.184 | -0.293* |
| | (0.148) | (0.177) | (0.175) |
| 6-12 months / Part-time working mothers | 0.318** | 0.319** | 0.235 |
| | (0.144) | (0.146) | (0.162) |
| 12-18 months / Part-time working mothers | -0.121 | -0.328* | 0.090 |
| | (0.244) | (0.184) | (0.254) |
| Observations | 2,596 | 2,596 | 2,596 |
| R-squared | 0.204 | 0.161 | 0.180 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children of full-time working mothers and part-time working mothers respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Higher scores mean more socio-emotional problems. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1

In sum, maternal intensity of work is a relevant moderator in the association between timing of early maternal employment and child cognitive and socio-emotional development. In particular, part-time early maternal employment is associated with more positive cognitive child outcomes relative to full-time maternal employment. In addition part-time early maternal employment initiation between zero and three, or three and six months after childbirth is associated with better child socio-emotional development relative to full-time maternal employment. Finally, when mothers start working between six and 12 months after childbirth, part-time work is less detrimental for child development relative to full-time work.

Test of potential moderators: child vulnerability (maternal education and family structure)

Second, I estimate two separate groups of regressions restricting these two samples to children whose mothers are less educated and highly educated (two groups of maternal education[40]),) In addition I estimate two separate groups of regressions restricting the sample to children from single=parent and two-parent families (two groups of family structure[41]). Subsequently, I run post-hoc t-test analyses to test whether the difference between the key coefficients on the different timings of early maternal employment for each of the two groups of regressions is statistically significant.

**Cognitive outcomes**

Table 4.13 shows that the association between timing of early maternal employment and child cognitive development differs slightly by maternal education. In Panel A, children whose mothers with a low level of education initiated employment between six and 12 months after childbirth show better cognitive outcomes (higher communication skills and higher cognitive skills according to the EEDP test) relative to children whose mothers with a low level of education did not engage in early maternal employment. In panel B, children whose mothers with a high level of education initiated employment during the first year after childbirth presented lower cognitive outcomes relative to children whose mother with a high level of education did not engage in early maternal employment. In what follows I describe the previously described association for each period during the first year after childbirth. First, children whose mothers with a high level of education initiated employment between zero and three months after childbirth show lower cognitive outcomes in four out seven outcomes relative to children whose mothers with a high level of education did not engage in early maternal employment. Second, children whose mothers with a high level of education initiated employment between three and six months after childbirth present lower cognitive, motor and cognitive skills) relative to children whose mothers with a high level of education did not engage in early maternal employment. Third, children whose mothers with a high level of education initiated employment between six and 12 months after childbirth show lower motor and communication skills relative to children whose mother did not engage in early maternal employment. Finally, children whose highly educated mother started working

[40] The reference group in maternal education is *low education* in Panel A and *high education*.in Panel B
[41] The reference group in family structure is *single-parent family* in Panel A and *two-parent family* in Panel B.

between 12 and 18 months after childbirth presented lower cognitive skills relative to children of highly educated mothers who did not engage in early maternal employment.

To analyse the significance of the difference in the association between timing of early maternal employment and child cognitive development for less educated and highly educated mothers I carry out post-hoc t-tests on such differences. I find that children whose mothers have low education and initiated employment between zero and three months after childbirth exhibited better cognitive, personal/social and motor skills relative to children of more educated mothers who also initiated employment between zero and three months after childbirth.

Finally, I find that family structure is not a relevant moderator in the association between timing of early maternal employment and child cognitive development. Panel A in Table 4.14 shows that children in single-parent families whose mothers initiated employment between three and six months after childbirth presented lower communication relative to children whose mothers did not engage in early maternal employment. In addition, Panel B shows that children in two-parent families whose mothers initiated employment between zero and three months after childbirth present lower cognitive development (significant differences in two out of seven cognitive outcomes) relative to children whose mothers did not engage in early maternal employment.

In addition, several post-hoc t-test analyses (not shown but available upon on request) show that the association between early initiation of maternal employment and child cognitive development is not heterogeneous depending on whether children live in two-parent or single-parent families.

**Table 4.13. Association between early maternal employment timing and child cognitive outcomes at age 12 to 24 months old for children of less educated and highly educated mothers: OLS regressions**

| Maternal employment timing | Battelle Total (1) | Personal/Social Battelle (2) | Adaptive Battelle (3) | Motor Battelle (4) | Communication Battelle (5) | Cognitive Battelle (6) | EEDP (7) |
|---|---|---|---|---|---|---|---|
| **Panel A** | | | | | | | |
| No early employment (ref. category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0–3 months / Less educated mothers | **0.158** | **0.165** | 0.090 | **0.099** | 0.155 | -0.064 | 0.221 |
| | (0.145) | (0.133) | (0.144) | (0.145) | (0.152) | (0.162) | (0.161) |
| 3–6 months / Less educated mothers | -0.035 | -0.089 | -0.119 | -0.025 | -0.033 | -0.143 | 0.038 |
| | (0.161) | (0.159) | (0.154) | (0.167) | (0.159) | (0.175) | (0.183) |
| 6–12 months / Less educated mothers | 0.223 | 0.118 | 0.160 | 0.113 | 0.278* | 0.249 | 0.332** |
| | (0.155) | (0.146) | (0.148) | (0.165) | (0.156) | (0.168) | (0.162) |
| 12–18 months / Less educated mothers | 0.246 | 0.120 | 0.144 | 0.222 | 0.230 | 0.212 | 0.175 |
| | (0.162) | (0.139) | (0.143) | (0.161) | (0.150) | (0.171) | (0.155) |
| Observations | 900 | 900 | 900 | 900 | 900 | 900 | 901 |
| R-squared | 0.087 | 0.103 | 0.090 | 0.150 | 0.058 | 0.070 | 0.094 |
| **Panel B** | | | | | | | |
| No early employment (ref. category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0–3 months / Highly educated mothers | **-0.306*****| **-0.207**** | -0.108 | **-0.308***** | -0.240** | -0.159 | -0.110 |
| | (0.113) | (0.105) | (0.105) | (0.114) | (0.119) | (0.121) | (0.117) |
| 3–6 months / Highly educated mothers | -0.237** | -0.158 | 0.032 | -0.239** | -0.218** | -0.135 | -0.127 |
| | (0.106) | (0.099) | (0.102) | (0.109) | (0.111) | (0.113) | (0.109) |
| 6–12 months / Highly educated mothers | -0.151 | -0.0681 | -0.0104 | -0.237** | -0.168* | 0.0335 | -0.0566 |
| | (0.101) | (0.094) | (0.098) | (0.106) | (0.096) | (0.105) | (0.103) |
| 12–18 months / Highly educated mothers | -0.157 | -0.103 | -0.071 | -0.068 | -0.209** | -0.104 | -0.151 |
| | (0.106) | (0.095) | (0.103) | (0.107) | (0.101) | (0.110) | (0.096) |
| Observations | 1,754 | 1,754 | 1,754 | 1,754 | 1,754 | 1,754 | 1,754 |
| R-squared | 0.047 | 0.089 | 0.084 | 0.098 | 0.047 | 0.046 | 0.059 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children of less educated and highly educated mothers respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1

**Table 4.14. Association between early maternal employment timing and child cognitive outcomes at age 12 to 24 months old analysing for children in single-parent and two-parent families: OLS regressions**

| Maternal employment timing | Battelle Total (1) | Personal/Social Battelle (2) | Adaptive Battelle (3) | Motor Battelle (4) | Communication Battelle (5) | Cognitive Battelle (6) | EEDP (7) |
|---|---|---|---|---|---|---|---|
| **Panel A** | | | | | | | |
| No early employment (reference category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0–3 months / single-parent families | -0.007 | 0.036 | 0.073 | 0.030 | -0.163 | -0.071 | 0.073 |
| | (0.147) | (0.140) | (0.135) | (0.152) | (0.145) | (0.167) | (0.148) |
| 3–6 months / single-parent families | -0.138 | -0.147 | 0.209 | -0.193 | -0.282* | -0.101 | -0.096 |
| | (0.160) | (0.148) | (0.144) | (0.165) | (0.159) | (0.162) | (0.151) |
| 6–12 months / single-parent families | 0.079 | 0.098 | 0.134 | -0.039 | -0.054 | -0.040 | -0.025 |
| | (0.159) | (0.140) | (0.137) | (0.165) | (0.146) | (0.153) | (0.155) |
| 12–18 months / single-parent families | 0.038 | -0.056 | -0.012 | 0.104 | -0.049 | 0.018 | -0.028 |
| | (0.159) | (0.141) | (0.134) | (0.163) | (0.143) | (0.155) | (0.146) |
| Observations | 814 | 814 | 814 | 814 | 814 | 814 | 812 |
| R-squared | 0.083 | 0.119 | 0.151 | 0.118 | 0.077 | 0.113 | 0.088 |
| **Panel B** | | | | | | | |
| No early employment (reference category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0–3 months / two-parent families | -0.198* | -0.119 | -0.088 | -0.259** | -0.049 | -0.157 | -0.051 |
| | (0.113) | (0.101) | (0.109) | (0.112) | (0.121) | (0.118) | (0.122) |
| 3–6 months / two-parent families | -0.166 | -0.117 | -0.054 | -0.145 | -0.099 | -0.146 | -0.085 |
| | (0.110) | (0.102) | (0.106) | (0.112) | (0.115) | (0.116) | (0.118) |
| 6–12 months / two-parent families | -0.080 | -0.052 | 0.031 | -0.155 | -0.061 | 0.119 | 0.083 |
| | (0.103) | (0.097) | (0.103) | (0.106) | (0.100) | (0.109) | (0.106) |
| 12–18 months / two-parent families | -0.056 | 0.002 | 0.016 | -0.003 | -0.094 | -0.045 | -0.082 |
| | (0.111) | (0.098) | (0.109) | (0.111) | (0.106) | (0.115) | (0.102) |
| Observations | 1,840 | 1,840 | 1,840 | 1,840 | 1,840 | 1,840 | 1,843 |
| R-squared | 0.058 | 0.104 | 0.061 | 0.117 | 0.041 | 0.048 | 0.074 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children of single-parent and two-parent families respectively. In both panels, the reference category are children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1

**Socio-emotional outcomes**

Next, I analyse whether child vulnerability (low maternal education or single-parent family) moderates the association between maternal employment initiation during the first years of life and child socio-emotional development.

First, I examine whether the relation between timing of early maternal employment and child socio-emotional outcomes is moderated by maternal education and family structure. Several post-hoc t-tests analyses (not shown but available upon on request) show that the association between early initiation of maternal employment and socio-emotional cognitive development is not moderated by maternal education.

Panel A of Table 4.15, shows that children of less educated mothers who initiated employment between zero and three months after childbirth presented more externalising and internalising socio-emotional problems relative to children whose mothers did not engage in early maternal employment. In addition, children of less educated mothers who initiated employment between three and six after childbirth presented more externalising problems relative to children whose mothers did not engage in early maternal employment.

Panel B of Table 4.15 shows that children of highly educated mothers who initiated employment between zero and three after childbirth presented more general socio-emotional problems relative to children whose mothers did not engage in early maternal employment. Children of highly educated mothers who initiated employment between three and six months after childbirth presented more externalising and general socio-emotional problems relative to children whose mothers did not engage in early maternal employment. Finally, children of highly educated mothers who initiated employment between six and 12 months after childbirth presented more internalising problems relative to children whose mothers did not engage in early maternal employment.

Finally, several post-hoc t-tests analyses (not shown but available upon on request) show that the association between early initiation of maternal employment and child socio-emotional development is slightly more negative for children from single-parent families relative to children from two-parent families when mothers initiated employment between three and six months after childbirth.

Panel A of Table 4.16 shows that children in single-parent families and whose mothers initiated employment between three and six months after childbirth presented more socio-emotional, externalising and internalising problems relative to children whose mothers did not engage in early maternal employment. In addition, children whose mothers initiated employment between zero and three months or between six and 12 months after childbirth presented more internalising problems and externalising problems respectively relative to children whose mothers did not engage in early maternal employment.

In addition, Panel B of table 4.15 shows that children in two-parent families and whose mothers initiated employment between zero and three months after childbirth presented more externalising, internalising, and socio-emotional problems relative to children whose mothers did not engage in early maternal employment. Finally, children in two-parent families and whose mothers initiated employment between three and six months after childbirth presented more externalising problems relative to children whose mothers did not engage in early maternal employment.

**Table 4.15. Association between timing of early maternal employment and child socio-emotional outcomes at 18-36 months old for children of less educated and highly educated mothers: OLS regressions**

| Maternal employment timing | CBCL Total (1) | Externalising problems (2) | Internalising problems (3) |
|---|---|---|---|
| **A. Less educated mothers** | | | |
| No early maternal employment (reference category) | 0<br>(0) | 0<br>(0) | 0<br>(0) |
| 0–3 months / less educated mothers | 0.234** | 0.309*** | 0.223** |
| | (0.110) | (0.118) | (0.109) |
| 3–6 months / less educated mothers | 0.128 | 0.304*** | 0.030 |
| | (0.106) | (0.111) | (0.110) |
| 6–12 months / less educated mothers | -0.044 | -0.007 | -0.071 |
| | (0.094) | (0.097) | (0.099) |
| 12–18 months / less educated mothers | -0.075 | -0.026 | -0.028 |
| | (0.097) | (0.098) | (0.096) |
| Observations | 1,425 | 1,425 | 1,425 |
| R-squared | 0.146 | 0.147 | 0.103 |
| **B. Highly educated mothers** | | | |
| No early maternal employment (reference category) | 0<br>(0) | 0<br>(0) | 0<br>(0) |
| 0–3 months / highly educated mothers | 0.138* | 0.091 | 0.133* |
| | (0.080) | (0.081) | (0.076) |
| 3–6 months / highly educated mothers | 0.132** | 0.157*** | 0.017 |
| | (0.056) | (0.060) | (0.064) |
| 6–12 months / highly educated mothers | 0.040 | 0.108* | -0.033 |
| | (0.056) | (0.059) | (0.056) |
| 12–18 months / highly educated mothers | 0.078 | 0.057 | 0.032 |
| | (0.055) | (0.057) | (0.058) |
| Observations | 2,824 | 2,824 | 2,824 |
| R-squared | 0.193 | 0.151 | 0.189 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children of less educated and highly educated mothers respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1

**Table 4.16. Association between timing of early maternal employment and child socio-emotional outcomes at 18-36 months old analysing for children in single-parent and two-parent families: OLS regressions**

| Maternal employment timing | CBCL Total (1) | Externalising problems (2) | Internalising problems (3) |
|---|---|---|---|
| **A. Family structure: single-parent families** | | | |
| No early maternal employment (reference category) | 0<br>(0) | 0<br>(0) | 0<br>(0) |
| 0-3 months / single-parent family | 0.144 | 0.156 | 0.181* |
| | (0.103) | (0.108) | (0.101) |
| 3-6 months / single-parent family | 0.220*** | **0.310*** ** | **0.145*** |
| | (0.081) | (0.090) | (0.081) |
| 6-12 months / single-parent family | 0.099 | 0.156* | 0.023 |
| | (0.082) | (0.087) | (0.079) |
| 12 -18 months / single-parent family | 0.017 | -0.006 | -0.023 |
| | (0.076) | (0.077) | (0.080) |
| Observations | 1,285 | 1,285 | 1,285 |
| R-squared | 0.200 | 0.158 | 0.198 |
| **B. Family structure: two-parent families** | | | |
| No early maternal employment (reference category) | 0<br>(0) | 0<br>(0) | 0<br>(0) |
| 0-3 months / two-parent family | 0.165** | 0.140* | 0.151* |
| | (0.083) | (0.084) | (0.078) |
| 3-6 months / two-parent family | 0.061 | **0.108*** | **-0.062** |
| | (0.062) | (0.065) | (0.072) |
| 6-12 months / two-parent family | -0.042 | 0.031 | -0.084 |
| | (0.060) | (0.063) | (0.061) |
| 12-18 months / two-parent family | 0.037 | 0.051 | 0.036 |
| | (0.062) | (0.064) | (0.063) |
| Observations | 2,964 | 2,964 | 2,964 |
| R-squared | 0.209 | 0.160 | 0.205 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children of single-parent and two-parent families respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1

The overall conclusion about the association between timing of early maternal employment and child cognitive and socio-emotional outcomes is that this association shows some variation by children vulnerability variables (maternal education and family structure). The association between early maternal employment and socio-emotional development is slightly more negative for children from single-parent families (relative to children in two-parent families) and slightly better for children of less educated mothers (relative to children of highly educated mothers).

<u>Test of potential moderators: gender of the child and type of care</u>

Third, I estimate the association between timing of maternal employment and child cognitive or socio-emotional outcomes analysing child's gender and type of care as moderators.

**Cognitive outcomes**

Table 4.17 shows the association between different timings of early maternal employment and child cognitive development for children who attended formal and informal type of care. Several t-tests on the difference between the coefficients on timing of early maternal employment for formal and informal care (t-tests not shown) show that the difference in cognitive indicators between children who attended informal or formal care is not statistically significant.

In addition, Panel A of Table 4.17 shows that children whose mothers initiated employment between three and six months after childbirth and attended informal care show lower personal/social skills relative to children whose mothers did not engage in early maternal employment. Panel B of Table 4.17 shows that children whose mother initiated employment between three and six months and six and 12 months after childbirth and attended formal care show lower cognitive development measured by the EDDP test relative to children whose mothers did not engage in early maternal employment.

Finally, a post-hoc analysis (results not shown) shows that the association between early initiation of maternal employment and child cognitive development is more negative for girls than for boys. More specifically, girls whose mothers initiated employment between zero and three months after childbirth presented less cognitive skills relative to boys whose mothers initiated employment during the same period. In addition, girls whose mother initiated employment between six and 12 months after childbirth presented less cognitive (measured by the Battelle total score) and motor skills relative to boys whose mothers initiated employment during the same period.

Panel A of Table 4.18 shows that boys whose mothers initiated employment between six and 12 months after childbirth presented more cognitive skills relative to girls whose mothers did not engage in early maternal employment. By contrast, Panel B in Table 4.18 shows that girls whose mothers initiated employment between zero and three, three and six and six and 12 months after childbirth presented worse cognitive indicators relative to children whose mothers did not engage in early maternal employment.

**Table 4.17. Association between timing of maternal employment and child cognitive outcomes at 12-24 months old analysing for children in informal and formal type of care: OLS regressions**

| Maternal employment timing | Battelle Total (1) | Personal/Social Battelle (2) | Adaptive Battelle (3) | Motor Battelle (4) | Communication Battelle (5) | Cognitive Battelle (6) | EEDP (7) |
|---|---|---|---|---|---|---|---|
| **A. Type of care: informal** | | | | | | | |
| No early maternal employment (ref. category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0-3 months / informal care | -0.049 | -0.114 | -0.006 | -0.059 | -0.114 | 0.140 | -0.092 |
| | (0.140) | (0.127) | (0.130) | (0.148) | (0.140) | (0.167) | (0.150) |
| 3-6 months / informal care | -0.182 | -0.233** | 0.010 | -0.119 | -0.116 | -0.020 | -0.020 |
| | (0.116) | (0.108) | (0.111) | (0.122) | (0.116) | (0.123) | (0.111) |
| 6-12 months / informal care | -0.062 | -0.087 | -0.019 | -0.157 | -0.027 | 0.178 | 0.002 |
| | (0.110) | (0.099) | (0.103) | (0.114) | (0.112) | (0.118) | (0.107) |
| 12-18 months / informal care | 0.023 | -0.073 | 0.020 | 0.124 | -0.088 | 0.068 | -0.132 |
| | (0.144) | (0.116) | (0.122) | (0.139) | (0.135) | (0.139) | (0.115) |
| Observations | 760 | 760 | 760 | 760 | 760 | 760 | 760 |
| R-squared | 0.095 | 0.135 | 0.113 | 0.127 | 0.085 | 0.101 | 0.097 |
| **B. Type of care: formal** | | | | | | | |
| No early maternal employment (ref. category) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0-3 months / formal care | -0.135 | -0.119 | -0.143 | 0.002 | -0.012 | -0.032 | -0.081 |
| | (0.233) | (0.242) | (0.233) | (0.232) | (0.239) | (0.248) | (0.244) |
| 3-6 months / formal care | -0.159 | -0.121 | 0.106 | -0.051 | -0.242 | -0.247 | -0.301* |
| | (0.193) | (0.180) | (0.193) | (0.191) | (0.200) | (0.198) | (0.178) |
| 6-12 months / formal care | -0.289 | -0.250 | -0.149 | -0.183 | -0.354* | -0.035 | -0.330* |
| | (0.211) | (0.198) | (0.216) | (0.201) | (0.198) | (0.206) | (0.192) |
| 12-18 months / formal care | -0.075 | -0.108 | -0.180 | 0.142 | 0.008 | 0.102 | -0.034 |
| | (0.216) | (0.193) | (0.212) | (0.222) | (0.220) | (0.221) | (0.185) |
| Observations | 277 | 277 | 277 | 277 | 277 | 277 | 277 |
| R-squared | 0.171 | 0.137 | 0.220 | 0.141 | 0.198 | 0.213 | 0.188 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children who attended informal and formal care respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1.

**Table 4.18. Association between timing of maternal employment and child cognitive outcomes at 12-24 months old analysing for male and female children: OLS regressions**

| Maternal employment timing | Battelle Total (1) | Personal/Social Battelle (2) | Adaptive Battelle (3) | Motor Battelle (4) | Communication Battelle (5) | Cognitive Battelle (6) | EEDP (7) |
|---|---|---|---|---|---|---|---|
| **A. Sex of the child: male** | | | | | | | |
| No early maternal | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| employment (ref. category) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0-3 months / male | -0.084 | -0.122 | -0.073 | -0.010 | 0.012 | 0.107 | 0.009 |
| | (0.108) | (0.105) | (0.104) | (0.106) | (0.110) | (0.119) | (0.124) |
| 3-6 months / male | -0.049 | -0.016 | 0.035 | -0.121 | -0.074 | -0.023 | 0.029 |
| | (0.087) | (0.082) | (0.089) | (0.091) | (0.090) | (0.098) | (0.095) |
| 6-12 months / male | 0.089 | 0.092 | 0.111 | -0.003 | 0.015 | 0.277*** | 0.096 |
| | (0.086) | (0.079) | (0.082) | (0.092) | (0.087) | (0.092) | (0.087) |
| 12-18 months / male | -0.015 | -0.009 | -0.031 | -0.044 | -0.063 | -0.024 | -0.054 |
| | (0.100) | (0.088) | (0.097) | (0.100) | (0.097) | (0.105) | (0.092) |
| Observations | 1,337 | 1,337 | 1,337 | 1,337 | 1,337 | 1,337 | 1,337 |
| R-squared | 0.053 | 0.095 | 0.055 | 0.116 | 0.037 | 0.052 | 0.054 |
| **B Sex of the child: female** | | | | | | | |
| No early maternal | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| employment (ref. category) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| 0-3 months / female | -0.128 | 0.022 | 0.013 | -0.131 | -0.139 | **-0.306**** | 0.054 |
| | (0.117) | (0.103) | (0.112) | (0.119) | (0.120) | (0.131) | (0.116) |
| 3-6 months / female | -0.228** | -0.181* | 0.008 | -0.160 | -0.196* | -0.246** | -0.133 |
| | (0.103) | (0.093) | (0.095) | (0.113) | (0.103) | (0.104) | (0.104) |
| 6-12 months / female | **-0.111** | -0.046 | -0.045 | **-0.209**** | -0.066 | **-0.079** | 0.038 |
| | (0.084) | (0.076) | (0.081) | (0.087) | (0.083) | (0.090) | (0.086) |
| 12-18 months / female | -0.007 | -0.0009 | -0.022 | 0.146 | -0.077 | -0.017 | -0.044 |
| | (0.107) | (0.086) | (0.095) | (0.104) | (0.101) | (0.106) | (0.087) |
| Observations | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,329 |
| R-squared | 0.068 | 0.111 | 0.089 | 0.111 | 0.056 | 0.071 | 0.082 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to males and females respectively. In both panels, the reference category are children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1.

**Socio-emotional outcomes**

Next, I analyse to what extent the degree of formality of the child's type of non-maternal care and gender moderate the association between timing of early maternal employment and child socio-emotional outcomes. Table 4.19 shows the association between timing of early maternal employment and child socio-emotional outcomes at 18 to 36 months old for children in informal and formal care when mothers initiated employment. A post-hoc analysis (results not shown, available on request) shows that the association between early initiation of maternal employment and child socio-emotional development is more negative (this is, more externalising problems) for children in informal care than in formal care when mothers initiated employment between zero and three, three and six and six, or 12 months after childbirth.

Additionally, panel A of Table 4.19 shows that children whose mothers initiated employment between zero and three months or three and six months after childbirth and attended informal care presented more externalising and overall socio-emotional problems relative to children whose mothers did not engage in early maternal employment. In addition, children whose mothers initiated employment between six and 12 months after childbirth and attended informal care presented more externalising problems.

**Table 4.19. Association between timing of early maternal employment and child socio-emotional outcomes at 18-36 months old analysing for informal and formal care when mothers initiated employment: OLS regressions**

| Maternal employment timing | CBCL Total (1) | Externalising problems (2) | Internalising problems (3) |
|---|---|---|---|
| **A. Type of care: informal** | | | |
| No early maternal employment (reference category) | 0<br>(0) | 0<br>(0) | 0<br>(0) |
| 0-3 months / Informal care | 0.243** | **0.245**** | 0.170 |
| | (0.114) | (0.109) | (0.112) |
| 3-6 months / Informal care | 0.166* | **0.255***** | 0.015 |
| | (0.086) | (0.091) | (0.085) |
| 6-12 months / Informal care | 0.044 | **0.158*** | -0.071 |
| | (0.082) | (0.084) | (0.083) |
| 12-18 months / Informal care | 0.003 | 0.063 | -0.104 |
| | (0.087) | (0.089) | (0.086) |
| Observations | 1,115 | 1,115 | 1,115 |
| R-squared | 0.245 | 0.203 | 0.237 |
| **B. Type of care: formal** | | | |
| No early maternal employment (reference category) | 0<br>(0) | 0<br>(0) | 0<br>(0) |
| 0-3 months / Formal care | -0.090 | -0.225 | -0.055 |
| | (0.182) | (0.189) | (0.170) |
| 3-6 months / Formal care | 0.028 | -0.104 | 0.065 |
| | (0.146) | (0.158) | (0.138) |
| 6-12 months / Formal care | -0.128 | -0.199 | -0.089 |
| | (0.148) | (0.168) | (0.137) |
| 12-18 months / Formal care | -0.121 | -0.195 | -0.021 |
| | (0.143) | (0.153) | (0.139) |
| Observations | 453 | 453 | 453 |
| R-squared | 0.263 | 0.209 | 0.314 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to children who attended informal and formal care respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1.

On the other hand, Table 4.20 shows the association between timing of maternal employment and child socio-emotional outcomes at 18–36 months old for males and females. A post-hoc analysis (results not shown, available on request) shows that the association between early initiation of maternal employment and child socio-emotional development is more negative (this is, more socio-emotional problems) for girls than for boys in the socio-emotional and externalising problems sub-dimensions of socio-emotional development when mothers initiated employment between six and 12 months after childbirth. In the other timings of early maternal employment (between zero and three, three and six or 12 and 18 months after childbirth), the association between early maternal employment and child socio-emotional development was not heterogeneous along the child's gender.

Panel A of Table 4.20 shows that boys whose mothers initiated employment between three and six months after childbirth presented more socio-emotional and externalising problems relative to children whose mothers did not engage in early maternal employment. In addition, panel B of Table 4.20 shows that girls whose mothers initiated employment between zero and three, three and six months, or six and 12 months after childbirth presented more socio-emotional and externalising problems relative to children whose mothers did not engage in early maternal employment.

**Table 4.20. Association between timing of maternal employment and child socio-emotional outcomes at 18–36 months old for males and females: OLS regressions**

| Maternal employment timing | CBCL Total (1) | Externalising problems (2) | Internalising problems (3) |
|---|---|---|---|
| **A. Sex of the child: male** | | | |
| 0-3 months / Male | 0.085 | 0.065 | 0.113 |
| | (0.091) | (0.094) | (0.088) |
| 3-6 months / Male | 0.126* | 0.156** | 0.056 |
| | (0.066) | (0.072) | (0.079) |
| 6-12 months / Male | -0.094 | -0.043 | -0.101 |
| | (0.067) | (0.072) | (0.068) |
| 12-18 months / Male | 0.039 | -0.025 | 0.066 |
| | (0.066) | (0.069) | (0.071) |
| Observations | 2,126 | 2,126 | 2,126 |
| R-squared | 0.222 | 0.177 | 0.211 |
| **B. Sex of the child: female** | | | |
| 0-3 months / Female | 0.245*** | 0.257*** | 0.198** |
| | (0.090) | (0.093) | (0.086) |
| 3-6 months / Female | 0.124* | 0.219*** | -0.025 |
| | (0.071) | (0.075) | (0.074) |
| 6-12 months / Female | **0.115*** | **0.210***** | -0.007 |
| | (0.067) | (0.071) | (0.069) |
| 12-18 months / Female | 0.018 | 0.093 | -0.062 |
| | (0.069) | (0.070) | (0.069) |
| Observations | 2,123 | 2,123 | 2,123 |
| R-squared | 0.204 | 0.150 | 0.206 |

Notes: Panel A and Panel B show the results of two separate groups of regressions. The samples in Panel A and Panel B are restricted to males and females respectively. In both panels, the reference category is children whose mothers did not engage in early maternal employment in each respective sample. Robust standard errors in parentheses. All regressions control for child, maternal and family characteristics. *** p<0.01, ** p<0.05, * p<0.1.

Concluding, there is some evidence that the association between early maternal employment and child cognitive development is heterogeneous depending on the child's type of care or gender. In the cognitive and socio-emotional domains, there is suggestive evidence that early maternal employment affects girls more negatively relative to its effect on boys.

In addition, children who attended informal care present more externalising problems compared to children who attended formal care.

*4.4.5. Mediators in the impact of timing of early maternal employment on child outcomes: child's environment quality (home stimulation environment, maternal depression, and family income)*

The third question in this chapter is whether the association between the timing of early maternal employment and child development is mediated by characteristics of the child's environment: home stimulation quality, maternal depression or household income. To analyse this association I estimate two models where I calculate the difference between the coefficients on timing of early maternal employment with and without the potential mediator (the child's home environment quality, maternal depression, and family income). If such association changes significantly after including the potential mediator this means that the latter variable would be a mediator in the relation between timing of early maternal employment and child development.

My hypothesis is that the degree to which the inclusion of household income as a control in the regression decreases (or increases) the estimates of the association between timing of early maternal employment and child cognitive development (measure by the Battelle test) can be interpreted as evidence that the latter association is driven mainly by differences in income across mothers (not just by the time that mothers spent with the child). In general terms, the association between timing of early maternal employment child cognitive development increase the coefficient and significance when I include household income as a regressor. (For more information on the change of child cognitive outcomes by family income see Appendix 4.8). When I introduce the household income variable in the analysis of association between early maternal employment timing and child socio-emotional development, the key coefficient does not change (see Appendix 4.10). To analyse whether the coefficients on the different timings of early maternal employment (with and without family income) are equal I used seemingly unrelated regression (SUR). SUR permits to jointly estimate both equations while assuming that the equation's error terms are correlated across the equations. After including and excluding household income as a regressor in the timing of early maternal employment regression, the coefficients on the different timings of maternal employment dummy variables do not change significantly.

Possibly, maternal depression could be affecting both employment timing and child outcomes. However, when I include postpartum maternal depression in the regression the coefficient on child socio-emotional and cognitive development do not change. Hence, I conclude that maternal depression is not a relevant mechanism in the association between early maternal employment and child development.

Finally, when I introduce the variable HOME score as a covariate in the regression, the coefficients on the dummies of the different timings of maternal employment decrease (for more information see appendices 4.9 and 4.11). However, the SUR analysis enables me to conclude that such change in the key coefficients in both domains (cognitive and socio-emotional development) is non-significant.

Hence, there is no evidence that home environment, maternal depression, or household income are relevant mechanisms in the association between timing of early maternal employment and child cognitive and socio-emotional development.

## 4.5. Summary, conclusions and discussion

Parental investments at the beginning of a child’s life play a significant role in fostering child development. This is why the relationship between the timing of early maternal employment and child development has received a lot of attention from psychologists, economists, and policy makers. In this chapter, I analyse whether the timing of early maternal employment matters for child cognitive and socio-emotional development. In this analysis, I compare children of mothers who did not engage in early maternal employment after childbirth with those whose mothers initiated employment between zero and three, or three and six, six and 12, and 12 and 18 months after childbirth.

The implicit question of this chapter is, from the point of view of child development, which is the optimal timing of maternal employment? Both in OLS regressions and PSM analyses I found differences in child cognitive and socio-emotional development for children aged 12–24 months old and 24–36 months old who experienced early maternal employment relative to children whose mothers did not engage in early maternal employment. Based on the analysis of these two cohorts, I conclude that there is a certain degree of negative association between early maternal employment and child development and that this association differs depending on the timing of early maternal employment.

This chapter and the previous literature find that the earlier the mothers initiate employment within the first year after childbirth, the larger is the negative impact on their child's development. In my OLS and PSM models, I find evidence that children whose mothers initiated employment between zero and three, three and six or six and 12 months after childbirth present lower cognitive development relative to children whose mothers did not engage in early maternal employment. However, children whose mothers initiated employment between 12 and 18 months after childbirth present a positive association with some cognitive outcomes relative to children whose mothers did not engage in early maternal employment.

Given the literature on the association between early maternal employment and child development is extremely thin, there are only a handful of studies with which I can contrast my results. Baum (2003) finds that children whose mothers engaged in early maternal employment—especially during the first quarter of the child's life—exhibited lower cognitive development at ages three and four relative to children whose mother did not engage in early maternal employment. In terms of the effect size in cognitive development, Baum (2003) finds that children whose mothers initiated employment at or before three months after childbirth, on average, had 17 per cent of one standard deviation lower cognitive scores (in the PPVT, PIAT-M, and PIAT-R) relative to children whose mothers who did not engage in early maternal employment. In this chapter, children whose mothers initiated employment between three and six months after childbirth presented between 13 and 30 per cent of one standard deviation lower cognitive scores (depending on the outcome) relative to children whose mothers who did not engage in early maternal employment. In addition, Huerta et al. (2011), using data from the UK and the USA, conclude that children whose mother initiated employment within six months after childbirth present a small negative effect on their cognitive outcomes at four years old relative to mothers who did not engage in early maternal employment. The effect size in vocabulary test scores for children aged four and five is seven and five per cent of one standard deviation respectively. In this chapter, children whose mother initiated employment between six and 12 months after childbirth present between 13 and 23 per cent of one standard deviation lower cognitive outcomes and a small and marginally positive association of 12 per cent of one standard deviation at the 10 per cent significance level with vocabulary skills at 24 to 36 months old relative to children whose mother did not engage in early maternal employment.

Finally, delaying maternal employment initiation from three-six to six-12 months is associated with less detrimental child cognitive development in some sub-dimensions. Moreover, children whose mother initiated employment between 12 and 18 months after childbirth present between 8 and 22 per cent better cognitive outcomes at 24 to 36 months relative to children whose mother did not engage in early maternal employment. This finding is in line with Ruhm (2004) that finds that children of mothers who delayed employment initiation from starting immediately after childbirth to six or twelve months after childbirth had 13, 13, and 8 per cent of one standard deviation increases in the PPVT, PIAT-R and PIAT-M (cognitive) scores respectively.

In the socio-emotional domain, the association between maternal employment timing and child development is mixed and depends on the specific timing of early maternal employment. Initiating employment immediately before childbirth is associated with more socio-emotional, externalising and internalising problems. However initiate maternal employment between three and six or six and 12 months is associated with more externalising problems but fewer internalising problems relative to children whose mothers did not engage in early maternal employment. Using the same method as in this chapter, Berger, Hill and Waldfogel's (2005) US-based study report that children whose mothers return full-time within 12 weeks (three months) after childbirth are more likely to have externalising behavioural problems with respect to children whose mothers initiated employment 12 weeks after childbirth. Regarding the effect size, using data from the US, Berger, Hill and Waldfogel (2005) report that children of mothers initiating full-time employment within 12 weeks after childbirth exhibited 20 per cent of one standard deviation more externalising problems relative to children whose mothers did not initiate employment within the same period. In my analyses, I find that children whose mothers initiated employment between three and six months after childbirth exhibit 14 per cent of one standard deviation more externalising and 9 per cent of one standard deviation fewer internalising problems relative to children whose mothers did not engage in early maternal employment.

In conclusion there is evidence that early maternal employment initiation during the first year after childbirth (between zero and three, three and six or six and 12 months after childbirth) is negatively associated with some sub-dimensions of child development relative to not engaging in early maternal employment. However maternal employment initiation between 12 and 18 months after childbirth has a positive association with child cognitive development at 24 to 36 months old and with child socio-emotional development at 18 to 36 months old relative to children whose mothers did not engage in early maternal employment. This finding is in line with Han et al. (2001) and Baydar and Brooks-Gunn's (1991) conclusion that initiating employment during the last quarter of the first year after childbirth is more beneficial for child cognitive and socio-emotional development relative to initiating employment during the first three quarters of a child's life. One explanation for this result is that at during the last quarter of children's first year of life, children have more mature cognitive conceptions of object permanence relative to children in their first three quarters of life (Harris, 1983); this may facilitated children to deal better with separation from their mothers. Another reason for my finding could be that the result is driven by unobservable characteristics of mothers who initiated employment between 12 and 18 months after childbirth. Although my results controlled for a large number of covariates, still other omitted variables may bias my results. For example, mothers who initiated employment between 12 and 18 months after childbirth could be more committed to work and less anxious about using non-maternal care relative to mothers who did not engage in early maternal employment after childbirth or who engaged in early maternal employment during the first four quarters of their child's life. Unfortunately, the ELPI dataset does not contain information about maternal anxiety or beliefs about work.

The second focus of this chapter is whether the association between early maternal employment and child outcomes differs according to three groups of variables that the literature has shown to be relevant moderators. First, this chapter shows that work intensity (part-time or full-time) is a relevant moderator in the association between early maternal employment and child cognitive and socio-emotional outcomes. More specifically, I find suggestive evidence that part-time work during the first year after childbirth has a more positive association with child cognitive development relative to full-time work. This is in line with the evidence from the USA and the UK suggesting that full-time early maternal employment is associated with worse child development relative to part-time early maternal employment (Brooks-Gunn et al., 2002; Gregg et al., 2005). In addition, I find suggestive evidence that part-time work during the first year after childbirth is more beneficial to child socio-emotional development relative to full-time work. Unfortunately, the ELPI dataset does not allow for a more detailed look at maternal work intensity because it only contains information about whether the mother worked part or full-time, not including the number of hours worked[42]. Data with a greater detailed data on work intensity is needed to understand the nuances of part-time and full-time work in a country like Chile and why part-time jobs in this country are more positively associated with child cognitive development and child socio-emotional development relative to full-time jobs.

Secondly, I find that child vulnerability proxied by family structure is a relevant moderator in the association between timing of maternal employment and child socio-emotional development. Early maternal employment between three and six months after childbirth is associated with more negative socio-emotional development for children in single-parent families relative to the same association for children in two-parent families. This is not in line with the evidence from the USA and the UK where the association between early maternal employment and child development is more negative for children in two-parent families relative to the same association for children in single-parent families (Brooks-Gunn et al., 2002; Goldberg et al., 2008). An explanation for my result

[42] On the other hand Chilean workers work on average 2,029 hours per year, far more than the 1,765 hours worked on average in OECD countries (OECD, 2012). Considering that the ELPI dataset does not include the exact amount of hours worked, these differences in labour market contexts could affect what mothers understand as part-time or full-time work.

is that the investment of parental time in children is higher in two-parent families relative to the same investment in single-parent families. O'Reilly and Fagan (1998) finds that the hours of weekly hours of mothers increase, the father's engagement with the child increases.

Third, I find that the association between timing of early maternal employment and child socio-emotional outcomes varies by type of care. Maternal employment initiation is associated with more socio-emotional problems in children who attended informal care relative to children who attended formal care (centre-based care) during the same period. One explanation could be the structural characteristics of publicly-funded centre-based care programs in Chile. The publicly-funded centre-based care represents 80 per cent of the total centre-based care coverage in Chile; this is explained in greater detail in Chapter 2. An interesting venue of future research would be to understand the difference between child-adult interactions in centre-based care relative to child-adult interactions in informal care explains to some degree my finding.

Finally, I find that the association between timing of early maternal employment and child cognitive and socio-emotional outcomes varies along the child's sex. Girls whose mothers initiated employment between six and 12 months after childbirth presented worse cognitive skills and more socio-emotional problems (externalising problems) relative to boys whose mothers initiated employment during the same period. This finding is not in line with the results of Goldberg et al., (2008)'s meta-analysis that concludes that early maternal employment has more positive effects on female relative to male development. In future work, it would be interesting to explore whether there is any difference in the mother–child relation along the child's sex.

*Strengths and limitations*

Given that the vast majority of research about maternal employment and child development has been conducted in developed countries, a strength of this chapter is to focus on mothers and children living in a middle-income country context. Currently, most Latin American countries mandate three months of post-natal leave and are discussing extending it. Hence, it seems relevant to address the previously stated question in the context of a developing country to shed light on parental leave policies and their impact on child development. In addition, this study uses a relatively new, unknown, large Chilean longitudinal dataset that has information related to child development about the children, their mothers and families. The nature of the sample of this survey (children born between 2006 and 2009) is a strength of this chapter. Considering that most of the literature on maternal employment and child development comes from older cohorts of children, understanding the answers to old questions in new settings is in itself a contribution to knowledge.

Although this chapter uses relatively robust methods to address selection bias and causality issues, further work is needed. It is important to look even more rigorously into causality. Future research would greatly benefit from an experimental design that could introduce exogenous incentives to the timing of early maternal employment. In addition, establishing the mechanisms by which early maternal employment is associated to cognitive and socio-emotional outcomes (e.g. home environments), is vital to understanding the nature of the previously stated associations and for proposing welfare-enhancing policies. Studies with richer datasets and using structural equation modelling could contribute to better understand the mechanisms underlying the association between early maternal employment and child development.

Finally, it would be relevant to better understand the role of the child's type of care in the association between early maternal employment and child development. Hence, in the next chapter I analyse the association between different type of care during infancy and child development. In this way, the next chapter complements the knowledge provided in this chapter about the early experiences that shape child development.

## 4.6. Appendices

**Appendix 4.1 Rates of missing data for all covariates (in percentages)**

| Variables | Observations | Missing | Freq. missing | Non-missing | Freq. non-missing |
|---|---|---|---|---|---|
| Maternal education | | | | | |
| Without formal education | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Incomplete Primary | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Primary | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Incomplete High School | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| High School | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Vocational education | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| College Degree | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Child's type of care after mother starts to work | 7866 | 423 | 5.378 | 7443 | 94.62 |
| Mother income before childbirth | 7866 | 1111 | 14.12 | 6755 | 85.88 |
| Maternal age | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Maternal age square | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Mother married* (%) | 7866 | 51 | 0.6484 | 7815 | 99.35 |
| Mother's WAIS digit score | 7866 | 7 | 0.089 | 7859 | 99.91 |
| Mother's WAIS vocabulary score | 7866 | 7 | 0.089 | 7859 | 99.91 |
| Work before pregnancy (%) | 7866 | 1104 | 14.04 | 6762 | 85.96 |
| Mother drank alcohol during pregnancy (%) | 7866 | 84 | 1.068 | 7782 | 98.93 |
| Difficulties during pregnancy (%) | 7866 | 67 | 0.8518 | 7799 | 99.15 |
| Mental problems during pregnancy (%) | 7866 | 67 | 0.8518 | 7799 | 99.15 |
| Teenager pregnancy (%) | 7866 | 0 | 0 | 7866 | 100 |
| Extraversion | 7866 | 183 | 2.326 | 7683 | 97.67 |
| Agreeableness | 7866 | 183 | 2.326 | 7683 | 97.67 |
| Conscientiousness | 7866 | 183 | 2.326 | 7683 | 97.67 |
| Neuroticism | 7866 | 183 | 2.326 | 7683 | 97.67 |
| Openness | 7866 | 183 | 2.326 | 7683 | 97.67 |
| Boys (%) | 7866 | 0 | 0 | 7866 | 100 |
| Having older sibling (%) | 7866 | 0 | 0 | 7866 | 100 |
| Premature (%) | 7866 | 0 | 0 | 7866 | 100 |
| Child low weight (%) | 7866 | 609 | 7.742 | 7257 | 92.26 |
| Child age | 7866 | 0 | 0 | 7866 | 100 |
| Child age square | 7866 | 0 | 0 | 7866 | 100 |

**Appendix 4.2. Common support, pre-treatment covariates and balance t-statistics for children whose mothers initiated employment immediately after childbirth relative to children whose mothers who did not engage in early maternal employment. Dependent variable: the Battelle Inventory Test**

### Common support

| Treatment assignment | Common support | | |
|---|---|---|---|
| | Off support | On support | Total |
| Untreated | 0 | 24,119 | 24,119 |
| Treated | 1 | 1,336 | 1,337 |
| Total | 1 | 25,455 | 25,456 |

### Balance

| Variable | Unmatched Matched | Mean Treated | Mean Control | %bias | %reduction bias | t-test t | t-test p>\|t\| |
|---|---|---|---|---|---|---|---|
| Without formal education | U | 0.00075 | 0.00327 | -5.6 | | -1.61 | 0.108 |
| | M | 0.00075 | 0.00075 | 0 | 100 | 0 | 1 |
| Incomplete Primary | U | 0.09342 | 0.11194 | -6.1 | | -2.1 | 0.036 |
| | M | 0.09342 | 0.09342 | 0 | 100 | 0 | 1 |
| Primary | U | 0.14126 | 0.11382 | 8.2 | | 3.06 | 0.002 |
| | M | 0.14126 | 0.13229 | 2.7 | 67.3 | 0.67 | 0.5 |
| Incomplete High School | U | 0.24963 | 0.23119 | 4.3 | | 1.55 | 0.12 |
| | M | 0.24963 | 0.25785 | -1.9 | 55.4 | -0.49 | 0.625 |
| High School | U | 0.34679 | 0.4009 | -11.2 | | -3.94 | 0 |
| | M | 0.34679 | 0.36323 | -3.4 | 69.6 | -0.89 | 0.374 |
| Vocational education | U | 0.04858 | 0.07163 | -9.7 | | -3.21 | 0.001 |
| | M | 0.04858 | 0.03363 | 6.3 | 35.1 | 1.95 | 0.052 |
| College Degree | U | 0.11883 | 0.05981 | 20.8 | | 8.67 | 0 |
| | M | 0.11883 | 0.11809 | 0.3 | 98.7 | 0.06 | 0.952 |
| No answer | U | 0.00075 | 0.00744 | -10.5 | | -2.84 | 0.005 |
| | M | 0.00075 | 0.00075 | 0 | 100 | 0 | 1 |
| Mother’s age | U | 28.827 | 27.077 | 23.5 | | 8.52 | 0 |
| | M | 28.827 | 28.666 | 2.2 | 90.8 | 0.55 | 0.58 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mother's age squared | U | 888.48 | 786.52 | 23 | | 8.47 | 0 |
| | M | 888.48 | 877.8 | 2.4 | 89.5 | 0.61 | 0.542 |
| Married mother | U | 0.50149 | 0.72298 | -46.7 | | -17.5 | 1 0.000 |
| | M | 0.50149 | 0.63303 | -27.7 | 40.6 | -6.93 | 0 |
| Mother's numeracy level | U | -0.02396 | -0.15518 | 14.1 | | 4.92 | 0 |
| | M | -0.02396 | -0.28296 | 27.9 | -97.4 | 7.95 | 0 |
| Mother's vocabulary level | U | -0.07979 | -0.1857 | 11.3 | | 3.94 | 0 |
| | M | -0.07979 | -0.10307 | 2.5 | 78 | 0.69 | 0.488 |
| Work pre-pregnancy | U | 3.571 | 3.9267 | -45.3 | | -23.7 | 3 0.00 |
| | M | 3.571 | 3.5389 | 4.1 | 91 | 0.8 | 0.422 |
| Drank alcohol during pregnancy | U | 0.15695 | 0.0675 | 28.6 | | 12.35 | 0 |
| | M | 0.15695 | 0.12257 | 11 | 61.6 | 2.57 | 0.01 |
| Difficulties during pregnancy | U | 0.47309 | 0.41157 | 12.4 | | 4.45 | 0 |
| | M | 0.47309 | 0.43946 | 6.8 | 45.3 | 1.75 | 0.081 |
| Mental health during pregnancy | U | 0.24664 | 0.1502 | 24.4 | | 9.5 | 0 |
| | M | 0.24664 | 0.18087 | 16.6 | 31.8 | 4.16 | 0 |
| Teenager mother | U | 0.21226 | 0.22486 | -3 | | -1.08 | 0.282 |
| | M | 0.21226 | 0.21898 | -1.6 | 46.6 | -0.42 | 0.672 |
| Mother's extraversion score | U | 0.14023 | -0.10806 | 24.6 | | 8.85 | 0 |
| | M | 0.14023 | 0.08025 | 5.9 | 75.8 | 1.7 | 0.09 |
| Mother's agreeableness score | U | 0.00094 | -0.05575 | 5.5 | | 2 | 0.046 |
| | M | 0.00094 | 0.06871 | -6.6 | -19.6 | -1.83 | 0.067 |
| Mother's conscientiousness score | U | -0.14622 | -0.14733 | 0.1 | | 0.04 | 0.969 |
| | M | -0.14622 | -0.14011 | -0.6 | -451 | -0.16 | 0.871 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mother's neuroticism score | U | 0.15176 | 0.07964 | 7.3 | | 2.59 | 0.01 |
| | M | 0.15176 | 0.03983 | 11.3 | -55.2 | 2.94 | 0.003 |
| Mother's openness score | U | -0.10692 | -0.02966 | -7.2 | | -2.65 | 0.008 |
| | M | -0.10692 | 0.0024 | -10.2 | -10.2 | -41.5 | 0.009 |
| Male | U | 0.61883 | 0.50327 | 23.4 | | 8.24 | 0 |
| | M | 0.61883 | 0.5142 | 21.2 | 9.5 | 5.49 | 0 |
| Have a older sibling | U | 0.60837 | 0.54796 | 12.3 | | 4.33 | 0 |
| | M | 0.60837 | 0.60613 | 0.5 | 96.3 | 0.12 | 0.906 |
| Premature | U | 0.06203 | 0.06431 | -0.9 | | -0.33 | 0.741 |
| | M | 0.06203 | 0.06203 | 0 | 100 | 0 | 1 |
| Low birth weight | U | 0.04709 | 0.04481 | 1.1 | | 0.39 | 0.695 |
| | M | 0.04709 | 0.04709 | 0 | 100 | 0 | 1 |
| Child's age (in months) | U | 18.003 | 18.241 | -7.4 | | -2.72 | 0.007 |
| | M | 18.003 | 17.982 | 0.7 | 91.2 | 0.17 | 0.867 |
| Child's age (in months) squared | U | 3.30E+05 | 3.30E+05 | -6.5 | | -2.39 | 0.017 |
| | M | 3.30E+05 | 3.20E+05 | 2.4 | 63.6 | 0.61 | 0.542 |
| Monthly maternal income pre-birth | U | 2.30E+05 | 2.00E+05 | 9.7 | | 3.61 | 0 |
| | M | 2.30E+05 | 2.20E+05 | 2.3 | 76.6 | 0.6 | 0.552 |

**Appendix 4.3. Pre-treatment covariates and balance t-statistics for children whose mothers initiated employment three months after childbirth versus mothers who did not engage in early maternal employment after childbirth**

## Common support

| Treatment assignment | Common support | | |
|---|---|---|---|
| | Off support | On support | Total |
| Untreated | 0 | 28,839 | 28,839 |
| Treated | 1 | 3,191 | 3,191 |
| Total | 1 | 32,029 | 32,030 |

## Balance

| Variables | Unmatched Matched | Mean Treated | Mean Control | %bias | %reduct bias | t-test t | t-test p>t |
|---|---|---|---|---|---|---|---|
| Without formal education | U | .00658 | .00277 | 6 | | 3.64 | 0.000 |
| | M | .00658 | .00596 | 0.9 | 83.5 | 0.32 | 0.751 |
| Incomplete Primary | U | .021 | .10812 | -36 | | -15.66 | 0.000 |
| | M | .021 | .0185 | 1.0 | 97.1 | 0.72 | 0.472 |
| Primary | U | .07897 | .10902 | -10.3 | | -5.23 | 0.000 |
| | M | .079 | .07837 | 0.2 | 97.9 | 0.09 | 0.926 |
| Incomplete High School | U | .10279 | .22171 | -32.7 | | -15.71 | 0.000 |
| | M | .10282 | .09749 | 1.5 | 95.5 | 0.71 | 0.478 |
| High School | U | .44814 | .40175 | 9.4 | | 5.06 | 0.000 |
| | M | .44828 | .43386 | 2.9 | 68.9 | 1.16 | 0.246 |
| Vocational education | U | .13225 | .07809 | 17.7 | | 10.51 | 0.000 |
| | M | .13229 | .15329 | -6.9 | 61.2 | -2.40 | 0.017 |
| College Degree | U | .20965 | .07154 | 40.5 | | 26.80 | 0.000 |
| | M | .2094 | .20846 | 0.3 | 99.3 | 0.09 | 0.926 |
| Mother's age | U | 28.432 | 27.156 | 18.7 | | 9.58 | 0.000 |
| | M | 28.431 | 28.187 | 3.6 | 80.9 | 1.54 | 0.124 |
| Mother's age squared | U | 849.32 | 789.62 | 14.8 | | 7.64 | 0.000 |
| | M | 849.27 | 833.94 | 3.8 | 74.3 | 1.62 | 0.105 |
| Married mother | U | .64995 | .72274 | -15.7 | | -8.66 | 0.000 |
| | M | .64984 | .63699 | 2.8 | 82.3 | 1.07 | 0.284 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mother's numeracy level | U | .2945 | -.13615 | | 41.4 | 23.75 | 0.000 |
| | M | .29379 | .29345 | 0.0 | 99.9 | 0.01 | 0.990 |
| Mother's vocabulary level | U | .20391 | -.14841 | | 38.3 | 19.72 | 0.000 |
| | M | .20356 | .17512 | 3.1 | 91.9 | 1.25 | 0.210 |
| Work pre-pregnancy | U | 3.0156 | 3.7657 | | -66.5 | -44.84 | 0.000 |
| | M | 3.0171 | 3.0181 | -0.1 | 99.9 | -0.03 | 0.978 |
| Drank alcohol during pregnancy | U | .12567 | .07112 | | 18.4 | 11.02 | 0.000 |
| | M | .12539 | .1232 | 0.7 | 96.0 | 0.27 | 0.791 |
| Difficulties during pregnancy | U | .50893 | .40799 | | 20.4 | 10.99 | 0.000 |
| | M | .50909 | .49498 | 2.8 | 86.0 | 1.13 | 0.260 |
| Mental health during pregnancy | U | .26355 | .15236 | | 27.7 | 16.18 | 0.000 |
| | M | .26364 | .28746 | -5.9 | 78.6 | -2.13 | 0.033 |
| Teenager mother | U | .09057 | .21356 | | -34.8 | -16.51 | 0.000 |
| | M | .0906 | .09028 | 0.1 | 99.7 | 0.04 | 0.965 |
| Mother's extraversion score | U | .1943 | -.10898 | | 30.2 | 16.31 | 0.000 |
| | M | .1939 | .17339 | 2.0 | 93.2 | 0.83 | 0.406 |
| Mother's agreeableness score | U | .01766 | -.06247 | | 7.8 | 4.25 | 0.000 |
| | M | .01786 | -.0268 | 4.3 | 44.3 | 1.79 | 0.073 |
| Mother's conscientiousness score | U | .05153 | -.12126 | | 17.2 | 9.16 | 0.000 |
| | M | .05124 | .09117 | -4.0 | 76.9 | -1.59 | 0.113 |
| Mother's neuroticism score | U | -.04265 | .07992 | | -12.3 | -6.63 | 0.000 |
| | M | -0.04969 | | -3.5 | 71.5 | -1.40 | 0.162 |
| Mother's openness score | U | .06034 | -.02791 | | 9 | 4.63 | 0.000 |
| | M | .06025 | .0738 | -1.4 | 84.6 | -0.59 | 0.555 |
| Male | U | .56691 | .49759 | | 13.9 | 7.44 | 0.000 |
| | M | .56708 | .56458 | 0.5 | 96.4 | 0.20 | 0.840 |
| Have a older sibling | U | .56033 | .54034 | | 4 | 2.15 | 0.032 |
| | M | .56019 | .55329 | 1.4 | 65.5 | 0.55 | 0.579 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Premature | U | .0398 | .05662 | | -7.9 | -3.96 | 0.000 |
| | M | .03981 | .03793 | 0.9 | 88.8 | 0.39 | 0.698 |
| Low birth weight | U | .02225 | .04008 | | -10.3 | -4.98 | 0.000 |
| | M | .02226 | .02257 | -0.2 | 98.2 | -0.08 | 0.933 |
| Child’s age (in months) | U | 17.633 | 18.221 | | -18.3 | -10.15 | 0.000 |
| | M | 17.632 | 17.689 | -1.8 | 90.3 | -0.71 | 0.476 |
| Child’s age (in months) squared | | 3.1e+05 | 3.3e+05 | | -18.3 | -10.02 | 0.000 |
| | M | 3.1e+05 | 3.1e+05 | -1.7 | 90.7 | -0.69 | 0.493 |
| Monthly maternal income pre-birth | U | 2.7e+05 | 1.8e+05 | | 35.3 | 19.78 | 0.000 |
| | M | 2.7e+05 | 2.7e+05 | 0.0 | 100.0 | 0.00 | 0.999 |

BEFORE MATCHING

| Percentiles | Smallest | | | |
|---|---|---|---|---|
| 1% | 4.017116 | 4.017116 | | |
| 5% | 5.580986 | 5.580986 | | |
| 10% | 7.8271 | 7.79431 | Obs | 30 |
| 25% | 10.30918 | 7.859891 | Sum of Wgt. | 30 |
| | | | | |
| 50% | 18.0306 | | Mean | 21.46254 |
| | | Largest | Std. Dev. | 14.12736 |
| 75% | 32.68249 | 38.26904 | | |
| 90% | 39.40337 | 40.5377 | Variance | 199.5824 |
| 95% | 41.44737 | 41.44737 | Skewness | 1.213084 |
| 99% | 66.54108 | 66.54108 | Kurtosis | 4.449072 |

AFTER MATCHING

| Percentiles | Smallest | | | |
|---|---|---|---|---|
| 1% | .0030962 | .0030962 | | |
| 5% | .032809 | .032809 | | |
| 10% | .0865115 | .0844198 | Obs | 30 |
| 25% | .5037873 | .0886032 | Sum of Wgt. | 30 |
| | | | | |
| 50% | 1.584152 | | Mean | 2.132278 |
| Largest | | | Std. Dev. | 1.906484 |
| 75% | 3.522871 | 4.34438 | | |
| 90% | 4.972401 | 5.600423 | Variance | 3.63468 |
| 95% | 5.925572 | 5.925572 | Skewness | .8198601 |
| 99% | 6.872674 | 6.872674 | Kurtosis | 2.814332 |

| Sample | Pseudo R2 | LR chi2 | p>chi2 | MeanBias | MedBias |
|---|---|---|---|---|---|
| Raw | 0.159 | 3296.22 | 0.000 | 21.5 | 18.0 |
| Matched | 0.005 | 44.68 | 0.032 | 2.1 | 1.6 |

**Appendix 4.4. Pre-treatment covariates and balance t-statistics for children whose mothers initiated employment six months after childbirth versus mothers who did not engage in early maternal employment after childbirth**

| Treatment assignment | support Off support | On support | Total |
|---|---|---|---|
| Untreated | 0 | 28,839 | 28,839 |
| Treated | 6 | 4,786 | 4,792 |
| Total | 6 | 33,625 | 33,631 |

**Common support**

**Balance**

| Variable | Unmatched Matched | Mean Treated | Control | %bias | %reduct bias | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Without formal education | U | .00021 | .00277 | -7 | | -3.36 | 0.001 |
| | M | .00021 | 0 | 0.5 | 91.9 | 1.00 | 0.317 |
| Incomplete Primary | U | .05113 | .10812 | -21 | | -12.20 | 0.000 |
| | M | .05119 | .04659 | 1.7 | 91.9 | 1.04 | 0.297 |
| Primary | U | .02692 | .10902 | -33.1 | | -17.84 | 0.000 |
| | M | .02695 | .02737 | -0.2 | 99.5 | -0.13 | 0.900 |
| Incomplete High School | U | .17321 | .22171 | -12.2 | | -7.58 | 0.000 |
| | M | .17342 | .17092 | 0.6 | 94.8 | 0.32 | 0.745 |
| High School | U | .43531 | .40175 | 6.8 | | 4.38 | 0.000 |
| | M | .43585 | .47221 | -15.7 | | -3.57 | 0.000 |
| Vocational education | U | .1563 | .07809 | 24.5 | | 17.67 | 0.000 |
| | M | .1565 | .14333 | 4.1 | 83.2 | 1.80 | 0.071 |
| College Degree | U | .15213 | .07154 | 25.8 | | 18.82 | 0.000 |
| | M | .15107 | .13393 | 5.5 | 78.7 | 2.40 | 0.016 |
| Mother’s age | U | 26.386 | 27.156 | -11.3 | | -6.95 | 0.000 |
| | M | 26.386 | 26.068 | 4.7 | 58.7 | 2.47 | 0.014 |
| Mother’s age squared | U | 736.12 | 789.62 | -13.5 | | -8.25 | 0.000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | M | 736.18 | 718.84 | 4.4 | 67.6 | 2.35 | 0.019 |
| Married mother | U | .56156 | .72274 | -34.1 | | -22.71 | 0.000 |
| | M | .56226 | .55307 | 1.9 | 94.3 | 0.91 | 0.365 |
| Mother’s numeracy level | U | .20835 | -.13615 | 35.7 | | 23.06 | 0.000 |
| | M | .20565 | .24564 | -4.1 | 88.4 | -2.01 | 0.044 |
| Mother’s vocabulary level | U | .17763 | -.14841 | 34.2 | | 21.71 | 0.000 |
| | M | .17686 | .159 | 1.9 | 94.5 | 0.95 | 0.341 |
| Work pre-pregnancy | U | 3.3088 | 3.7657 | -44.2 | | -32.81 | 0.000 |
| | M | 3.3138 | 3.2618 | 5.0 | 88.6 | 2.06 | 0.039 |
| Drank alcohol during pregnancy | U | .07575 | .07112 | 1.8 | | 1.15 | 0.250 |
| | M | .07564 | .07146 | 1.6 | 9.8 | 0.78 | 0.434 |
| Difficulties during pregnancy | U | .46411 | .40799 | 11.3 | | 7.30 | 0.000 |
| | M | .46344 | .45738 | 1.2 | 89.2 | 0.59 | 0.552 |
| Mental health during pregnancy | U | .21661 | .15236 | 16.6 | | 11.21 | 0.000 |
| | M | .21563 | .19975 | 4.1 | 75.3 | 1.92 | 0.056 |
| Teenager mother | U | .20576 | .21356 | -1.9 | | -1.22 | 0.221 |
| | M | .20602 | .22879 | -197.4 | | -2.70 | 0.007 |
| Mother’s extraversion score | U | .16035 | -.10898 | 28.2 | | 17.54 | 0.000 |
| | M | .15869 | .18631 | -2.9 | 89.7 | -1.47 | 0.143 |
| Mother’s agreeableness score | U | -0.09746 | | 2.8 | | 1.76 | 0.079 |
| | M | -0.0899 | | 2.1 | 25.2 | 1.02 | 0.308 |
| Mother’s conscientiousness score | U | -0.14029 | | 10.6 | | 6.57 | 0.000 |
| | M | -0.04876 | | 1.0 | 90.6 | 0.50 | 0.621 |
| Mother’s neuroticism score | U | -.02572 | .07992 | -10.7 | | -6.83 | 0.000 |
| | M | -0.0376 | | -1.7 | 84.5 | -0.81 | 0.420 |
| Mother’s openness score | U | .0985 | -.02791 | 13.3 | | 8.03 | 0.000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | M | .09817 | .10997 | -1.2 | 90.7 | -0.67 | 0.501 |
| Male | U | .46828 | .49759 | -5.9 | | -3.76 | 0.000 |
| | M | .46866 | .45173 | 3.4 | 42.3 | 1.66 | 0.097 |
| Have a older sibling | U | .37354 | .54034 | -34 | | -21.54 | 0.000 |
| | M | .37296 | .34392 | 5.9 | 82.6 | 2.96 | 0.003 |
| Premature | U | .05196 | .05662 | -2.1 | | -1.30 | 0.193 |
| | M | .05077 | .04931 | 0.6 | 68.6 | 0.33 | 0.743 |
| Low birth weight | U | .03151 | .04008 | -4.6 | | -2.84 | 0.004 |
| | M | .03155 | .03218 | -0.3 | 92.7 | -0.17 | 0.861 |
| Child’s age (in months) | U | 17.276 | 18.221 | -28.1 | | -19.15 | 0.000 |
| | M | 17.282 | 17.553 | -8.1 | 71.4 | -3.84 | 0.000 |
| Child’s age (in months) squared | U | 3.0e+05 | 3.3e+05 | -25 | | -16.78 | 0.000 |
| | M | 3.0e+05 | 3.1e+05 | -7.6 | 69.6 | -3.63 | 0.000 |
| Monthly maternal income pre-birth | U | 2.3e+05 | 1.8e+05 | 19.3 | | 12.70 | 0.000 |
| | M | 2.3e+05 | 2.2e+05 | 2.2 | 88.5 | 1.04 | 0.297 |

| Summary of the distribution of the abs(bias) | | | | |
|---|---|---|---|---|
| BEFORE MATCHING | | | | |
| Percentiles | | Smallest | | |
| 1% | 1.775805 | 1.775805 | | |
| 5% | 1.917434 | 1.917434 | | |
| 10% | 2.404979 | 2.057889 | Obs | 30 |
| 25% | 6.651337 | 2.752069 | Sum of Wgt. | 30 |
| 50% | 13.38458 | | Mean | 17.40235 |
| | | Largest | Std. Dev. | 12.38884 |
| 75% | 28.1319 | 34.10573 | | |
| 90% | 34.16134 | 34.21695 | Variance | 153.4834 |
| 95% | 35.65893 | 35.65893 | Skewness | .4094417 |
| 99% | 44.15194 | 44.15194 | Kurtosis | 1.961733 |

| AFTER MATCHING | | | | |
|---|---|---|---|---|
| Percentiles | | Smallest | | |
| 1% | .1682767 | .1682767 | | |
| 5% | .3374645 | .3374645 | | |
| 10% | .5863627 | .5417405 | Obs | 30 |
| 25% | 1.223789 | .6309849 | Sum of Wgt. | 30 |
| 50% | 2.143461 | | Mean | 3.089633 |
| | | Largest | Std. Dev. | 2.312863 |
| 75% | 4.682745 | 5.913391 | | |
| 90% | 6.643454 | 7.373516 | Variance | 5.349333 |
| 95% | 7.582308 | 7.582308 | Skewness | .6373196 |
| 99% | 8.05494 | 8.05494 | Kurtosis | 2.28924 |

| Sample | Pseudo R2 | LR chi2 | p>chi2 | MeanBias | MedBias |
|---|---|---|---|---|---|
| Raw | 0.128 | 3538.63 | 0.000 | 17.4 | 13.4 |
| Matched | 0.005 | 72.38 | 0.000 | 3.1 | 2.1 |

**Appendix 4.5. Pre-treatment covariates and balance t-statistics for children whose mothers initiated employment 12 months after childbirth versus mothers who did not engage in early maternal employment after childbirth**

**Common support**

| Treatment assignment | support Off suppo | On suppor | Total |
|---|---|---|---|
| Untreated | 0 | 28,839 | 28,839 |
| Treated | 3 | 4,203 | 4,206 |
| Total | 3 | 33,042 | 33,045 |

**Balance**

| Variable | Unmatched Matched | Mean Treated | Control | %bias | %reduct bias | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Without formal education | U | .00048 | .00277 | -6 | | -2.80 | 0.005 |
| | M | .00048 | 0 | 1.2 | 79.3 | 1.41 | 0.157 |
| Incomplete Primary | U | .02496 | .10812 | -34 | | -17.05 | 0.000 |
| | M | .02498 | .01142 | 5.5 | 83.7 | 4.66 | 0.000 |
| Primary | U | .07252 | .10902 | -12.7 | | -7.24 | 0.000 |
| | M | .07257 | .06852 | 1.4 | 88.9 | 0.72 | 0.469 |
| Incomplete High School | U | .23562 | .22171 | 3.3 | | 2.02 | 0.043 |
| | M | .23578 | .24483 | -2.2 | 35.0 | -0.97 | 0.332 |
| High School | U | .40728 | .40175 | 1.1 | | 0.68 | 0.495 |
| | M | .40757 | .41375 | | -13.2 | -0.58 | 0.564 |
| Vocational education | U | .102 | .07809 | 8.4 | | 5.31 | 0.000 |
| | M | .10207 | .11539 | -4.7 | 44.3 | -1.96 | 0.050 |
| College Degree | U | .13766 | .07154 | 21.7 | | 14.82 | 0.000 |
| | M | .13728 | .13181 | 1.8 | 91.7 | 0.74 | 0.462 |
| Mother's age | U | 25.837 | 27.156 | -19.3 | | -11.21 | 0.000 |
| | M | 25.838 | 25.841 | -0.0 | 99.8 | -0.02 | 0.982 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mother's age squared | U | 708.49 | 789.62 | | -20.7 | -11.84 | 0.000 |
| | M | 708.57 | 708.38 | 0.0 | 99.8 | 0.02 | 0.981 |
| Married mother | U | .59035 | .72274 | | -28.2 | -17.69 | 0.000 |
| | M | .59077 | .6098 | -4.0 | 85.6 | -1.78 | 0.075 |
| Mother's numeracy level | U | .03051 | -.13615 | | 16.7 | 10.45 | 0.000 |
| | M | .02949 | .01879 | 1.1 | 93.6 | 0.49 | 0.622 |
| Mother's vocabulary level | U | .02467 | -.14841 | | 18.1 | 10.88 | 0.000 |
| | M | .02471 | .03002 | -0.6 | 96.9 | -0.26 | 0.795 |
| Work pre-pregnancy | U | 3.5006 | 3.7657 | | -27.7 | -18.59 | 0.000 |
| | M | 3.5034 | 3.4575 | 4.8 | 82.7 | 1.90 | 0.057 |
| Drank alcohol during pregnancy | U | .07394 | .07112 | | 1.1 | 0.66 | 0.507 |
| | M | .07399 | .0778 | | -36.3 | -0.66 | 0.510 |
| Difficulties during pregnancy | U | .48027 | .40799 | | 14.6 | 8.89 | 0.000 |
| | M | .4799 | .45943 | 4.1 | 71.7 | 1.88 | 0.060 |
| Mental health during pregnancy | U | .16809 | .15236 | | 4.3 | 2.64 | 0.008 |
| | M | .16774 | .17226 | -1.2 | 71.3 | -0.55 | 0.581 |
| Teenager mother | U | .2582 | .21356 | | 10.5 | 6.54 | 0.000 |
| | M | .25839 | .25387 | 1.1 | 89.9 | 0.47 | 0.635 |
| Mother's extraversion score | U | .1929 | -.10898 | | 32.1 | 18.63 | 0.000 |
| | M | .19266 | .17048 | 2.4 | 92.7 | 1.10 | 0.270 |
| Mother's agreeableness score | U | -0.16109 | | | -3.7 | -2.19 | 0.028 |
| | M | -0.2409 | | 4.4 | -19.7 | 2.04 | 0.042 |
| Mother's conscientiousness score | U | -0.22302 | | | 1.8 | 1.16 | 0.248 |
| | M | -0.21177 | | 0.7 | 59.6 | 0.34 | 0.735 |
| Mother's neuroticism score | U | .02255 | .07992 | | -5.8 | -3.50 | 0.000 |
| | M | .02284 | .07936 | -5.7 | 1.5 | -2.59 | 0.010 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mother's openness score | U | -0.04666 | | | 0.9 | 0.54 | 0.591 |
| | M | -0.02223 | | | -74.2 | -0.71 | 0.478 |
| Male | U | .5 | .49759 | | 0.5 | 0.29 | 0.770 |
| | M | .50012 | .50464 | | -88.5 | -0.41 | 0.679 |
| Have a older sibling | U | .43248 | .54034 | | -21.7 | -13.12 | 0.000 |
| | M | .43255 | .43802 | -1.1 | 94.9 | -0.51 | 0.613 |
| Premature | U | .05302 | .05662 | | -1.6 | -0.95 | 0.343 |
| | M | .05282 | .0571 | | -20.7 | -0.86 | 0.389 |
| Low birth weight | U | .05421 | .04008 | | 6.7 | 4.27 | 0.000 |
| | M | .05401 | .04925 | 2.2 | 66.3 | 0.99 | 0.324 |
| Child's age (in months) | U | 18.448 | 18.221 | | 7.6 | 4.51 | 0.000 |
| | M | 18.448 | 18.361 | 2.9 | 61.8 | 1.36 | 0.174 |
| Child's age (in months) squared | U | 3.4e+05 | 3.3e+05 | | 5.9 | 3.53 | 0.000 |
| | M | 3.4e+05 | 3.4e+05 | 2.9 | 51.7 | 1.34 | 0.179 |
| Monthly maternal income pre-birth | U | 2.1e+05 | 1.8e+05 | | 11.8 | 7.26 | 0.000 |
| | M | 2.1e+05 | 2.1e+05 | -0.5 | 95.7 | -0.22 | 0.823 |

Summary of the distribution of the abs(bias)

BEFORE MATCHING

| Percentiles | | Smallest | | |
|---|---|---|---|---|
| 1% | .4819562 | .4819562 | | |
| 5% | .8850831 | .8850831 | | |
| 10% | 1.107293 | 1.088378 | Obs | 30 |
| 25% | 3.697357 | 1.126208 | Sum of Wgt. | 30 |
| 50% | 9.443537 | | Mean | 11.96667 |
| | Largest | | Std. Dev. | 9.931848 |
| 75% | 19.32291 | 27.66068 | | |
| 90% | 27.90651 | 28.15235 | Variance | 98.64161 |
| 95% | 32.09075 | 32.09075 | Skewness | . 7073071 |
| 99% | 33.83757 | 33.83757 | Kurtosis | 2.393382 |

AFTER MATCHING

| Percentiles | | Smallest | | |
|---|---|---|---|---|
| 1% | . 0453214 | .0453214 | | |
| 5% | .0481028 | .0481028 | | |
| 10% | .5294618 | .5025023 | Obs | 30 |
| 25% | 1.070687 | .5564213 | Sum of Wgt. | 30 |
| 50% | 1.663546 | | Mean | 2.265247 |
| | Largest | | Std. Dev. | 1.667385 |
| 75% | 4.047547 | 4.658437 | | |
| 90% | 4.725496 | 4.792556 | Variance | 2.780172 |
| 95% | 5.518689 | 5.518689 | Skewness | .6611553 |
| 99% | 5.667669 | 5.667669 | Kurtosis | 2.168714 |

| Sample | Pseudo R2 | LR chi2 | p>chi2 | MeanBias | MedBias |
|---|---|---|---|---|---|
| Raw | 0.068 | 1706.14 | 0.000 | 12.0 | 9.4 |
| Matched | 0.006 | 64.93 | 0.000 | 2.3 | 1.7 |

## Appendix 4.6. The association between timing of early maternal employment and child cognitive outcomes with and without controls: no imputations in incomplete variables or income as covariate

| | Model without controls | | | | | | Model with mothers' characteristics controls | | | | | | Model with Mothers and children characteristics controls | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| Variables | Battelle Total | Cognitive Battelle | Comm Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle | Battelle Total | Cognitive Battelle | Comm Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle | Battelle Total | Cognitive Battelle | Comm Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle |
| 0-3 months | -0.0001 | 0.013 | 0.015 | -0.029 | -0.012 | 0.051 | -0.115 | -0.0987 | -0.0822 | -0.113 | -0.0506 | -0.0460 | -0.0702 | -0.0711 | -0.0377 | -0.0810 | -0.0129 | -0.0329 |
| | (0.063) | (0.067) | (0.060) | (0.064) | (0.061) | (0.059) | (0.0745) | (0.0799) | (0.0744) | (0.0749) | (0.0720) | (0.0698) | (0.0773) | (0.0843) | (0.0790) | (0.0791) | (0.0742) | (0.0715) |
| 3-6.months | -0.001 | -0.033 | -0.035 | -0.032 | 0.040 | 0.064 | -0.114* | -0.116* | -0.136** | -0.114* | 0.0237 | -0.0789 | -0.118* | -0.124* | -0.125* | -0.121* | 0.0131 | -0.0838 |
| | (0.049) | (0.056) | (0.053) | (0.056) | (0.051) | (0.047) | (0.0621) | (0.0672) | (0.0635) | (0.0669) | (0.0622) | (0.0579) | (0.0645) | (0.0695) | (0.0660) | (0.0701) | (0.0640) | (0.0605) |
| 6-12 months | 0.115** | 0.154*** | 0.105** | -0.008 | 0.064 | 0.168*** | -0.00374 | 0.104* | -0.0248 | -0.0879 | 0.0290 | 0.0325 | -0.00906 | 0.0990 | -0.0387 | -0.0899 | 0.0181 | 0.0232 |
| | (0.049) | (0.053) | (0.047) | (0.054) | (0.047) | (0.043) | (0.0568) | (0.0600) | (0.0555) | (0.0598) | (0.0552) | (0.0518) | (0.0582) | (0.0623) | (0.0576) | (0.0612) | (0.0559) | (0.0529) |
| 12-18 months | 0.098* | 0.078 | 0.015 | 0.084 | 0.054 | 0.130*** | 0.0143 | 0.00925 | -0.0756 | 0.0550 | 0.0152 | 0.0261 | -4.91e-05 | -0.00804 | -0.0816 | 0.0522 | -0.0123 | 0.00694 |
| | (0.059) | (0.064) | (0.059) | (0.059) | (0.057) | (0.050) | (0.0682) | (0.0711) | (0.0657) | (0.0678) | (0.0642) | -0.0567 | (0.0706) | (0.0737) | (0.0685) | (0.0699) | (0.0661) | (0.0586) |
| Without formal education | | | | | | | 0.207 | 0.229 | -0.153 | -0.123 | 0.120 | 0.236 | 0.142 | 0.142 | -0.0832 | -0.114 | 0.0204 | 0.113 |
| | | | | | | | (0.302) | (0.292) | (0.294) | (0.337) | (0.310) | (0.282) | (0.317) | (0.303) | (0.295) | (0.362) | (0.343) | (0.282) |
| Incomplete Primary | | | | | | | 0.237 | 0.268 | -0.139 | -0.168 | 0.180 | 0.232 | 0.176 | 0.193 | -0.0813 | -0.135 | 0.0842 | 0.109 |
| | | | | | | | (0.300) | (0.289) | (0.292) | (0.336) | (0.309) | (0.280) | (0.315) | (0.300) | (0.292) | (0.361) | (0.341) | (0.280) |
| Primary | | | | | | | 0.295 | 0.279 | -0.0313 | -0.141 | 0.193 | 0.315 | 0.249 | 0.209 | 0.0384 | -0.0666 | 0.0944 | 0.183 |
| | | | | | | | (0.298) | (0.286) | (0.291) | (0.333) | (0.305) | (0.277) | (0.312) | (0.297) | (0.291) | (0.358) | (0.338) | (0.276) |
| Imcomplete High School | | | | | | | 0.338 | 0.317 | -0.0333 | -0.0566 | 0.173 | 0.347 | 0.281 | 0.234 | 0.0291 | -0.00888 | 0.0820 | 0.208 |
| | | | | | | | (0.296) | (0.285) | (0.289) | (0.332) | (0.303) | (0.275) | (0.310) | (0.295) | (0.289) | (0.356) | (0.336) | (0.273) |
| High School | | | | | | | 0.382 | 0.226 | 0.0624 | 0.00667 | 0.211 | 0.362 | 0.333 | 0.159 | 0.116 | 0.0665 | 0.124 | 0.234 |
| | | | | | | | (0.301) | (0.290) | (0.293) | (0.337) | (0.308) | (0.278) | (0.314) | (0.300) | (0.293) | (0.361) | (0.340) | (0.276) |
| Vocational education | | | | | | | 0.243 | 0.188 | -0.00692 | -0.0702 | 0.0885 | 0.322 | 0.160 | 0.0560 | 0.0107 | -0.0101 | -0.0298 | 0.159 |
| | | | | | | | (0.301) | (0.290) | (0.294) | (0.338) | (0.308) | (0.278) | (0.315) | (0.301) | (0.293) | (0.363) | (0.340) | (0.276) |
| College Degree | | | | | | | 0.360 | 0.167 | 0.0331 | -0.127 | 0.112 | 0.486 | 0.352 | 0.0681 | 0.0909 | -0.0590 | 0.0781 | 0.385 |
| | | | | | | | (0.350) | (0.351) | (0.330) | (0.384) | (0.356) | (0.324) | (0.360) | (0.361) | (0.331) | (0.408) | (0.380) | (0.321) |
| Maternal age | | | | | | | 0.0119 | -0.00912 | -0.0117 | 0.00575 | -0.00903 | 0.0263 | 0.0187 | 0.00739 | 0.00415 | 0.00966 | -0.00759 | 0.0263 |
| | | | | | | | (0.0299) | (0.0317) | (0.0307) | (0.0304) | (0.0289) | (0.0279) | (0.0321) | (0.0340) | (0.0324) | (0.0328) | (0.0309) | (0.0296) |
| Mother married | | | | | | | -0.0534 | -0.0361 | -0.0239 | -0.0371 | -0.0168 | -0.0266 | -0.0335 | -0.028 | -0.00177 | -0.0146 | -0.0205 | -0.0163 |
| | | | | | | | (0.0424) | (0.0450) | (0.0423) | (0.0440) | (0.0417) | (0.0390) | (0.0439) | (0.0469) | (0.0444) | (0.0455) | (0.0433) | (0.0407) |
| Mother’s WAIS digit score | | | | | | | 0.0002 | 0.0149 | 0.0123 | 0.00105 | -0.0274 | 0.000379 | 0.00344 | 0.0181 | 0.0167 | 0.0002 | -0.0259 | 0.00735 |
| | | | | | | | (0.0210) | (0.0223) | (0.0215) | (0.0211) | (0.0207) | (0.0197) | (0.022) | (0.0232) | (0.0222) | (0.0217) | (0.0210) | (0.0201) |
| Mother’s WAIS vocabulary score | | | | | | | 0.104*** | 0.127*** | 0.079*** | 0.071*** | 0.021 | 0.123*** | 0.100*** | 0.128*** | 0.074*** | 0.068*** | 0.0203 | 0.123*** |
| | | | | | | | (0.0230) | (0.0238) | (0.0229) | (0.0239) | (0.0232) | (0.0212) | (0.024) | (0.025) | (0.0239) | (0.0248) | (0.0239) | (0.0220) |
| Work before pregnancy | | | | | | | -0.0244 | -0.0183 | -0.0210 | -0.0151 | -0.0273* | -0.0179 | -0.0191 | -0.0125 | -0.0135 | -0.0116 | -0.0203 | -0.0178 |
| | | | | | | | (0.0150) | (0.0160) | (0.0152) | (0.0153) | (0.0146) | (0.0138) | (0.0154) | (0.0164) | (0.0157) | (0.0159) | (0.0150) | (0.0142) |
| Mother drank alcohol during pregnancy | | | | | | | 0.0147 | -0.0235 | -0.0467 | 0.0496 | 0.0275 | -0.0623 | 0.0367 | -0.0122 | -0.0205 | 0.0265 | 0.0517 | -0.0256 |
| | | | | | | | (0.0718) | (0.0754) | (0.0705) | (0.0725) | (0.0703) | (0.0659) | (0.075) | (0.078 | (0.0737) | (0.0753) | (0.0736) | (0.0689) |
| Difficulties during pregnancy | | | | | | | -0.0363 | -0.099** | -0.0117 | 0.00438 | 0.0354 | -0.0505 | -0.0174 | -0.0785* | 0.000328 | 0.0219 | 0.0417 | -0.0490 |
| | | | | | | | (0.0374) | (0.0394) | (0.0373) | (0.0388) | (0.0368) | (0.0338) | (0.0388) | (0.0412) | (0.0389) | (0.0400) | (0.0380) | (0.0350) |

| | Model without controls | | | | | | Model with mothers' characteristics controls | | | | | | Model with Mothers and children characteristics controls | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| Variables | Battelle Total | Cognitive Battelle | Comm Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle | Battelle Total | Cognitive Battelle | Comm Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle | Battelle Total | Cognitive Battelle | Comm Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle |
| Mental problems during pregnancy | | | | | | | 0.0683 | 0.0578 | 0.0485 | 0.0554 | 0.0712 | 0.0291 | 0.0997* | 0.0769 | 0.0743 | 0.0613 | 0.110** | 0.0598 |
| | | | | | | | (0.0510) | (0.0530) | (0.0508) | (0.0517) | (0.0490) | (0.0468) | (0.0519) | (0.0545) | (0.0520) | (0.0529) | (0.0498) | (0.0477) |
| Teenager pregnancy | | | | | | | 0.0620 | 0.0167 | -0.0373 | 0.0786 | -0.00940 | 0.0964 | 0.0563 | 0.0196 | -0.0493 | 0.0598 | -0.0216 | 0.0917 |
| | | | | | | | (0.0792) | (0.0840) | (0.0814) | (0.081) | (0.077) | (0.0735) | (0.0823) | (0.0876) | (0.0845) | (0.0837) | (0.080) | (0.0759) |
| Extraversion | | | | | | | 0.0334* | 0.0232 | -0.000498 | 0.0219 | 0.0481** | 0.0402** | 0.0324 | 0.0149 | -0.00331 | 0.0233 | 0.052*** | 0.0429** |
| | | | | | | | (0.0200) | (0.0214) | (0.0202) | (0.0201) | (0.0195) | (0.0179) | (0.0206) | (0.0222) | (0.0208) | (0.021) | (0.0200) | (0.0184) |
| Agreeableness | | | | | | | 0.048** | 0.00455 | 0.0501** | 0.00824 | 0.0377* | 0.0642*** | 0.0416** | 0.00444 | 0.0384* | 0.00296 | 0.0287 | 0.0613*** |
| | | | | | | | (0.0200) | (0.0212) | (0.0197) | (0.021) | (0.020) | (0.0181) | (0.0206) | (0.0221) | (0.0206) | (0.0216) | (0.0208) | (0.0187) |
| Conscientiousness | | | | | | | 0.0351* | 0.0143 | 0.000380 | 0.00893 | 0.067*** | 0.0323* | 0.0417** | 0.00911 | 0.00440 | 0.0144 | 0.078*** | 0.0335* |
| | | | | | | | (0.021) | (0.022) | (0.021) | (0.0214) | (0.0201) | (0.0188) | (0.0211) | (0.0222) | (0.0215) | (0.0220) | (0.0206) | (0.0195) |
| Neuroticism | | | | | | | -0.0170 | -0.00714 | -0.0170 | -0.0102 | -0.00393 | -0.0139 | -0.0183 | -0.0112 | -0.0148 | -0.0105 | -0.00640 | -0.0123 |
| | | | | | | | (0.0203) | (0.0211) | (0.0205) | (0.0212) | (0.0200) | (0.0184) | (0.0209) | (0.0218) | (0.0212) | (0.0219) | (0.0206) | (0.0190) |
| Openness | | | | | | | 0.049*** | 0.033* | 0.045** | 0.033* | 0.044** | 0.038** | 0.0445** | 0.0316 | 0.0481** | 0.0281 | 0.044** | 0.0369** |
| | | | | | | | | | | | | | (0.0191) | (0.021) | (0.0197) | (0.0196) | (0.0190) | (0.0185) |
| Boys | | | | | | | | | | | | | -0.151*** | -0.096** | -0.199*** | 0.0434 | -0.217*** | -0.182*** |
| | | | | | | | | | | | | | (0.038) | (0.0400) | (0.0379) | (0.0396) | (0.0374) | (0.0346) |
| Having older sibling | | | | | | | | | | | | | -0.122** | -0.116** | -0.149*** | -0.0514 | -0.0920* | -0.0958** |
| | | | | | | | | | | | | | (0.0495) | (0.0516) | (0.0484) | (0.0519) | (0.0493) | (0.0451) |
| Premature | | | | | | | | | | | | | -0.100 | -0.178** | -0.0175 | -0.0920 | -0.172* | -0.0562 |
| | | | | | | | | | | | | | (0.0961) | (0.0903) | (0.0898) | (0.114) | (0.0916) | (0.0831) |
| Child low weight | | | | | | | | | | | | | -0.0204 | -0.0126 | 0.0451 | -0.0704 | 0.163* | 0.000624 |
| | | | | | | | | | | | | | (0.0924) | (0.0956) | (0.0969) | (0.0937) | (0.0923) | (0.0784) |
| Child age | 0.063 | 0.046 | -0.010 | 0.047 | 0.086** | -0.043 | 0.0693 | 0.0268 | -0.0150 | 0.0534 | 0.093** | -0.0245 | 0.0640 | 0.0253 | -0.0189 | 0.0504 | 0.0832* | -0.0380 |
| | (0.042) | (0.046) | (0.043) | (0.04) | (0.041) | (0.038) | (0.0449) | (0.0478) | (0.0456) | (0.0470) | (0.0442) | (0.0411) | (0.0461) | (0.0494) | (0.0470) | (0.0483) | (0.0449) | (0.0419) |
| Child age square | -2.32e-06* | -2.68e-07 | 8.43e-07 | -3.98e-06*** | -9.16e-07 | -2.21e-08 | -2.55e-06* | 3.90e-07 | 9.05e-07 | -4.20e-06*** | -1.12e-06 | -6.08e-07 | -2.43e-06* | 3.99e-07 | 9.98e-07 | -4.16e-06*** | -9.19e-07 | -2.30e-07 |
| | (1.24e-06) | (1.36e-06) | (1.28e-06) | (1.29e-06) | (1.22e-06) | (1.12e-06) | (1.32e-06) | (1.43e-06) | (1.37e-06) | (1.38e-06) | (1.31e-06) | (1.20e-06) | | | | | | |
| | (0.362) | (0.390) | (0.360) | (0.38) | (0.352) | (0.332) | (0.680) | (0.686) | (0.676) | (0.713) | (0.660) | (0.633) | (0.713) | (0.724) | (0.703) | (0.749) | (0.702) | (0.653) |
| Observations | 3,568 | 3,568 | 3,568 | 3,568 | 3,568 | 3,568 | 2,953 | 2,953 | 2,953 | 2,953 | 2,953 | 2,953 | 2,758 | 2,758 | 2,758 | 2,758 | 2,758 | 2,758 |
| R-squared | 0.006 | 0.016 | 0.005 | 0.075 | 0.034 | 0.031 | 0.042 | 0.044 | 0.028 | 0.094 | 0.053 | 0.080 | 0.052 | 0.048 | 0.041 | 0.098 | 0.071 | 0.094 |

**Appendix 4.7. The association between timing of early maternal employment and child cognitive outcomes: with and without income before pregnancy**

| | Without income pre-pregnancy | | | | | | With income pre-pregnancy | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | (1) Battelle Total | (2) Cognitive Battelle | (3) Comm Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/ Social Battelle | (7) Battelle Total | (8) Cognitive Battelle | (9) Comm Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/ Social Battelle |
| 0-3 months | -0.070 | -0.071 | -0.038 | -0.081 | -0.0129 | -0.033 | -0.101 | -0.088 | -0.0539 | -0.116 | -0.0321 | -0.0499 |
| | (0.077) | (0.084) | (0.079) | (0.079) | (0.074) | (0.072) | (0.078) | (0.086) | (0.080) | (0.080) | (0.075) | (0.0729) |
| 3-6 months | -0.118* | -0.124* | -0.125* | -0.121* | 0.0131 | -0.0838 | -0.128* | -0.128* | -0.128* | -0.128* | 0.0140 | -0.0932 |
| | (0.065) | (0.070) | (0.0660) | (0.070) | (0.064) | (0.0605) | (0.066) | (0.071) | (0.068) | (0.071) | (0.065) | (0.062) |
| 6-12.months | -0.0091 | 0.0990 | -0.0387 | -0.0899 | 0.0181 | 0.0232 | -0.0152 | 0.0965 | -0.0332 | -0.114* | 0.0294 | 0.0164 |
| | (0.058) | (0.062) | (0.058) | (0.061) | (0.056) | (0.0529) | (0.060) | (0.064) | (0.060) | (0.063) | (0.057) | (0.0549) |
| 12-18.months | -4.91e-05 | -0.008 | -0.082 | 0.052 | -0.012 | 0.007 | -0.006 | -0.0107 | -0.0705 | 0.0543 | -0.0228 | -0.0018 |
| | (0.071) | (0.074) | (0.0685) | (0.070) | (0.066) | (0.059) | (0.072) | (0.074) | (0.0696) | (0.071) | (0.066) | (0.060) |
| Without formal education | 0.142 | 0.141 | -0.0821 | -0.114 | 0.0207 | 0.113 | 0.123 | 0.141 | -0.0802 | -0.134 | 0.00581 | 0.109 |
| | (0.316) | (0.301) | (0.294) | (0.362) | (0.343) | (0.282) | (0.323) | (0.302) | (0.297) | (0.369) | (0.348) | (0.286) |
| Incomplete Primary | 0.177 | 0.195 | -0.0834 | -0.136 | 0.0831 | 0.110 | 0.141 | 0.159 | -0.104 | -0.164 | 0.0389 | 0.0943 |
| | (0.314) | (0.298) | (0.292) | (0.361) | (0.341) | (0.280) | (0.322) | (0.298) | (0.294) | (0.367) | (0.346) | (0.284) |
| Primary | 0.250 | 0.209 | 0.0403 | -0.0657 | 0.0959 | 0.184 | 0.242 | 0.209 | 0.0246 | -0.0895 | 0.0800 | 0.195 |
| | (0.311) | (0.295) | (0.291) | (0.358) | (0.338) | (0.275) | (0.319) | (0.296) | (0.293) | (0.365) | (0.343) | (0.280) |
| Incomplete High School | 0.282 | 0.235 | 0.0302 | -0.0077 | 0.0841 | 0.210 | 0.258 | 0.238 | 0.0114 | -0.0524 | 0.0679 | 0.210 |
| | (0.309) | (0.293) | (0.288) | (0.356) | (0.336) | (0.273) | (0.317) | (0.294) | (0.291) | (0.363) | (0.341) | (0.277) |
| High School | 0.335 | 0.162 | 0.117 | 0.0678 | 0.127 | 0.236 | 0.288 | 0.165 | 0.0755 | -0.005 | 0.0984 | 0.217 |
| | (0.313) | (0.298) | (0.292) | (0.361) | (0.340) | (0.276) | (0.321) | (0.299) | (0.295) | (0.368) | (0.344) | (0.280) |
| Vocational education | 0.162 | 0.0582 | 0.0112 | -0.009 | -0.028 | 0.161 | 0.140 | 0.0798 | -0.00503 | -0.0888 | -0.0308 | 0.179 |
| | (0.314) | (0.298) | (0.293) | (0.362) | (0.340) | (0.276) | (0.322) | (0.300) | (0.296) | (0.369) | (0.346) | (0.281) |
| College Degree | 0.353 | 0.0697 | 0.0915 | -0.0581 | 0.0797 | 0.386 | 0.123 | 0.141 | -0.0802 | -0.134 | 0.00581 | 0.109 |
| | (0.359) | (0.359) | (0.331) | (0.408) | (0.380) | (0.321) | (0.323) | (0.302) | (0.297) | (0.369) | (0.348) | (0.286) |
| Maternal age | 0.0203 | 0.00935 | 0.00420 | 0.0103 | -0.006 | 0.0276 | 0.0266 | 0.0264 | 0.00987 | 0.0207 | -0.0020 | 0.0254 |
| | (0.032) | (0.034) | (0.032) | (0.03) | (0.031) | (0.0296) | (0.033) | (0.035) | (0.0331) | (0.033) | (0.032) | (0.0304) |
| Maternal age square | -0.0002 | -1.88e-06 | -1.99e-05 | -8.47e-05 | 8.24e-05 | -0.0003 | -0.0003 | -0.0003 | -0.00013 | -0.0003 | -1.16e-05 | -0.0003 |
| | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) |

| | Without income pre-pregnancy | | | | | | With income pre-pregnancy | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | (1) Battelle Total | (2) Cognitive Battelle | (3) Comm Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/ Social Battelle | (7) Battelle Total | (8) Cognitive Battelle | (9) Comm Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/ Social Battelle |
| Mother married | -0.0338 | -0.0287 | -0.0014 | -0.0145 | -0.0204 | -0.0170 | -0.0416 | -0.0313 | -0.0101 | -0.0426 | -0.0191 | -0.0165 |
| | (0.044) | (0.0469) | (0.0444) | (0.0456) | (0.0433) | (0.0407) | (0.045) | (0.0471) | (0.045) | (0.046) | (0.0436) | (0.0414) |
| Mother's WAIS digit score | 0.00337 | 0.0182 | 0.0164 | 0.000116 | -0.0261 | 0.00737 | -0.008 | 0.0143 | 0.0084 | -0.0089 | -0.0332 | -0.00236 |
| | (0.022) | (0.0232) | (0.0222) | (0.0217) | (0.0210) | (0.0201) | (0.022) | (0.0238) | (0.022) | (0.022) | (0.0215) | (0.0206) |
| Mother's WAIS vocabulary score | 0.101*** | 0.128*** | 0.075*** | 0.068*** | 0.0211 | 0.123*** | 0.099*** | 0.131*** | 0.076*** | 0.058** | 0.0179 | 0.128*** |
| | (0.024) | (0.025) | (0.024) | (0.025) | (0.024) | (0.022) | (0.0244) | (0.0252) | (0.0243) | (0.0256) | (0.0243) | (0.0226) |
| Work before pregnancy | 0.0395 | 0.0157 | 0.0399 | 0.0271 | 0.0468 | 0.0416 | 0.0141 | -0.0174 | -0.0056 | -0.0492 | 0.107 | 0.00965 |
| | (0.0463) | (0.0494) | (0.0470) | (0.0475) | (0.0450) | (0.0427) | (0.0753) | (0.0818) | (0.0750) | (0.0792) | (0.0749) | (0.0664) |
| Mother drank alcohol during pregnancy | 0.0354 | -0.0138 | -0.0205 | 0.0260 | 0.0507 | -0.0265 | 0.0618 | -0.00174 | 0.00374 | 0.0529 | 0.0779 | -0.0171 |
| | (0.0753) | (0.0774) | (0.0738) | (0.0753) | (0.0736) | (0.0689) | (0.0751) | (0.0779) | (0.0735) | (0.0759) | (0.0732) | (0.0692) |
| Difficulties during pregnancy | -0.0180 | -0.078* | -0.0008 | 0.0213 | 0.0407 | -0.0492 | -0.0244 | -0.0802* | -0.0146 | 0.0154 | 0.0426 | -0.0537 |
| | (0.0388) | (0.0412) | (0.0389) | (0.0400) | (0.0380) | (0.0350) | (0.0396) | (0.0419) | (0.0397) | (0.0406) | (0.0386) | (0.0357) |
| Mental problems during pregnancy | 0.101* | 0.0776 | 0.0754 | 0.0622 | 0.112** | 0.0605 | 0.0990* | 0.0699 | 0.0762 | 0.0710 | 0.112** | 0.0477 |
| | (0.0520) | (0.0545) | (0.0520) | (0.0529) | (0.0498) | (0.0477) | (0.0530) | (0.0556) | (0.0529) | (0.0538) | (0.0506) | (0.0488) |
| Teenager pregnancy | 0.0547 | 0.0195 | -0.0515 | 0.0584 | -0.0240 | 0.0911 | 0.0494 | 0.0496 | -0.0585 | 0.0534 | -0.0211 | 0.0781 |
| | (0.0824) | (0.0877) | (0.0845) | (0.0837) | (0.0796) | (0.0759) | (0.0834) | (0.0891) | (0.0857) | (0.0842) | (0.0807) | (0.0773) |
| Extraversion | 0.032 | 0.015 | -0.004 | 0.0231 | 0.052*** | 0.0429** | 0.044** | 0.0230 | 0.00820 | 0.0283 | 0.064*** | 0.050*** |
| | (0.021) | (0.022) | (0.021) | (0.021) | (0.020) | (0.018) | (0.0214) | (0.0228) | (0.0214) | (0.0212) | (0.021) | (0.019) |
| Agreeableness | 0.042** | 0.0042 | 0.0392* | 0.0034 | 0.0295 | 0.0615*** | 0.0360* | 0.0070 | 0.0323 | -0.003 | 0.0243 | 0.057*** |
| | (0.021) | (0.022) | (0.021) | (0.022) | (0.021) | (0.0187) | (0.0209) | (0.0224) | (0.0208) | (0.0219) | (0.021) | (0.019) |
| Conscientiousness | 0.042** | 0.00957 | 0.00399 | 0.0143 | 0.077*** | 0.034* | 0.029 | 0.0017 | -0.0043 | 0.005 | 0.074*** | 0.022 |
| | (0.021) | (0.022) | (0.022) | (0.022) | (0.021) | (0.020) | (0.0214) | (0.023) | (0.0218) | (0.022) | (0.021) | (0.020) |
| Neuroticism | -0.018 | -0.011 | -0.015 | -0.011 | -0.006 | -0.012 | -0.0239 | -0.0124 | -0.0208 | -0.0178 | -0.0064 | -0.0171 |
| | (0.021) | (0.022) | (0.021) | (0.022) | (0.0206) | (0.0190) | (0.0212) | (0.0222) | (0.0216) | (0.0222) | (0.0209) | (0.0193) |
| Openness | 0.045** | 0.031 | 0.049** | 0.0285 | 0.044** | 0.0367** | 0.045** | 0.0344 | 0.047** | 0.0289 | 0.048** | 0.0359* |
| | (0.019) | (0.021) | (0.020) | (0.020) | (0.019) | (0.019) | (0.0193) | (0.0211) | (0.0199) | (0.0198) | (0.0193) | (0.0187) |
| Boys | -0.151*** | -0.096** | -0.199*** | 0.043 | -0.218*** | -0.182*** | -0.151*** | -0.082** | -0.201*** | 0.042 | -0.218*** | -0.184*** |
| | (0.038) | (0.040) | (0.038) | (0.039) | (0.037) | (0.035) | (0.039) | (0.041) | (0.039) | (0.040) | (0.038) | (0.035) |

| | Without income pre-pregnancy | | | | | | With income pre-pregnancy | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | (1) Battelle Total | (2) Cognitive Battelle | (3) Comm Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/ Social Battelle | (7) Battelle Total | (8) Cognitive Battelle | (9) Comm Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/ Social Battelle |
| Having older sibling | -0.123** | -0.118** | -0.149*** | -0.0519 | -0.093* | -0.0968** | -0.119** | -0.121** | -0.146*** | -0.048 | -0.079 | -0.090* |
| | (0.050) | (0.052) | (0.0485) | (0.0519) | (0.049) | (0.0452) | (0.0503) | (0.0519) | (0.0490) | (0.0521) | (0.0496) | (0.046) |
| Premature | -0.102 | -0.181** | -0.0169 | -0.0926 | -0.173* | -0.0583 | -0.0667 | -0.168* | -0.0085 | -0.0733 | -0.123 | -0.0388 |
| | (0.0962) | (0.090) | (0.0897) | (0.114) | (0.092) | (0.0831) | (0.0999) | (0.0941) | (0.0938) | (0.117) | (0.0949) | (0.0874) |
| Child low weight | -0.0197 | -0.0050 | 0.0380 | -0.0726 | 0.160* | 0.00355 | -0.0425 | 0.00109 | 0.0299 | -0.0784 | 0.141 | -0.0215 |
| | (0.093) | (0.096) | (0.098) | (0.0943) | (0.093) | (0.0791) | (0.0949) | (0.0996) | (0.0994) | (0.0946) | (0.0947) | (0.0811) |
| Child age | 0.0646 | 0.0260 | -0.0189 | 0.0507 | 0.0836* | -0.0374 | 0.0554 | 0.0236 | -0.0257 | 0.0430 | 0.0813* | -0.0501 |
| | (0.046) | (0.049) | (0.047) | (0.048) | (0.045) | (0.042) | (0.0469) | (0.0501) | (0.0478) | (0.0488) | (0.0457) | (0.0427) |
| Child age square | -2.45e-06* | 3.74e-07 | 9.99e-07 | -4.16e-06*** | -9.32e-07 | -2.51e-07 | -2.21e-06 | 4.58e-07 | 1.18e-06 | -3.96e-06*** | -8.85e-07 | 1.17e-07 |
| | (1.36e-06) | (1.48e-06) | (1.41e-06) | (1.42e-06) | (1.33e-06) | (1.22e-06) | (1.38e-06) | (1.50e-06) | (1.44e-06) | (1.44e-06) | (1.35e-06) | (1.24e-06) |
| Income pre-pregnancy | | | | | | | 2.35e-07 | 1.62e-07 | 2.95e-07 | 5.25e-07 | -2.57e-07 | 2.47e-07 |
| | | | | | | | (3.18e-07) | (3.47e-07) | (3.18e-07) | (3.35e-07) | (3.15e-07) | (2.64e-07) |
| Non-maternal income | | | | | | | 5.97e-08 | -4.20e-08 | 2.40e-08 | 1.40e-07*** | 2.48e-08 | -4.15e-09 |
| | | | | | | | (4.79e-08) | (5.55e-08) | (4.91e-08) | (5.23e-08) | (5.28e-08) | (4.44e-08) |
| Constant | -0.942 | -0.870 | -0.0274 | 0.202 | -1.062 | 0.0664 | -0.920 | -1.116 | 0.00317 | 0.140 | -1.070 | 0.22 |
| | (0.706) | (0.716) | (0.694) | (0.742) | (0.693) | (0.648) | (0.720) | (0.724) | (0.707) | (0.753) | (0.707) | (0.664) |
| Observations | 2,758 | 2,758 | 2,758 | 2,758 | 2,758 | 2,758 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 |
| R-squared | 0.052 | 0.048 | 0.041 | 0.098 | 0.071 | 0.094 | 0.052 | 0.050 | 0.041 | 0.101 | 0.071 | 0.093 |

**Appendix 4.8. The association between timing of early maternal employment and child cognitive outcomes: analysing household income as a mediator in such association**

| Variable | Without income | | | | | | With income | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) Battelle Total | (2) Cognitive Battelle | (3) Communication Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/Social Battelle | (7) Battelle Total | (8) Cognitive Battelle | (9) Communication Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/Social Battelle |
| 0-3 months | -0.101 | -0.0875 | -0.0539 | -0.116 | -0.0321 | -0.0499 | -0.103 | -0.0908 | -0.0572 | -0.118 | -0.0263 | -0.0525 |
| | (0.0783) | (0.0863) | (0.0801) | (0.0797) | (0.0752) | (0.0729) | (0.0785) | (0.0864) | (0.0805) | (0.0798) | (0.0756) | (0.0728) |
| 3-6 months | -0.128* | -0.128* | -0.128* | -0.128* | 0.0140 | -0.0932 | -0.139** | -0.147* | -0.146** | -0.139* | 0.0473 | -0.108* |
| | (0.0662) | (0.0712) | (0.0677) | (0.0710) | (0.0646) | (0.0615) | (0.0700) | (0.0755) | (0.0713) | (0.0728) | (0.0649) | (0.0638) |
| 6-12.months | -0.0152 | 0.0965 | -0.0332 | -0.114* | 0.0294 | 0.0164 | -0.0236 | 0.0814 | -0.0480 | -0.123* | 0.0561 | 0.00449 |
| | (0.0604) | (0.0644) | (0.0600) | (0.0629) | (0.0572) | (0.0549) | (0.0645) | (0.0687) | (0.0634) | (0.0672) | (0.0609) | (0.0579) |
| 12-18.months | -0.00568 | -0.0107 | -0.0705 | 0.0543 | -0.0228 | -0.00180 | -0.0136 | -0.0248 | -0.0843 | 0.0459 | 0.00213 | -0.0129 |
| | (0.0717) | (0.0744) | (0.0696) | (0.0713) | (0.0664) | (0.0597) | (0.0731) | (0.0762) | (0.0704) | (0.0736) | (0.0685) | (0.0610) |
| Without formal education | 0.161 | 0.119 | -0.142 | 0.0338 | 0.0734 | 0.0943 | 0.0865 | 0.0688 | -0.212 | 0.0328 | -0.0722 | -0.0336 |
| | (0.256) | (0.245) | (0.234) | (0.296) | (0.270) | (0.231) | (0.288) | (0.284) | (0.258) | (0.0907) | (0.293) | (0.247) |
| Incomplete Primary | 0.216 | 0.148 | -0.146 | 0.0308 | 0.165 | 0.118 | 0.121 | 0.0624 | -0.271 | -0.0006 | -0.0206 | -0.0313 |
| | (0.255) | (0.243) | (0.231) | (0.294) | (0.268) | (0.229) | (0.286) | (0.281) | (0.254) | (0.0905) | (0.290) | (0.245) |
| Primary | 0.304 | 0.222 | 0.000163 | 0.110 | 0.166 | 0.207 | 0.192 | 0.120 | -0.0995 | 0.0644 | -0.0202 | 0.0537 |
| | (0.252) | (0.240) | (0.230) | (0.292) | (0.265) | (0.225) | (0.283) | (0.279) | (0.254) | (0.0901) | (0.288) | (0.241) |
| Incomplete High School | 0.322 | 0.224 | -0.00836 | 0.153 | 0.146 | 0.226 | 0.249 | 0.153 | -0.0821 | 0.122 | -0.0160 | 0.101 |
| | (0.250) | (0.237) | (0.228) | (0.290) | (0.262) | (0.223) | (0.281) | (0.276) | (0.251) | (0.0897) | (0.286) | (0.239) |
| High School | 0.345 | 0.187 | 0.0573 | 0.171 | 0.178 | 0.250 | 0.260 | 0.0786 | -0.006 | 0.0758 | -0.00832 | 0.129 |
| | (0.254) | (0.242) | (0.232) | (0.295) | (0.266) | (0.226) | (0.287) | (0.283) | (0.258) | (0.0915) | (0.291) | (0.243) |
| Vocational education | 0.199 | 0.114 | -0.0335 | 0.114 | -0.0164 | 0.199 | 0.163 | 0.139 | -0.0829 | 0.160* | -0.106 | 0.0798 |
| | (0.255) | (0.245) | (0.234) | (0.297) | (0.268) | (0.226) | (0.289) | (0.288) | (0.261) | (0.0927) | (0.295) | (0.246) |
| College Degree | 0.389 | 0.145 | 0.0861 | 0.0904 | 0.220 | 0.408 | 0.386 | 0.280 | 0.0627 | 0.00678 | 0.0858 | 0.345 |
| | (0.302) | (0.311) | (0.271) | (0.339) | (0.312) | (0.270) | (0.338) | (0.346) | (0.294) | (0.101) | (0.342) | (0.293) |

| | Without income | | | | | | With income | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Variable | Battelle Total | Cognitive Battelle | Communication Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle | Battelle Total | Cognitive Battelle | Communication Battelle | Motor Battelle | Adaptive Battelle | Personal/Social Battelle |
| Maternal age | -0.000524 | -0.00978 | 0.00847 | -0.00398 | -0.0344 | 0.0178 | 0.0191 | 0.0123 | 0.0164 | 0.00675 | -0.0128 | 0.0385 |
| | (0.0294) | (0.0318) | (0.0304) | (0.0304) | (0.0285) | (0.0274) | (0.0333) | (0.0361) | (0.0345) | (0.00897) | (0.0332) | (0.0320) |
| Maternal age square | 8.38e-05 | 0.000327 | -0.000135 | 0.000139 | 0.000483 | -0.000204 | -0.000248 | -2.72e-05 | -0.000280 | 5.64e-05 | 8.38e-05 | -0.000549 |
| | (0.0005) | (0.000502) | (0.000481) | (0.000481) | (0.000448) | (0.000433) | (0.000522) | (0.000569) | (0.000544) | (0.000142) | (0.000523) | (0.000506) |
| Mother married | -0.00348 | -0.0197 | 0.0130 | 0.00367 | 0.00831 | 0.0249 | 0.0346 | -0.00938 | 0.0178 | 0.00195 | 0.0470 | 0.0516 |
| | (0.0408) | (0.0444) | (0.0416) | (0.0429) | (0.0403) | (0.0376) | (0.0457) | (0.0496) | (0.0470) | (0.0129) | (0.0455) | (0.0424) |
| Mother's WAIS digit score | 0.0215 | 0.0492** | 0.0238 | 0.0132 | -0.0228 | 0.0191 | 0.0239 | 0.0422* | 0.0350 | 0.0221*** | -0.0283 | 0.0215 |
| | (0.0201) | (0.0224) | (0.0206) | (0.0210) | (0.0195) | (0.0181) | (0.0225) | (0.0250) | (0.0235) | (0.00650) | (0.0223) | (0.0210) |
| Mother's WAIS vocabulary | 0.105*** | 0.124*** | 0.0717*** | 0.0694*** | 0.0342 | 0.125*** | 0.102*** | 0.158*** | 0.0609** | 0.0772*** | 0.0296 | 0.122*** |
| | (0.0222) | (0.0236) | (0.0221) | (0.0235) | (0.0219) | (0.0200) | (0.0251) | (0.0264) | (0.0251) | (0.00671) | (0.0252) | (0.0233) |
| Work before pregnancy | 0.0348 | 0.0276 | 0.0346 | 0.0169 | 0.0436 | 0.0315 | 0.0134 | 0.00464 | 0.00126 | 0.0113 | 0.0470 | 0.00758 |
| | (0.0459) | (0.0538) | (0.0476) | (0.0495) | (0.0460) | (0.0409) | (0.0509) | (0.0556) | (0.0536) | (0.0199) | (0.0518) | (0.0467) |
| Drank alcohol pregnancy | 0.00155 | -0.0953 | -0.0357 | -0.00812 | -0.00463 | -0.0129 | 0.0716 | -0.0277 | 0.00370 | 0.161*** | 0.0507 | -0.00878 |
| | (0.0705) | (0.0767) | (0.0693) | (0.0729) | (0.0670) | (0.0590) | (0.0772) | (0.0789) | (0.0783) | (0.0216) | (0.0746) | (0.0704) |
| Difficulties during pregnancy | -0.0482 | -0.0907** | -0.0370 | -0.00870 | 0.00602 | -0.0640** | -0.0545 | -0.0766* | -0.0482 | -0.067*** | -0.000454 | -0.0745** |
| | (0.0358) | (0.0388) | (0.0365) | (0.0374) | (0.0349) | (0.0320) | (0.0404) | (0.0439) | (0.0417) | (0.0110) | (0.0399) | (0.0365) |
| Mental problems | 0.0907* | 0.0847 | 0.0581 | 0.0601 | 0.0817* | 0.0523 | 0.0744 | 0.0771 | 0.0761 | 0.0640*** | 0.0756 | 0.0258 |
| | (0.0472) | (0.0518) | (0.0500) | (0.0490) | (0.0454) | (0.0429) | (0.0545) | (0.0590) | (0.0554) | (0.0157) | (0.0522) | (0.0498) |
| Teenager pregnancy | 0.0613 | 0.0560 | 0.0218 | 0.0341 | -0.0828 | 0.123* | 0.0632 | 0.0875 | -0.00259 | 0.108*** | -0.114 | 0.134* |
| | (0.0762) | (0.0829) | (0.0786) | (0.0787) | (0.0743) | (0.0702) | (0.0861) | (0.0939) | (0.0898) | (0.0214) | (0.0855) | (0.0799) |
| Extraversion | 0.0361* | 0.0208 | 0.00973 | 0.0186 | 0.0459** | 0.0456*** | 0.0360* | 0.0117 | 0.00675 | -0.00250 | 0.0567*** | 0.0338* |
| | (0.0189) | (0.0207) | (0.0194) | (0.0196) | (0.0185) | (0.0167) | (0.0217) | (0.0234) | (0.0219) | (0.00589) | (0.0214) | (0.0192) |
| Agreeableness | 0.0306 | -0.00538 | 0.0324* | -0.00575 | 0.0201 | 0.0585*** | 0.0378* | 0.0146 | 0.0321 | 0.00554 | 0.0258 | 0.0621*** |
| | (0.0188) | (0.0210) | (0.0194) | (0.0206) | (0.0190) | (0.0168) | (0.0211) | (0.0234) | (0.0220) | (0.00600) | (0.0216) | (0.0192) |

| Variable | Without income (1) Battelle Total | (2) Cognitive Battelle | (3) Communication Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/Social Battelle | With income (7) Battelle Total | (8) Cognitive Battelle | (9) Communication Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/Social Battelle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conscientiousness | 0.0489** | 0.0261 | 0.0138 | 0.0145 | 0.0643*** | 0.0426** | 0.0265 | 0.00693 | 0.00376 | 0.00289 | 0.0512** | 0.0224 |
| | (0.0193) | (0.0211) | (0.0199) | (0.0205) | (0.0192) | (0.0177) | (0.0220) | (0.0243) | (0.0226) | (0.00610) | (0.0219) | (0.0201) |
| Neuroticism | -0.0157 | 0.00914 | -0.0130 | -0.0137 | -0.0135 | -0.00848 | -0.00784 | 0.0129 | -0.00763 | -0.00885 | -0.00805 | 0.00631 |
| | (0.0191) | (0.0206) | (0.0197) | (0.0206) | (0.0189) | (0.0173) | (0.0216) | (0.0230) | (0.0226) | (0.00614) | (0.0215) | (0.0196) |
| Openness | 0.0361** | 0.0177 | 0.0350* | 0.0203 | 0.0422** | 0.0312* | 0.0488** | 0.0331 | 0.0422** | 0.0149*** | 0.0509** | 0.0500*** |
| | (0.0178) | (0.0198) | (0.0186) | (0.0182) | (0.0176) | (0.0170) | (0.0197) | (0.0226) | (0.0209) | (0.00527) | (0.0201) | (0.0190) |
| Boys | -0.150*** | -0.0858** | -0.208*** | 0.0489 | -0.205*** | -0.181*** | -0.162*** | -0.0510 | -0.218*** | 0.0609*** | -0.205*** | -0.207*** |
| | (0.0349) | (0.0376) | (0.0355) | (0.0370) | (0.0343) | (0.0313) | (0.0394) | (0.0424) | (0.0403) | (0.0109) | (0.0391) | (0.0358) |
| Older sibling | -0.122*** | -0.107** | -0.112** | -0.0697 | -0.0946** | -0.0918** | -0.143*** | -0.130** | -0.0994* | -0.077*** | -0.0954* | -0.124*** |
| | (0.0454) | (0.0493) | (0.0457) | (0.0491) | (0.0448) | (0.0406) | (0.0516) | (0.0550) | (0.0525) | (0.0153) | (0.0515) | (0.0471) |
| Premature | -0.0252 | -0.123 | 0.0190 | -2.33e-05 | -0.147* | 0.00174 | 0.0239 | -0.0908 | 0.0375 | -0.090*** | -0.116 | 0.0404 |
| | (0.0905) | (0.0855) | (0.0855) | (0.108) | (0.0857) | (0.0760) | (0.107) | (0.0960) | (0.101) | (0.0270) | (0.103) | (0.0911) |
| Child low weight | -0.0318 | -0.00826 | -0.0138 | -0.0650 | 0.176** | -0.00840 | -0.0531 | 0.00503 | 0.0387 | 0.0243 | 0.115 | -0.0391 |
| | (0.0883) | (0.0906) | (0.0931) | (0.0918) | (0.0866) | (0.0755) | (0.102) | (0.106) | (0.106) | (0.0312) | (0.0988) | (0.0878) |
| Child age | 0.0685 | 0.0645 | -0.0111 | 0.0470 | 0.0815* | -0.0453 | 0.0571 | 0.0744 | -0.0335 | -0.075*** | 0.0681 | -0.0515 |
| | (0.0431) | (0.0473) | (0.0442) | (0.0460) | (0.0421) | (0.0385) | (0.0486) | (0.0530) | (0.0507) | (0.0140) | (0.0483) | (0.0442) |
| Child age square | -2.49e-06** | -7.23e-07 | 8.69e-07 | -4.01e-06*** | -8.22e-07 | 1.58e-08 | -2.23e-06 | -1.17e-06 | 1.46e-06 | -8.84e-07** | -6.51e-07 | 2.16e-07 |
| | (1.27e-06) | (1.41e-06) | (1.33e-06) | (1.35e-06) | (1.25e-06) | (1.12e-06) | (1.44e-06) | (1.59e-06) | (1.53e-06) | (4.09e-07) | (1.43e-06) | (1.29e-06) |
| Income pre-preg | -2.43e-08 | -3.04e-08 | -2.71e-08 | 3.87e-09 | -3.81e-09 | -3.96e-08 | -2.67e-08 | -4.18e-08 | -3.64e-08 | 1.35e-08 | -5.54e-09 | -4.14e-08 |
| | (9.38e-08) | (9.44e-08) | (9.99e-08) | (1.04e-07) | (1.00e-07) | (9.07e-08) | (1.11e-07) | (1.18e-07) | (1.14e-07) | (2.39e-08) | (1.12e-07) | (1.06e-07) |
| Household income | | | | | | | 7.74e-08 | 1.38e-07 | 1.35e-07 | 8.21e-08 | -2.45e-07 | 1.09e-07 |
| | | | | | | | (1.70e-07) | (1.84e-07) | (1.56e-07) | (1.81e-07) | (1.63e-07) | (1.37e-07) |
| Constant | -0.920 | -1.116 | 0.00317 | 0.140 | -1.070 | 0.220 | -0.915 | -1.108 | 0.0111 | 0.145 | -1.085 | 0.226 |
| | (0.720) | (0.724) | (0.707) | (0.753) | (0.707) | (0.664) | (0.720) | (0.724) | (0.706) | (0.752) | (0.707) | (0.664) |
| Obs. | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 |
| R-square | 0.052 | 0.050 | 0.041 | 0.101 | 0.071 | 0.093 | 0.052 | 0.050 | 0.042 | 0.101 | 0.073 | 0.093 |

**Appendix 4.9. The association between timing of early maternal employment and child cognitive outcomes: analysing home environment as a mediator in such association**

| | Without Home Environment | | | | | | With Home environment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | (1) Battelle Total | (2) Cognitive Battelle | (3) Communication Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/Social Battelle | (7) Battelle Total | (8) Cognitive Battelle | (9) Communication Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/Social Battelle |
| 0-3 months | -0.101 | -0.0875 | -0.0539 | -0.116 | -0.032 | -0.0499 | -0.108 | -0.0922 | -0.0587 | -0.120 | -0.0370 | -0.108 |
| | (0.0783) | (0.0863) | (0.0801) | (0.0797) | (0.075) | (0.0729) | (0.0789) | (0.0867) | (0.0801) | (0.080) | (0.0758) | (0.0789) |
| 3-6.months | -0.128* | -0.128* | -0.128* | -0.128* | 0.0140 | -0.0932 | -0.113* | -0.118* | -0.117* | -0.120* | 0.0252 | -0.113* |
| | (0.0662) | (0.0712) | (0.0677) | (0.071) | (0.065) | (0.0615) | (0.0658) | (0.0710) | (0.0675) | (0.071) | (0.0645) | (0.0658) |
| 6-12 months | -0.0152 | 0.0965 | -0.0332 | -0.114* | 0.0294 | 0.0164 | -0.00827 | 0.101 | -0.0281 | -0.110* | 0.0346 | -0.00827 |
| | (0.0604) | (0.0644) | (0.0600) | (0.0629) | (0.057) | (0.0549) | (0.0598) | (0.0642) | (0.0597) | (0.063) | (0.0571) | (0.0598) |
| 12-18 months | -0.00568 | -0.0107 | -0.0705 | 0.0543 | -0.023 | -0.00180 | -0.00318 | -0.00894 | -0.0687 | 0.0557 | -0.0209 | -0.00318 |
| | (0.0717) | (0.0744) | (0.0696) | (0.0713) | (0.066) | (0.0597) | (0.0711) | (0.0741) | (0.0694) | (0.071) | (0.0658) | (0.0711) |
| Without formal education | 0.161 | 0.119 | -0.142 | 0.0338 | 0.0734 | 0.0943 | 0.135 | 0.0992 | -0.163 | 0.0204 | 0.0535 | 0.0668 |
| | (0.256) | (0.245) | (0.234) | (0.296) | (0.270) | (0.231) | (0.249) | (0.238) | (0.233) | (0.291) | (0.262) | (0.219) |
| Incomplete Primary | 0.216 | 0.148 | -0.146 | 0.0308 | 0.165 | 0.118 | 0.172 | 0.114 | -0.183 | 0.00794 | 0.132 | 0.0715 |
| | (0.255) | (0.243) | (0.231) | (0.294) | (0.268) | (0.229) | (0.248) | (0.236) | (0.230) | (0.290) | (0.260) | (0.217) |
| Primary | 0.304 | 0.222 | 0.000163 | 0.110 | 0.166 | 0.207 | 0.236 | 0.170 | -0.0562 | 0.0744 | 0.114 | 0.135 |
| | (0.252) | (0.240) | (0.230) | (0.292) | (0.265) | (0.225) | (0.245) | (0.233) | (0.230) | (0.288) | (0.258) | (0.213) |
| Incomplete High School | 0.322 | 0.224 | -0.00836 | 0.153 | 0.146 | 0.226 | 0.252 | 0.170 | -0.0665 | 0.117 | 0.0921 | 0.151 |
| | (0.250) | (0.237) | (0.228) | (0.290) | (0.262) | (0.223) | (0.243) | (0.231) | (0.227) | (0.286) | (0.255) | (0.211) |
| High School | 0.345 | 0.187 | 0.0573 | 0.171 | 0.178 | 0.250 | 0.259 | 0.121 | -0.0137 | 0.127 | 0.112 | 0.158 |
| | (0.254) | (0.242) | (0.232) | (0.295) | (0.266) | (0.226) | (0.248) | (0.236) | (0.232) | (0.291) | (0.259) | (0.214) |
| Vocational education | 0.199 | 0.114 | -0.0335 | 0.114 | -0.016 | 0.199 | 0.112 | 0.0473 | -0.106 | 0.0684 | -0.0831 | 0.107 |
| | (0.255) | (0.245) | (0.234) | (0.297) | (0.268) | (0.226) | (0.249) | (0.239) | (0.234) | (0.294) | (0.261) | (0.215) |
| College Degree | 0.389 | 0.145 | 0.0861 | 0.0904 | 0.220 | 0.408 | 0.340 | 0.107 | 0.0454 | 0.0650 | 0.183 | 0.356 |
| | (0.302) | (0.311) | (0.271) | (0.339) | (0.312) | (0.270) | (0.292) | (0.303) | (0.270) | (0.334) | (0.305) | (0.258) |
| Maternal age | -0.0005 | -0.010 | 0.00847 | -0.004 | -0.034 | 0.0178 | 0.004 | -0.006 | 0.0124 | -0.002 | -0.0308 | 0.0228 |
| | (0.029) | (0.032) | (0.0304) | (0.030) | (0.029) | (0.0274) | (0.029) | (0.032) | (0.030) | (0.030) | (0.028) | (0.0273) |
| Maternal age square | 8.38e-05 | 0.0003 | -0.0001 | 0.0001 | 0.0005 | -0.0002 | -8.15e-06 | 0.0002 | -0.0002 | 9.18e-05 | 0.0004 | -0.0003 |
| | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0004) | (0.0004) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0004) |

| | Without Home Environment | | | | | | With Home environment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | (1) Battelle Total | (2) Cognitive Battelle | (3) Communication Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/Social Battelle | (7) Battelle Total | (8) Cognitive Battelle | (9) Communication Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/Social Battelle |
| Mother married | -0.004 | -0.0197 | 0.0130 | 0.00367 | 0.00831 | 0.0249 | -0.0040 | -0.0201 | 0.0125 | 0.00338 | 0.00789 | 0.0243 |
| | (0.041) | (0.044) | (0.0416) | (0.043) | (0.040) | (0.0376) | (0.041) | (0.044) | (0.0414) | (0.043) | (0.040) | (0.0373) |
| Mother's WAIS digit score | 0.0215 | 0.049** | 0.0238 | 0.0132 | -0.0228 | 0.0191 | 0.0160 | 0.045** | 0.0193 | 0.0103 | -0.0270 | 0.0133 |
| | (0.020) | (0.022) | (0.021) | (0.021) | (0.020) | (0.0181) | (0.021) | (0.023) | (0.0207) | (0.02) | (0.020) | (0.0183) |
| Mother's WAIS vocabulary score | 0.105*** | 0.124*** | 0.072*** | 0.069*** | 0.0342 | 0.125*** | 0.077*** | 0.103*** | 0.0487** | 0.055** | 0.0129 | 0.095*** |
| | (0.022) | (0.024) | (0.022) | (0.024) | (0.022) | (0.0200) | (0.022) | (0.024) | (0.0225) | (0.024) | (0.022) | (0.0202) |
| Work before pregnancy | 0.0348 | 0.0276 | 0.0346 | 0.0169 | 0.0436 | 0.0315 | 0.0312 | 0.0248 | 0.0316 | 0.0150 | 0.0409 | 0.0277 |
| | (0.046) | (04) | (0.048) | (0.050) | (0.046) | (0.0409) | (0.046) | (0.054) | (0.047) | (0.050) | (0.046) | (0.0401) |
| Mother drank alcohol during pregnancy | 0.00155 | -0.0953 | -0.0357 | -0.008 | -0.005 | -0.0129 | 0.0009 | -0.0957 | -0.0362 | -0.008 | -0.005 | -0.014 |
| | (0.071) | (0.077) | (0.069) | (0.073) | (0.067) | (0.059) | (0.071) | (0.078) | (0.0691) | (0.074) | (0.068) | (0.0587) |
| Difficulties during pregnancy | -0.048 | -0.091** | -0.037 | -0.009 | 0.00602 | -0.064** | -0.050 | -0.092** | -0.039 | -0.010 | 0.004 | -0.066** |
| | (0.036) | (0.039) | (0.0365) | (0.037) | (0.035) | (0.0320) | (0.036) | (0.039) | (0.0363) | (0.037) | (0.035) | (0.0318) |
| Mental problems during pregnancy | 0.0907* | 0.0847 | 0.0581 | 0.0601 | 0.0817* | 0.0523 | 0.092** | 0.0858* | 0.0593 | 0.0608 | 0.083* | 0.0539 |
| | (0.047) | (0.052) | (0.050) | (0.049) | (0.045) | (0.0429) | (0.047) | (0.051) | (0.0493) | (0.049) | (0.045) | (0.0425) |
| Teenager pregnancy | 0.0613 | 0.0560 | 0.0218 | 0.0341 | -0.0828 | 0.123* | 0.0746 | 0.0661 | 0.0328 | 0.041 | -0.0726 | 0.137** |
| | (0.076) | (0.083) | (0.0786) | (0.079) | (0.074) | (0.0702) | (0.076) | (0.083) | (0.078) | (0.079) | (0.075) | (0.0699) |
| Extraversion | 0.0361* | 0.0208 | 0.00973 | 0.0186 | 0.046** | 0.0456*** | 0.0264 | 0.0134 | 0.00171 | 0.0135 | 0.0389 | 0.0353** |
| | (0.019) | (0.021) | (0.0194) | (0.012) | (0.019) | (0.0167) | (0.019) | (0.021) | (0.0193) | (0.02) | (0.019) | (0.0166) |
| Agreeableness | 0.0306 | -0.0054 | 0.032* | -0.0058 | 0.0201 | 0.059*** | 0.0315* | -0.0047 | 0.0331* | -0.005 | 0.0207 | 0.0595*** |
| | (0.019) | (0.021) | (0.0194) | (0.021) | (0.019) | (0.0168) | (0.019) | (0.021) | (0.0192) | (0.02) | (0.019) | (0.0167) |
| Conscientiousness | 0.049** | 0.0261 | 0.0138 | 0.0145 | 0.064*** | 0.043** | 0.040** | 0.0190 | 0.0061 | 0.0097 | 0.057*** | 0.033* |
| | (0.019) | (0.021) | (0.0199) | (0.021) | (0.019) | (0.0177) | (0.019) | (0.021) | (0.0199) | (0.021) | (0.019) | (0.0176) |
| Neuroticism | -0.0157 | 0.00914 | -0.0130 | -0.0137 | -0.0135 | -0.00848 | -0.0171 | 0.00807 | -0.0141 | -0.0144 | -0.0145 | -0.00996 |
| | (0.019) | (0.021) | (0.020) | (0.021) | (0.019) | (0.017) | (0.019) | (0.021) | (0.020) | (0.021) | (0.019) | (0.017) |
| Openness | 0.036** | 0.0177 | 0.0350* | 0.0203 | 0.042** | 0.0312* | 0.031* | 0.0135 | 0.0304 | 0.0175 | 0.038** | 0.0254 |
| | (0.018) | (0.020) | (0.019) | (0.018) | (0.018) | (0.017) | (0.018) | (0.020) | (0.019) | (0.) | (0.018) | (0.017) |
| Boys | -0.150*** | -0.086** | -0.208*** | 0.049 | -0.205*** | -0.181*** | -0.143*** | -0.080** | -0.202*** | 0.053 | -0.200*** | -0.173*** |
| | (0.035) | (0.038) | (0.0355) | (0.037) | (0.034) | (0.0313) | (0.035) | (0.038) | (0.035) | (0.037) | (0.034) | (0.0310) |

| Variables | Without Home Environment | | | | | | With Home environment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) Battelle Total | (2) Cognitive Battelle | (3) Communication Battelle | (4) Motor Battelle | (5) Adaptive Battelle | (6) Personal/Social Battelle | (7) Battelle Total | (8) Cognitive Battelle | (9) Communication Battelle | (10) Motor Battelle | (11) Adaptive Battelle | (12) Personal/Social Battelle |
| Having older sibling | -0.122*** | -0.107** | -0.112** | -0.0697 | -0.095** | -0.0918** | -0.110** | -0.098** | -0.102** | -0.0636 | -0.0856* | -0.0793** |
| | (0.045) | (0.049) | (0.046) | (0.049) | (0.045) | (0.0406) | (0.046) | (0.049) | (0.0455) | (0.050) | (0.045) | (0.040) |
| Premature | -0.0252 | -0.123 | 0.0190 | -2.33e-05 | -0.147* | 0.00174 | -0.00683 | -0.109 | 0.0342 | 0.00951 | -0.133 | 0.0213 |
| | (0.091) | (0.086) | (0.0855) | (0.108) | (0.086) | (0.0760) | (0.092) | (0.086) | (0.0864) | (0.109) | (0.086) | (0.0766) |
| Child low weight | -0.0318 | -0.008 | -0.0138 | -0.0650 | 0.176** | -0.00840 | -0.0521 | -0.0238 | -0.0306 | -0.0756 | 0.161* | -0.0300 |
| | (0.088) | (0.091) | (0.0931) | (0.092) | (0.087) | (0.0755) | (0.088) | (0.091) | (0.0926) | (0.092) | (0.087) | (0.0757) |
| Child age | 0.0685 | 0.0645 | -0.0111 | 0.0470 | 0.0815* | -0.0453 | 0.0634 | 0.0606 | -0.0153 | 0.0444 | 0.0776* | -0.0507 |
| | (0.043) | (0.047) | (0.0442) | (0.046) | (0.042) | (0.0385) | (0.043) | (0.048) | (0.0441) | (0.046) | (0.042) | (0.0382) |
| Child age square | -2.49e-06** | -7.23e-07 | 8.69e-07 | -4.01e-06*** | -8.22e-07 | 1.58e-08 | -2.34e-06* | -6.07e-07 | 9.95e-07 | -3.93e-06*** | -7.05e-07 | 1.77e-07 |
| | (1.27e-06) | (1.41e-06) | (1.33e-06) | (1.35e-06) | (1.25e-06) | (1.12e-06) | (1.27e-06) | (1.42e-06) | (1.33e-06) | (1.36e-06) | (1.24e-06) | (1.12e-06) |
| Income pre birth | -2.43e-08 | -3.04e-08 | -2.71e-08 | 3.87e-09 | -3.81e-09 | -3.96e-08 | -2.60e-08 | -3.17e-08 | -2.85e-08 | 3.01e-09 | -5.09e-09 | -4.14e-08 |
| | (9.38e-0) | (9.44e-0) | (9.99e-08) | (1.04e-0) | (1.00e-0) | (9.07e-08) | (9.22e-0) | (9.33e-0) | (9.94e-08) | (1.04e-07) | (9.94e-0) | (8.80e-08) |
| Home score | | | | | | | 0.043*** | 0.033*** | 0.035*** | 0.022*** | 0.033*** | 0.045*** |
| | | | | | | | (0.006) | (0.007) | (0.006) | (0.006) | (0.006) | (0.006) |
| Constant | -0.920 | -1.116 | 0.0032 | 0.140 | -1.070 | 0.220 | -1.412** | -1.470** | -0.356 | -0.137 | -1.440** | -1.412** |
| | (0.720) | (0.724) | (0.707) | (0.753) | (0.707) | (0.664) | (0.719) | (0.726) | (0.709) | (0.749) | (0.707) | (0.719) |
| Observations | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 | 2,665 |
| R-squared | 0.052 | 0.050 | 0.041 | 0.101 | 0.071 | 0.093 | 0.065 | 0.056 | 0.048 | 0.105 | 0.079 | 0.065 |

**Appendix 4.10. The association between timing of early maternal employment and child socio-emotional outcomes analysing family income as a mediator in such association**

| | Without household income | | | With household income | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Variables | Total | Externalising | Internalising | Total | Externalising | Internalising |
| 0-3 months | 0.151** | 0.145** | 0.151** | 0.154** | 0.146** | 0.155** |
| | (0.0637) | (0.0654) | (0.0611) | (0.0635) | (0.0654) | (0.0610) |
| 3-6.months | 0.106** | 0.175*** | -0.0001 | 0.132*** | 0.188*** | 0.0408 |
| | (0.0469) | (0.0498) | (0.0520) | (0.0484) | (0.0514) | (0.0513) |
| 6-12 months | 0.00172 | 0.0806* | -0.0602 | 0.0214 | 0.0907* | -0.0285 |
| | (0.0459) | (0.0487) | (0.0474) | (0.0473) | (0.0499) | (0.0495) |
| 12-18 months | 0.0228 | 0.0356 | 0.000132 | 0.0380 | 0.0435 | 0.0246 |
| | (0.0460) | (0.0472) | (0.0477) | (0.0465) | (0.0475) | (0.0486) |
| Without formal education | -0.0778 | 0.134 | 0.0513 | -0.194 | -0.0773 | 0.135 |
| | (0.207) | (0.164) | (0.362) | (0.340) | (0.208) | (0.164) |
| Incomplete Primary | -0.212 | 0.0269 | -0.0544 | -0.228 | -0.212 | 0.0268 |
| | (0.205) | (0.161) | (0.361) | (0.339) | (0.206) | (0.161) |
| Primary | -0.131 | 0.138 | -0.114 | -0.252 | -0.131 | 0.138 |
| | (0.202) | (0.157) | (0.357) | (0.333) | (0.203) | (0.157) |
| Incomplete High School | -0.286 | 0.0216 | -0.224 | -0.330 | -0.285 | 0.0221 |
| | (0.200) | (0.155) | (0.354) | (0.329) | (0.201) | (0.155) |
| High School | -0.356* | -0.0262 | -0.342 | -0.402 | -0.350* | -0.0233 |
| | (0.203) | (0.159) | (0.358) | (0.336) | (0.204) | (0.159) |
| Vocational education | -0.475** | -0.141 | -0.418 | -0.579* | -0.454** | -0.130 |
| | (0.204) | (0.161) | (0.361) | (0.338) | (0.205) | (0.161) |
| College Degree | -0.0778 | 0.134 | -0.271 | -0.328 | -0.0773 | 0.135 |
| | (0.207) | (0.164) | (0.394) | (0.386) | (0.208) | (0.164) |
| Maternal age | -0.0173 | -0.0127 | -0.0403 | -0.0720* | -0.0574 | -0.0823* |
| | (0.0374) | (0.0391) | (0.0377) | (0.0435) | (0.0453) | (0.0447) |
| Maternal age square | -9.49e-05 | -0.0002 | 0.000323 | 0.0008 | 0.000538 | 0.000982 |
| | (0.0006) | (0.0006) | (0.0006) | (0.0007) | (0.0007) | (0.0007) |
| Mother married | -0.0357 | -0.00943 | -0.0827* | 0.0179 | 0.0461 | -0.0589 |
| | (0.0496) | (0.0526) | (0.0500) | (0.0569) | (0.0606) | (0.0566) |
| Mother's WAIS digit score | -0.069** | -0.045 | -0.090*** | -0.070** | -0.053 | -0.094*** |
| | (0.0272) | (0.0282) | (0.0278) | (0.0313) | (0.0319) | (0.032) |
| Mother's WAIS vocabulary score | -0.0303 | 0.0214 | -0.100*** | -0.0362 | 0.0215 | -0.104*** |
| | (0.0276) | (0.0278) | (0.0284) | (0.0319) | (0.0324) | (0.0331) |
| Work before pregnancy | 0.0138 | 0.0236 | 0.00240 | 0.0548 | 0.0599 | 0.0173 |
| | (0.0587) | (0.0591) | (0.0622) | (0.0665) | (0.0684) | (0.0701) |
| Mother drank alcohol during | -0.0008 | 0.0187 | -0.0357 | -0.0648 | -0.0388 | -0.0636 |
| | (0.0893) | (0.0945) | (0.0904) | (0.0948) | (0.0978) | (0.0970) |

| | Without household income | | | With household income | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Variables | Total | Externalising | Internalising | Total | Externalising | Internalising |
| pregnancy | | | | | | |
| Difficulties during pregnancy | 0.178*** | 0.124*** | 0.120*** | 0.159*** | 0.0964* | 0.116** |
| | (0.0436) | (0.0462) | (0.0443) | (0.0499) | (0.0523) | (0.0506) |
| Mental problems during pregnancy | 0.0157 | 0.0125 | 0.000914 | -0.0182 | -0.0106 | -0.0416 |
| | (0.0625) | (0.0628) | (0.0619) | (0.0721) | (0.0718) | (0.0716) |
| Teenager pregnancy | -0.0379 | -0.0474 | -0.0942 | -0.0488 | -0.0562 | -0.133 |
| | (0.0934) | (0.0988) | (0.0934) | (0.107) | (0.112) | (0.107) |
| Extraversion | -0.058** | -0.010 | -0.097*** | -0.056** | -0.0127 | -0.082*** |
| | (0.0235) | (0.0256) | (0.0235) | (0.0269) | (0.0292) | (0.0268) |
| Agreeableness | -0.063*** | -0.073*** | -0.0314 | -0.055** | -0.0672 | -0.0250 |
| | (0.0241) | (0.025) | (0.0243) | (0.0278) | (0.0287) | (0.0274) |
| Conscientiousness | -0.074*** | -0.099*** | -0.0140 | -0.0632** | -0.0926*** | -0.00624 |
| | (0.0235) | (0.0252) | (0.0239) | (0.0266) | (0.0287) | (0.0267) |
| Neuroticism | 0.182*** | 0.173*** | 0.169*** | 0.192*** | 0.174*** | 0.186*** |
| | (0.025) | (0.0256) | (0.0251) | (0.0277) | (0.0288) | (0.0284) |
| Openness | -0.0392* | -0.0438** | -0.0173 | -0.0437* | -0.0475* | -0.0256 |
| | (0.0211) | (0.0222) | (0.0214) | (0.0239) | (0.0252) | (0.0237) |
| Boys | 0.115*** | 0.147*** | -0.0288 | 0.091* | 0.105** | -0.0306 |
| | (0.0433) | (0.0456) | (0.0440) | (0.0485) | (0.0512) | (0.0493) |
| Having older sibling | 0.0763 | 0.116** | 0.0314 | 0.127** | 0.151** | 0.0607 |
| | (0.0554) | (0.0584) | (0.0568) | (0.0639) | (0.0676) | (0.0650) |
| Premature | -0.0622 | -0.0544 | -0.0555 | -0.0701 | -0.0920 | -0.0499 |
| | (0.109) | (0.110) | (0.0999) | (0.119) | (0.123) | (0.109) |
| Child low weight | 0.169 | 0.138 | 0.146 | 0.225* | 0.268* | 0.130 |
| | (0.107) | (0.120) | (0.102) | (0.123) | (0.147) | (0.114) |
| Child age | 0.0107 | 0.00283 | 0.0163 | -0.001 | -0.0210 | -0.00746 |
| | (0.0734) | (0.0772) | (0.0733) | (0.0829) | (0.0864) | (0.0828) |
| Child age square | -2.04e-08 | 1.26e-07 | 5.49e-08 | -3.03e-08 | 5.08e-07 | 3.10e-07 |
| | (1.88e-06) | (1.97e-06) | (1.86e-06) | (2.11e-06) | (2.19e-06) | (2.11e-06) |
| Income pre-pregnancy | -4.88e-08 | -1.44e-08 | -1.23e-07 | -7.54e-08 | -4.47e-08 | -8.56e-08 |
| | (1.08e-07) | (1.10e-07) | (1.11e-07) | (1.25e-07) | (1.26e-07) | (1.30e-07) |
| Household | | | | -1.96e-07* | -1.01e-07 | -3.16e-07*** |
| | | | | (1.01e-07) | (1.06e-07) | (1.22e-07) |
| Constant | 0.618 | 0.286 | 0.803 | 0.614 | 0.284 | 0.797 |
| | (0.525) | (0.523) | (0.565) | (0.525) | (0.523) | (0.565) |
| Obs | 4,263 | 4,263 | 4,263 | 4,263 | 4,263 | 4,263 |
| R-squared | 0.208 | 0.161 | 0.200 | 0.209 | 0.162 | 0.202 |

**Appendix 4.11. The association between timing of early maternal employment and child socio-emotional outcomes: analysing home environment as a mediator in such association**

| | Without Home score | | | With Home score | | |
|---|---|---|---|---|---|---|
| Variables | (1) Total | (2) Externalising | (3) Internalising | (4) Total | (5) Externalising | (6) Internalising |
| 0-3 months | 0.151** | 0.145** | 0.151** | 0.162** | 0.153** | 0.161*** |
| | (0.0637) | (0.0654) | (0.0611) | (0.0634) | (0.0653) | (0.0609) |
| 3-6.months | 0.106** | 0.175*** | -0.0001 | 0.104** | 0.173*** | -0.00140 |
| | (0.0469) | (0.0498) | (0.0520) | (0.0468) | (0.0498) | (0.0519) |
| 6-12 months | 0.00172 | 0.0806* | -0.0602 | 0.00378 | 0.0823* | -0.0584 |
| | (0.0459) | (0.0487) | (0.0474) | (0.0457) | (0.0486) | (0.0473) |
| 12-18 months | 0.0228 | 0.0356 | 0.000132 | 0.0272 | 0.0391 | 0.00403 |
| | (0.0460) | (0.0472) | (0.0477) | (0.0460) | (0.0472) | (0.0476) |
| Without formal | -0.0778 | 0.134 | -0.185 | -0.138 | -0.0719 | 0.0639 |
| education | (0.207) | (0.164) | (0.241) | (0.288) | (0.322) | (0.367) |
| Incomplete Primary | -0.212 | 0.0269 | -0.265 | -0.239 | -0.169 | -0.0341 |
| | (0.205) | (0.161) | (0.239) | (0.288) | (0.322) | (0.366) |
| Primary | -0.131 | 0.138 | -0.239 | -0.212 | -0.0663 | -0.0766 |
| | (0.202) | (0.157) | (0.236) | (0.282) | (0.316) | (0.361) |
| Incomplete High School | -0.286 | 0.0216 | -0.415* | -0.332 | -0.165 | -0.187 |
| | (0.200) | (0.155) | (0.234) | (0.279) | (0.312) | (0.358) |
| High School | -0.356* | -0.0262 | -0.524** | -0.451 | -0.219 | -0.303 |
| | (0.203) | (0.159) | (0.238) | (0.285) | (0.319) | (0.362) |
| Vocational education | -0.475** | -0.141 | -0.628*** | -0.518* | -0.310 | -0.374 |
| | (0.204) | (0.161) | (0.238) | (0.287) | (0.321) | (0.365) |
| College Degree | -0.0778 | 0.134 | -0.185 | -0.336 | 0.0579 | -0.244 |
| | (0.207) | (0.164) | (0.241) | (0.334) | (0.365) | (0.403) |
| Maternal age | -0.0445* | -0.0295 | -0.0563** | -0.0214 | -0.0163 | -0.0447 |
| | (0.0232) | (0.0236) | (0.0246) | (0.0374) | (0.0391) | (0.0377) |
| Maternal age square | 0.000398 | 0.000121 | 0.000648* | -2.11e-05 | -0.000113 | 0.0004 |
| | (0.000362) | (0.0004) | (0.0004) | (0.000594) | (0.0006) | (0.0006) |
| Mother married | -0.0596* | -0.0681** | -0.0505 | -0.0354 | -0.00940 | -0.0829* |
| | (0.0320) | (0.0337) | (0.0322) | (0.0496) | (0.0526) | (0.0500) |
| Mother’s WAIS digit | -0.069*** | -0.065*** | -0.062*** | -0.0662** | -0.0427 | -0.088*** |
| score | (0.0163) | (0.0169) | (0.0171) | (0.0270) | (0.0279) | (0.0274) |
| Mother’s WAIS | -0.00961 | 0.0419** | -0.068*** | -0.0178 | 0.0326 | -0.089*** |
| vocabulary score | (0.0175) | (0.0176) | (0.0183) | (0.0277) | (0.0279) | (0.0285) |
| Work before pregnancy | 0.0138 | 0.0236 | 0.00240 | 0.0189 | 0.0280 | 0.00766 |
| | (0.0587) | (0.0591) | (0.0622) | (0.0584) | (0.0590) | (0.0620) |
| Mother drank alcohol | -0.000840 | 0.0187 | -0.0357 | -0.00453 | 0.0153 | -0.0389 |
| during pregnancy | (0.0893) | (0.0945) | (0.0904) | (0.0870) | (0.0926) | (0.0882) |
| Difficulties during | 0.178*** | 0.124*** | 0.120*** | 0.184*** | 0.129*** | 0.125*** |
| pregnancy | (0.0436) | (0.0462) | (0.0443) | (0.0436) | (0.0461) | (0.0443) |
| Mental problems during | 0.0157 | 0.0125 | 0.000914 | 0.0193 | 0.0162 | 0.00301 |
| pregnancy | (0.0625) | (0.0628) | (0.0619) | (0.0626) | (0.0629) | (0.0622) |
| Teenager pregnancy | -0.0379 | -0.0474 | -0.0942 | -0.0500 | -0.0580 | -0.106 |
| | (0.0934) | (0.0988) | (0.0934) | (0.0938) | (0.0990) | (0.0934) |
| Extraversion | -0.0582** | -0.00984 | -0.097*** | -0.0530** | -0.00542 | -0.091*** |
| | (0.0235) | (0.0256) | (0.0235) | (0.0238) | (0.0258) | (0.0238) |

| | Without Home score | | | With Home score | | |
|---|---|---|---|---|---|---|
| Variables | (1) Total | (2) Externalising | (3) Internalising | (4) Total | (5) Externalising | (6) Internalising |
| Agreeableness | -0.0626*** | -0.073*** | -0.031 | -0.065*** | -0.076*** | -0.0337 |
| | (0.0241) | (0.0250) | (0.0243) | (0.0241) | (0.0250) | (0.0243) |
| Conscientiousness | -0.0736*** | -0.099*** | -0.0140 | -0.0674*** | -0.093*** | -0.00802 |
| | (0.0235) | (0.0252) | (0.0239) | (0.0235) | (0.0252) | (0.0240) |
| Neuroticism | 0.182*** | 0.173*** | 0.169*** | 0.179*** | 0.170*** | 0.167*** |
| | (0.0246) | (0.0256) | (0.0251) | (0.0246) | (0.0255) | (0.0251) |
| Openness | -0.0392* | -0.0438** | -0.0173 | -0.0379* | -0.0425* | -0.0159 |
| | (0.0211) | (0.0222) | (0.0214) | (0.0213) | (0.0224) | (0.0217) |
| Boys | 0.115*** | 0.147*** | -0.0288 | 0.110** | 0.143*** | -0.0333 |
| | (0.0433) | (0.0456) | (0.0440) | (0.0430) | (0.0454) | (0.0438) |
| Having older sibling | 0.0763 | 0.116** | 0.0314 | 0.0693 | 0.110* | 0.0248 |
| | (0.0554) | (0.0584) | (0.0568) | (0.0553) | (0.0583) | (0.0568) |
| Premature | -0.0622 | -0.0544 | -0.0555 | -0.0880 | -0.0757 | -0.0795 |
| | (0.109) | (0.110) | (0.0999) | (0.110) | (0.112) | (0.101) |
| Child low weight | 0.169 | 0.138 | 0.146 | 0.184* | 0.150 | 0.160 |
| | (0.107) | (0.120) | (0.102) | (0.108) | (0.121) | (0.103) |
| Child age | 0.0107 | 0.00283 | 0.0163 | 0.0137 | 0.00493 | 0.0207 |
| | (0.0734) | (0.0772) | (0.0733) | (0.0733) | (0.0772) | (0.0733) |
| Child age square | -2.04e-08 | 1.26e-07 | 5.49e-08 | -1.26e-07 | 4.71e-08 | -7.94e-08 |
| | (1.88e-06) | (1.97e-06) | (1.86e-06) | (1.87e-06) | (1.96e-06) | (1.86e-06) |
| Income pre-pregnancy | -4.88e-08 | -1.44e-08 | -1.23e-07 | -4.28e-08 | -9.08e-09 | -1.18e-07 |
| | (1.08e-07) | (1.10e-07) | (1.11e-07) | (1.08e-07) | (1.10e-07) | (1.11e-07) |
| Home score | | | | -0.023*** | -0.017*** | -0.021*** |
| | | | | (0.005) | (0.005) | (0.005) |
| Constant | 0.618 | 0.286 | 0.803 | 1.025* | 0.597 | 1.154** |
| | (0.525) | (0.523) | (0.565) | (0.530) | (0.527) | (0.574) |
| Observations | 4,263 | 4,263 | 4,263 | 4,258 | 4,258 | 4,258 |
| R-squared | 0.208 | 0.161 | 0.200 | 0.214 | 0.165 | 0.204 |

**Appendix 4.12. The association between early maternal employment timing and child cognitive outcomes at 12–24 months old: OLS and PSM models estimating the average treatment effect (ATE)**

| | Total Battelle (1) | | Personal/Social Battelle (2) | | Adaptive Battelle (3) | | Motor Battelle (4) | | Communication Battelle (5) | | Cognitive Battelle (6) | | EEDP (7) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OLS | PSM ATE | OLS | PSM ATE | OLS | PSM ATE | OLS | PSM ATE | OLS | PSM ATE | OLS | PSM ATE | OLS | PSM ATE |
| (A) Between 0-3 months | -0.093 | -0.140 | -0.026 | 0.056 | -0.098 | -0.197** | -0.058 | -0.112 | 0.016 | -0.111 | -0.126 | -0.198 | 0.044 | -0.440* |
| | (0.116) | (0.119) | (0.109) | (0.132) | (0.109) | (0.085 | (0.114) | (0.131) | (0.128) | (0.145) | (0.125) | (0.134) | (0.133) | (0.234) |
| N | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 | 1,580 |
| (B) Between 3-6 months | -0.120 | 0.203 | 0.008 | 0.245** | 0.061 | 0.194 | -0.274** | 0.165 | 0.074 | 0.327** | -0.066 | 0.201 | -0.032 | 0.241* |
| | (0.140) | (0.139) | (0.130) | (0.117) | (0.136) | (0.129) | (0.138) | (0.147) | (0.166) | (0.161) | (0.147) | (0.139) | (0.158) | (0.128) |
| N | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,750 | 1,749 | 1,749 |
| (C) Between 6-12 months | -0.150 | -0.009 | -0.015 | 0.066 | 0.080 | 0.305*** | -0.265* | -0.168*** | -0.280** | -0.196** | -0.020 | 0.135** | 0.070 | -0.036 |
| | (0.132) | (0.048) | (0.132 | (0.051) | (0.131) | (0.048) | (0.148) | (0.043) | (0.100) | (0.068) | (0.126) | (0.061) | (0.148) | (0.068) |
| N | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,818 | 1,819 | 1,819 |
| (D) Between 12-18 months | 0.003 | 0.139 | -0.127 | -0.017 | 0.002 | 0.116 | 0.170 | 0.294** | -0.051 | -0.016 | 0.010 | 0.043 | -0.073 | 0.060 |
| | (0.133) | (0.095) | (0.114) | (0.088) | (0.123) | (0.089) | (0.131) | (0.093) | (0.115) | (0.076) | (0.133) | (0.075) | (0.111) | (0.078) |
| N | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,688 | 1,689 | 1,689 |
| (E) Difference between (A) and (B) | ns | *** | ns | ** | ns | ** | ns | *** | ns | *** | ns | *** | ns | *** |
| (F) Difference Between (B) and (C) | ** | ns | * | ** | ns | ns | ns | ns | ns | ns | *** | ** | ns | ** |
| (G) Difference Between (C) and (D) | ns | *** | ns | ns | ns | ** | * | *** | ns | ** | * | ns | ns | ns |

Notes: The PSM analyses estimate the average treatment effect (ATE). Each model controls for child characteristics (age, age squared, gender, prematurity, low weight at birth and whether the child has an older sibling) and maternal characteristics (WAIS vocabulary score, WAIS digit score, Big Five Inventory dimensions score, marital status, years of education, age, mental health problems during pregnancy and maternal income pre- pregnancy). Columns (1), trough (7) show mean values for dummy coefficients with standard deviation in parentheses are shown. The reference group in rows (A) through (D) is mothers who did not engage in early maternal employment. *$p$<.05, **$p$<.01, ***$p$<.001

# Chapter 5

# Type of care in infancy and child cognitive and socio-emotional development in Chile

## 5.1. Introduction

Despite the concern about a potentially detrimental impact of early non-maternal care[43] on child development, in OECD countries, 25 per cent of children attend some type of non-maternal care during early childhood (UNICEF, 2008). Unfortunately, few countries have information about under-one year olds' type of care. In the UK in 2011, 57 per cent of under-two-year-old children were in some form of non-maternal type of care (Huskinson et al., 2013). In contrast, in OECD countries in 2008, approximately 45 per cent of children between zero and two years old went to some kind of non-maternal care during a typical week (OECD, 2010). In Chile in 2010, 10 per cent of under-one-year-old children attended centre-based care (CASEN, 2010) and more than 20 per cent attended other types of non-maternal care[44] (author's estimate from ELPI 2010 data).

Although an important proportion of children start non-maternal care during infancy, only a few studies have analysed the effect of non-maternal care on child development during children's first year of life. This chapter focuses on the first year because the association between non-maternal care and child development varies according to which age the child enters into non-maternal care (Melhuish, 2004; NICHD Early Child Care Research Network, 2004; Sylva et al., 2011). There appears to be more positive or neutral effects of non-maternal care on toddlers and preschoolers but results in relation to the effects of attendance during infancy are more ambivalent (Clarke-Stewart & Allhusen, 2002).

Non-maternal care during infancy may potentially have detrimental consequences on child development. According to attachment theory, early non-maternal care could be a risk factor that impedes establishing a secure attachment between the baby and her mother and, in the long term, increases the risk of the child developing behavioural problems (Belsky

[43] In this thesis, I refer to non-maternal care as the different types of care by someone other than the mother: This includes relatives, grandparents, non-relatives (nannies), or centre-based care.
[44] Author's calculations based on Chile's *Encuesta Longitudinal de Primera Infancia* (ELPI), 2010.

& Rovine, 1988; Belsky, 2001). Researchers in neuroscience have found that experiencing early non-maternal care (mainly in group settings) possibly leads to an increase in child stress levels (Vermeer & Vanijzendoorn, 2006; Watamura et al., 2003). Finally, the quality of early interactions between the child and her caregiver(s) is crucial for child socio-emotional and cognitive development (Jaffee, 2007); in non-maternal care settings, children have fewer opportunities to interact with their caregivers relative to home settings (National Institute of Child Health and Human Development Early Child Care Research Network, 2000a).

The empirical evidence about the impact of non-maternal care during infancy and child development shows mixed results. While some studies show a positive association between non-maternal care (relative to maternal care) and child cognitive development (Côté et al., 2013; Hansen & Hawkes, 2009; Sylva et al., 2011), other studies do not find any association between them (Jaffee, Van Hulle and Rodgers, 2011). In addition, there is evidence that children in non-maternal care exhibit more behavioural problems relative to children in maternal care (NICHD Early Child Care Research Network., 2006).

Even though the care of infants and very young children often occurs in the child's own home or the home of a caregiver, childcare research has tended to focus on centre-based care (Adams et al., 2007; Hofferth et al., 1998). The evidence indicates that the child's type of care matters for child development (Dowsett, Huston, & Imes, 2008; National Institute of Child Health and Human Development Early Child Care Research Network, 2005). For example, Sylva et al. (2011) find that centre-based care (group setting) is associated with better child cognitive outcomes, while individual care is associated with less frequent behavioural problems.

There is evidence suggesting that the impact of non-maternal care varies according to variables which express the child's level of vulnerability such as low socio-economic status or low maternal education (Côté et al., 2008, 2013). One explanation for this variation is that non-maternal care of high quality may compensate for and protect vulnerable children from their disadvantaged situations, with their potentially more stressful environments and less enriching learning environments (Berger et al., 2009; Loeb, Fuller, Kagan, & Carrol, 2004; Lupie et al., 2001). On the other hand, poor quality, or extensive hours of non-maternal care could be a risk factor for child development (Dearing, McCartney, & Taylor, 2009).

In sum, the association between non-maternal care and child development varies according to the age at which the child enters into non-maternal care, the type of care under consideration (Belsky et al., 2007; Gregg, Washbrook, Propper, & Burgess, 2005; NICHD Early Child Care Research Network, 2004), and the child's family characteristics (NICHD Early Child Care Research Network., 2006). For these reasons, the aim of this study is to study the association between non-maternal care during the first year of a child's life and child cognitive and socio-emotional development in Chile[45]. In addition, this study examines the association between each specific type of care (relative, grandparent, centre-based, and non-relative care) received during the first year of life and child development in Chile. Finally, family vulnerability is analysed as a moderator in the association between type of care and child development.

In this chapter, I analyse three research questions:

- Do children in non-maternal care do better or worse than those who are at maternal care?
- Does the impact of non-maternal care on child outcomes differ according to the type of care (relative, grandparent, centre-based care or non-relative)?
- Do characteristics which proxy child vulnerability such as maternal education or family structure (single versus two-parent family), and family income moderate the association between type of care and child development?

The present study uses the first wave (2010) of Chile's Longitudinal Survey of Early Childhood, or *Encuesta Longitudinal de Primera Infancia* (ELPI). The large sample size allows for the detection of small effects and for dividing the sample into small groups (e.g. different types of care). The detailed data about the specific types of care in the ELPI dataset enables me to analyse the effect on child development of centre-based care and the different kinds of informal care (versus maternal care) experienced by children during their second semester of life (this is, between six and 12 months after childbirth). Moreover, the dataset has an extensive set of covariates, which enables me to control for most omitted variables identified in the literature. Finally, to deal with selection bias, I analyse the research questions using multivariate regressions and propensity score matching

[45] It is worth noting that the first research question of this chapter ("Do children in non-maternal care do better or worse than those who are at maternal care?") is strongly linked with my analysis of the previous chapter (Does maternal employment affect child outcomes in the first year of life?). However, both questions apply to different samples of women because while there are mothers that work and do not use non-maternal care, there are also mothers that do not work and use non-maternal care.

techniques. In these analyses, I control for an extensive set of variables that could be correlated with type of non-maternal care and child development.

To my knowledge, this is the first study that explores the previously stated research questions in a middle-income-country context. Additionally, this chapter attempts to fill the knowledge gap in the relation between different *types* of non-maternal care and child socio-emotional and cognitive development during the first year of life. This study might also contribute to debates about the importance of government investment in specific types of non-maternal care—in addition to centre-based care—and which groups of children would likely benefit from the different types of care.

This chapter is organised as follows. In section 5.2, I review the results from previous studies about non-maternal care and child development, state hypotheses and identify the gaps in the literature. In section 5.3, I describe the data and the estimation method. In section 5.4, I present the results and in section 5.5, I discuss the results and conclude the present chapter.

## 5.2. Evidence on the association between type of care and child development

In this subsection, I describe the types of care usually described in the literature. In addition, I summarize the evidence about the association between the different types of care and child development. Finally, I discuss the evidence about how the children's background and level of families' vulnerability moderate the association between early non-maternal care and child development.

### *5.2.1. Types of care*

Non-maternal care settings are often categorized into four main groups according to increasing formality (Huston, Chang, & Gennetian, 2002): (1) relative care, which is care provided by a relative, such as a grandparent or aunt, either in the child's or the caregiver's home; (2) in-home non-relative care, which is provided by a nanny or babysitter; (3) family day care homes, where care is provided by a non-relative in a private residence (some are certified or registered and some receive training and technical assistance)[46]; and (4) centre-based care, such as day-care centres, nursery schools, and preschools, where care is provided for groups of children (Sosinsky & Kim, 2013).

[46] This type of care is not commonly in use in Chile.

The different types of non-maternal care imply a distinct set of experiences for the child. In relative care situations, a grandparent usually provides care, the care is in the child's own home, and the care is informal and non-educationally oriented (Coley, Votruba-Drzal, Miller, & Koury, 2013). Relative or other informal care may provide more stability and engagement, chiefly for infants and toddlers (Dowsett et al., 2008). Dowsett et al. (2008) found that in relative care children spent less time in transition and unoccupied compared to children who were in centre-based or family childcare. In contrast, Leach et al. (2008) found that children cared for by their grandparents did fewer activities and had lower safety standards and health scores.

Childcare centres (i.e. centre-based care) organize children into larger groups, often based on age, and two or more adults are usually responsible for their care. Children in centre-based care spend more time in structured, adult-directed activities than do children in home-based care. Centres are usually equipped with a greater number and variety of toys and materials for children and have more space per child (Fuller et al., 2004; NICHD Early Child Care Research Network, 2004).

Due to differences in structure and process between informal and formal settings, it is difficult to compare the quality of these different types of care[47]. In general, informal settings provide higher quality care on some structural indicators (e.g. adult-child ratio) than formal settings, but formal settings such as centre-based care provide higher levels of caregiver training and education (Dowsett et al., 2008; National Institute of Child Health and Human Development Early Child Care Research Network., 2000). Regarding quality of processes, such as planning or communication with children, Bigras et al. (2010) found that quality was lower in relative care than in centre-based care.

### *5.2.2. Type of care and child outcomes*

Previous studies indicate the relevance of considering the specific type of care when analysing the effects of non-maternal care on child development (Gregg et al., 2005). Given the different characteristics of the types of non-maternal care, the relationship between non-maternal care and child development could differ for different kinds of non-maternal care.

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[47] Unfortunately, the ELPI survey does not include measures of quality.

The evidence about the association between non-maternal care during infancy and child development is extremely thin and is focused on the study of centre-based care. Based on the few available studies, the association between types of childcare during infancy and cognitive development is either neutral or positive. During the last decade, the USA-based National Institute of Child Health and Human Development (NICHD) Study of Early Childhood Care has carried out influential research on the effect of childcare on child development. Children who participate in centre-based care perform better in cognitive and language development and show better pre-academic skills than children who spend an equivalent amount of time in childcare homes or in relative care of comparable quality (Loeb et al., 2004; NICHD Early Child Care Research Network, 2002, 2004; NICHD National Early Child Care Research Network & Duncan, 2003).

In addition, Côté, Doyle, Petitclerc and Timmins (2013), using a British cohort, find that attending centre-based care at nine months old (versus informal care) is associated with better cognitive development at three and five years old (but not at seven years old). Attending centre-based care and informal care is also found to have a positive association with child cognitive development at three years old, but only for children whose mothers have low levels of education. This study uses OLS estimators and propensity score matching models to deal with selection on observables. Another study using data from the UK finds that nursery attendance is associated with higher cognitive functioning at 18 months old (Sylva et al., 2011). This observational study uses hierarchical regression analyses and controls for a large set of socio-demographic variables. In addition, Hansen and Hawkes (2009) using data from the Millennium Cohort Study and OLS regressions, find that attending centre-based care (formal group care) at nine months old is positively associated with school readiness. On the other hand, Jaffee et al. (2011), using the US National Longitudinal Survey of Youth (CNLSY), find that type of care in the first three years of life has no effect on child cognitive outcomes. To deal with omitted variable bias this study uses a family fixed-effect model.

The association between type of care during the children's first year of life and child socio-emotional outcomes is unclear. At four-and-a-half years old, children who experienced centre-based care during their first year show higher levels of externalising problems compared to maternal care (Belsky et al., 2007; National Institute of Child Health and Human Development Early Child Care Research Network, 2000, 2003; National Institute of Child Health and Human Development., 2006; NICHD Early Child Care Research Network, 2004). Another study from the USA which focused on low income families finds that children between 12 and 42 months old in family childcare homes show more behavioural problems than children in centre-based care (Loeb et al., 2004). This study uses OLS analysis and controls for several maternal, child, and family characteristics. In addition, Barnes, Leach, Malmberg, Stein and Sylva (2010) find in an English sample of 1,000 families that there is no effect of any type of childcare during the first three years of life on behavioural problems at age three years. This observational study uses multiple regression analyses. Finally, Hansen & Hawkes (2009) use the Millennium Cohort Study and focus on socio-emotional outcomes for children aged three. They find no association between centre-based care at nine months old and behavioural problems at three years old. This observational study uses regression analysis and controls for child, mother, and family characteristics.

Finally, some studies in the UK explore the association between grandparent care and child development. Sylva et al., (2011) using data from the UK, conclude that informal care (grandparents or nannies) during infancy is associated with lower orientation/engagement behaviour (e.g., enthusiasm for carrying out tasks, curiosity, and social engagement) at 18 months relative to maternal care. In addition, Fergusson, Maughan and Golding (2008) find that grandparent care during the first two years of life is associated with more behavioural problems , including hyperactivity and peer relationship problems at four years old relative to maternal care. Similarly, Hansen and Hawkes (2009) conclude that grandparent care (versus maternal care) at nine months is related with increased behavioural problems. In contrast, caregiver emotional responsiveness and sensitivity provided by grandparents and nannies was higher than the ones observed in centre-based care (Fergusson et al., 2008). Additionally, grandparent care is associated with higher vocabulary test scores (Hansen & Hawkes, 2009)

There are few studies about the impact of early childhood education on child development in Latin America and most of these studies are focused on children who are three year old or older (Behrman et al., 2004; Berlinski, Galiani, & Gertler, 2009; Rosero & Oosterbeek, 2011; Rosero, 2012). To my knowledge, only two studies evaluate the association between type of care before two years old and child development in Chile. Lira and Contreras (1999) conduct an observational study with a small sample study (90 cases) on the association between the child's type of care (maternal, centre-based or relative care) and child psychomotor development under two years old. They find that children who stayed with their mothers are more likely to improve from a lagged to a normal level of development relative to children in grandparent or centre-based care. Unfortunately, this study does not consider the characteristics of the nursery and the family care environment. In a more recent study, Noboa-Hidalgo and Urzua (2012) conclude that attendance at centre-based care (relative to maternal care) has a positive impact on emotional regulation and motor skills and a negative effect on child-adult interactions, reasoning, and memory. In this study, these authors deal with selection bias by using a control function approach (Heckman & Navarro-Lozano, 2004)

This study explores the association between types of childcare and child development in Chile. Given the lack of studies about centre-based care and informal care quality in Chile, it is hard to hypothesise what the effects of different types of care on child development might be in this middle-income country. The main type of non-maternal care during children's first year of life in Chile is relative care (mainly by grandparents) (ELPI, 2010). Given that grandparents usually care for only one child, that child may benefit from personalised care. Although there is some evidence that grandparent care has negative effects on child socio-emotional development (Fergusson et al., 2008; Hansen & Hawkes, 2009), it is also possible that children benefit from personalised care in socio-emotional terms.

On the other hand, caregivers in Chile's child centres usually hold a university degree. Hence, I also hypothesise that children from low socio-economic households (whose potential caregiver has a low level of education), may benefit in cognitive terms from centre-based care. However, it is not clear whether the well-trained teachers at child centres could have a positive impact on child socio-emotional development. As discussed in Chapter 2, even though they are graduates, there are concerns about the quality of the staff. Therefore, the effect of different types of care on child development is an empirical question.

*5.2.3. Household vulnerability as a moderator in the effect of different types of care on child development.*

Depending on their backgrounds, childcare experience could affect children in different ways. In this study, I analyse how specific factors of disadvantaged backgrounds like low maternal education, low family income, and one-parent family structure interacts with the type of childcare when affecting child outcomes.

Both Côté et al. (2013) and Peisner-Feinberg et al. (2001) have concluded that children from disadvantaged backgrounds benefit more from non-maternal care than children from more advantaged families. In the context of this study, a 'disadvantaged background' means low maternal education or low household income. One hypothesised mechanism that could explain the moderating role of household vulnerability on the effect of types of childcare on child development is that family income may be positively related with the level of stimulation that the child receives at home. In this sense, Votruba-Drzal (2012) concluded that the home environment in vulnerable families is more sensitive to household income changes than is the home environment in wealthier families. Following the logic of the previously stated hypothesis, for low-income children, it could be particularly beneficial to attend centre-based care because formal care could potentially provide them with better learning opportunities compared to the learning opportunities at home (Geoffroy, et al., 2010). Côté, et al. (2013) explore the interacted effect of family vulnerability (low family income and low maternal education) and non-maternal care on child cognitive and socio-emotional development. They find that the association between type of care and child cognitive outcomes is small to moderate and only significant for children whose mothers have low levels of education.

In this study, I also incorporate family structure as a potentially moderating variable in the relation between type of care and child development. I do this based on the maternal employment and child development literatures that state that the association between maternal employment and child development is more positive for one-parent families than for two-parent families (Brooks-Gunn et al., 2002; Goldberg et al., 2008).

In sum, the literature tells us that in the analysis of the effects of non-maternal care on child development it is important to consider the child's specific type of care. However, there is scarce information about the association between type of care during infancy and child development. Centre-based care in infancy is associated with positive effects on child cognitive development; however, the association between this type of care and child socio-emotional development is ambiguous. In addition, early entry into non-maternal care—especially grandparent care—is associated with higher levels of socio-emotional problems. Finally, apparently, the child's level of vulnerability moderates the previously mentioned association.

This chapter examines how the attendance at different types of care during the child's first year (6–12 months after childbirth) affects her cognitive and socio-emotional skills. This chapter also explores whether the child's family level of vulnerability moderates the previously mentioned association.

## 5.3. Method

### *5.3.1. Sample and Procedures*

In this chapter, I use the first wave of Chile's Longitudinal Survey of Early Childhood, or *Encuesta Longitudinal de la Primera Infancia*" (ELPI). The sample used for this analysis consists of children who were in any type of care between six and 12 months old, and who were between 24 and 48 months old in 2010. I restrict my sample in the described way for several reasons. First, I want to study the association between non-maternal care during the first year of child life on child development because there is less evidence of non-maternal care during infancy than during later years (e.g. pre-school). Second, I used the six to twelve months period because this period is half of the child's first year and it is a good representation of the first year. Third, before six months old most of the children were with their mothers and from the six to twelve months period the type of care variable has more variability. In total, this sample consisted of 7,564 children where 29 per cent were in non-maternal care at six to twelve months and 71 per cent were in exclusive maternal care. (For more information about the sample, see Chapter 3.)

<u>Dependent variables: Child cognitive and socio-emotional outcomes</u>

The ELPI 2010 survey used two measures of cognitive development at age 24-48 months: the Peabody Picture Vocabulary Test and the *Test de Desarrollo Psicomotor* (in English, Psychomotor Development Test). Additionally, the ELPI survey employed the Child

Behaviour Checklist as a socio-emotional measure at ages 24-48 months old. (For more information about these two tests, see Chapter 3.)

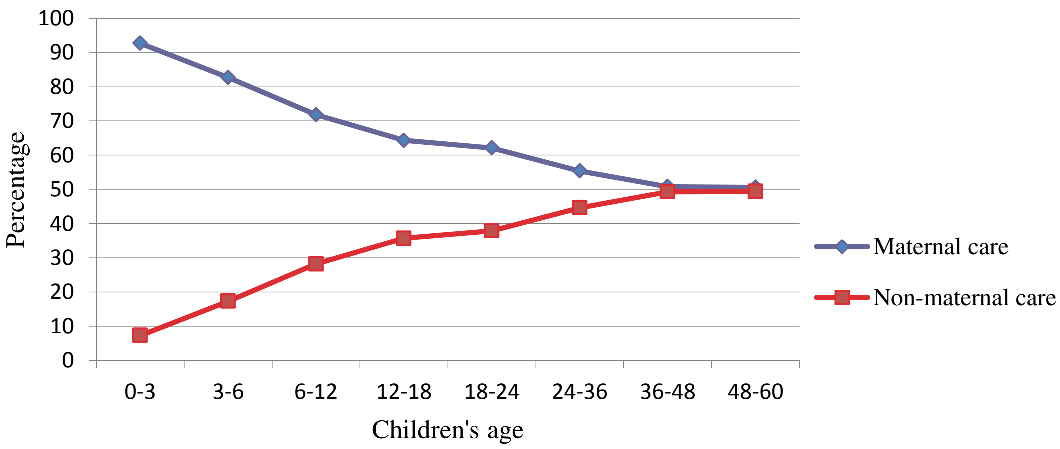
I transformed cognitive and socio-emotional assessment scores into Z scores (average and standard deviation equal to zero and one respectively). Higher scores indicate higher cognitive achievement and more behavioural problems in the cognitive and socio-emotional areas respectively.

Key variables: types of non-maternal care

Given that children normally experience multiple care arrangements during relatively short periods, studying the effects of non-maternal care on child development is a challenging task. It should not be assumed—as an important part of the literature does—that a single observation about the type of care during the child's first year of life is an adequate representation of a child's experience in childcare.

The ELPI survey collected information about the main care arrangement. Mothers were asked retrospectively about their children's main care arrangements between the following intervals of their children's first years: 0–3 months, 3–6 months, 6–12 months, 12–18 months, 18–24 months, 2–3 years, 3–4 years and 4–5 years old. I used this information to create two variables. According to Figure 1, only 7.3 per cent of infants between zero and three months old were in some kind of non-maternal care and the rest (92.7%) were in maternal care. In contrast, at age three, 44.6 per cent were in non-maternal care.

**Figure 5.1. Distribution of maternal and non-maternal care by children's age.**

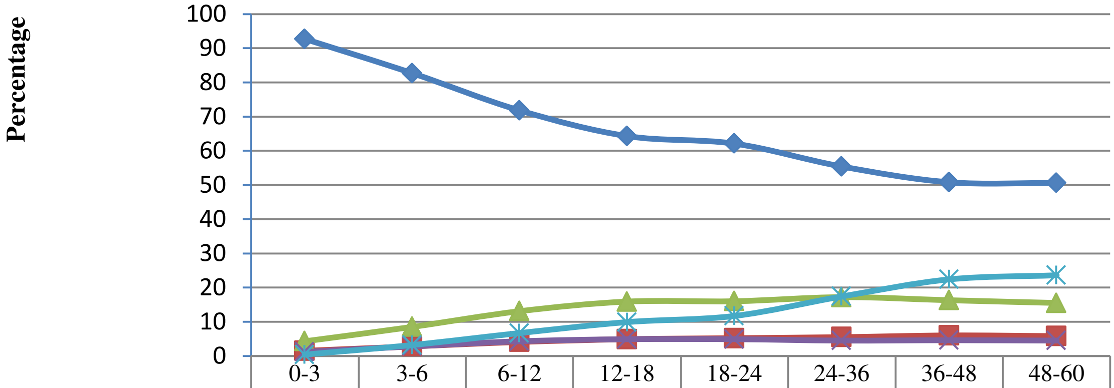



Source: Author's calculations based on Chile's ELPI 2010 survey.

I categorised primary care arrangements in each period into five types: a) exclusive maternal care, b) relative care (mostly aunts and sisters), c) grandparent care, d) non-relative care (e.g. nannies) and e) centre-based care.

Figure 5.2 shows the evolution of the different types of childcare. The most prevalent type of non-maternal care for children between 0 and 24 months old was grandparent care. Specifically, between 6-12 months, 13.1 per cent of the children were in grandparent care, followed by centre-based care (6.7%). Relative care and non-relative care were used by 4.1 per cent and 4.3 per cent of children in each childcare mode.

**Figure 5.2. Distribution of type of care by child's age**




| | 0-3 | 3-6 | 6-12 | 12-18 | 18-24 | 24-36 | 36-48 | 48-60 |
|---|---|---|---|---|---|---|---|---|
| Mother care | 92.7 | 82.7 | 71.8 | 64.3 | 62.1 | 55.4 | 50.8 | 50.6 |
| Relative care | 1.5 | 2.8 | 4.1 | 4.9 | 5.2 | 5.5 | 6 | 5.8 |
| Grandparents care | 4.3 | 8.5 | 13.1 | 15.9 | 16 | 17.2 | 16.3 | 15.5 |
| non-relative care | 1.2 | 2.8 | 4.3 | 4.9 | 4.9 | 4.5 | 4.6 | 4.5 |
| Centre-based care | 0.4 | 3.2 | 6.7 | 9.9 | 11.7 | 17.4 | 22.4 | 23.6 |

Source: Author's calculations based on Chile's 2010 '*Encuesta Longitudinal de Primera Infancia*' (ELPI).

I categorise children as having experienced non-maternal care during the first year of life if it was their primary care arrangement during the 6-12 month period. On the other hand, I created the variable "type of care during the first year" by assigning to this variable the main type of care that the child experienced during the 6-12 months period.

Users of non-maternal care and working mothers overlap only partially. In the ELPI survey, 83 per cent of children for whom non-maternal care is reported to be the main form of care between six and 12 months are children of mothers who reported they were working during this period. In addition, five per cent of working mothers declare that their child uses exclusive maternal care; these should be mainly women that work from home or who work with their children. Hence, although theoretically the children of working mothers and children in non-maternal care could overlap completely, in practice this does not occur. Therefore, this chapter analyses a slightly different set of mothers compared to the ones analysed in the chapter that explores the effects of maternal employment timing on child development (Chapter 4).

Variables that could influence childcare decisions

I choose as covariates those variables that are associated in the literature with both participation in non-maternal care and with child cognitive and socio-emotional development. The criterion to select the relevant variables was to select those variables that could be correlated with both the dependent variable (child development) and the key variable (types of care). In other words, the purpose of the covariates is to acknowledge the fact that mothers who choose different types of childcare could be different in their observable characteristics.

I include child characteristics such as gender, the child's age at the time of the test (linear and quadratic terms), whether the child has an older sibling, childbirth weight, and whether the child was premature as covariates. I also include maternal characteristics such as maternal age (log term), teenage mothers, maternal depression after birth, marital status, maternal level of education, whether the mother had worked before pregnancy, maternal income pre-birth, and maternal cognitive ability (measured by the WAIS test) as covariates. The WAIS test aims to assess adult global intelligence using the individual's IQ as a proxy for intelligence. In addition, I include the mother's personality measured by the Spanish Big Five Inventory ('BFI') as a covariate. The BFI assesses personality in the following dimensions: extraversion, agreeableness, conscientiousness, neuroticism, and openness (John et al., 2008).

I include the number of people in the household, family structure, and the quality of stimulation and support provided in the home environment as family covariates. The latter variable was measured using the Home Observation for Measurement of the Environment ("HOME") test and the mother-child interaction score. The mother-child interaction score is based on a self-reported questionnaire with a series of questions regarding mother-child interactions such as 'the mother reads to the child', 'the mother tells stories to the child' or 'the mother sings to the child'. Finally, factors such accessibility to centre-based care is an important variable when choosing a child's type of care (Chaudry et al., 2011). Given the varying availability of centre-based care in the different regions of the country and the cultural differences in terms of attitudes towards centre-based care and other types of care, I include the household's region of residence (15 regions) and whether the household is located in a rural area as control variables.

As in Chapter 4, I control for household income in all my regressions. However, as I mention in Chapter 4, neither wave of the ELPI survey asked for household income before the child's birth. Given that the ELPI 2010 wave includes pre-birth maternal income, to obtain a proxy for pre-birth household income, I need a proxy for pre-birth non-maternal income. To use it as a proxy for pre-birth non-maternal income, I construct the variable non-maternal income in 2010. This is non-maternal income some months after the children's birth. I construct this variable by subtracting household income at the 2010 survey minus maternal income during the same period. When using the 2010 non-maternal income as a proxy for pre-birth non-maternal income, I assume that non-maternal income—that is mainly paternal income—is relatively stable before and after childbirth. As we will see in subsection 5.4.4, the results when running the regression analyses and PSM models with and without non-maternal income as a covariate are consistent.

<u>Variables moderating the association between type of care and child development</u>

As in Chapter 4, I analyse whether family income, maternal education, and family structure moderate the association between non-maternal care during infancy and child cognitive and socio-emotional outcomes. These variables have been previously identified in the literature as relevant moderators in the previously mentioned association. For testing these potential moderators, I dichotomise household income per capita into poor and non-poor households to test Côté et al. (2008) and Peisner-Feinberg et al.'s (2001) conclusion that non-maternal care affects children from poor and non-poor families differently. Poor households is defined to be those ones with per capita family income below the Chilean poverty line (70 pounds per capita per month or 64,000 Chilean pesos). Using this criterion, 42 per cent of households in the sample classify as poor[48].

[48] This is higher relative to the national children under three years old poverty rate in Chile of 24 per cent (CASEN, 2011). The ELPI survey only selected families with at least one child between 0–6 years old. Hence, maybe the selected households have more children than the average Chilean household and maybe the breadwinners are younger than the average Chilean workers are. Both factors imply a higher rate of poverty.

I also test whether non-maternal care affects children of mothers with low or high levels of educational achievement differently. I consider that mothers with a low education level are those with less than 12 years of education (i.e. who did not achieve a high school degree). According to this criterion, 32 per cent of mothers in the ELPI survey have a low level of education.

Finally, I test whether non-maternal care affects children living in two-parent or one-parent households differently. The parents of a child living with two parents live together are married or cohabiting. The parent of a child living with one parent is divorced, is a widow or widower, and does not live with a partner. Following this criterion, 71 per cent of children between 24 and 36 months old in the ELPI survey live in a two-parent family.

*5.3.2. Data Analysis*

I conduct two main sets of analyses. First, I compare the cognitive and socio-emotional outcomes of children who used any type of non-maternal care during the first year of life (28.2%) with those children who experienced exclusive maternal care (71.8%). Second, I compare children who experienced different types of non-maternal care (relative care, grandparent care, in-home non-relative care, and centre-based care) with children who experienced only maternal care 6–12 months after childbirth. To explore the effect of types of care on child cognitive outcomes, I run different regressions using two different tests as dependent variables: the TEPSI and PPVT tests. Additionally, to explore the association between types of care and child socio-emotional development I use data from the Child Behaviour Checklist test (CBCL).

To address my research questions, I run ordinary least squares (OLS) regressions of a number of measures of child development on types of care and additional controls. To complement these results, I run propensity score matching analyses.

The first main research question is whether there is any association between non-maternal care during the first year of children's life and child development. The second main research question is whether there is any association between the *type* of care that a child experiences 6–12 months after childbirth and child development.

In the most complete analysis, I explore the association between different types of care at 6–12 months after childbirth and child development outcomes.

$$D_i = X_i'\beta + \sum_j \gamma_j \, TC_{i,j} + \varepsilon_i \qquad\qquad i = 1, .., N \, ; \quad j = 1, .., M \qquad (1)$$

Where

$D_i$ = Child $i$'s development outcome at the time of the interview. This is the dependent variable. It varies depending on the test used to measure child development.

The independent variables are:

$X_i'$ = Maternal, child and family characteristics that could be correlated both with the dependent variable and with the type of care.

$TC_{i,j}$= Dummy variable that equals 1 when child $i$ assisted to type of care $j$ during the 6–12 months-after-childbirth period. The reference category is maternal care.

$\varepsilon_i$ = Child $i$'s development outcome error term (i.e. factors determining the child's development outcome that are unobserved to the researcher).

The coefficients of interest are the $\gamma_j$. The interpretation of these coefficients is the association between child development and the specific type of care during the second-semester-after-childbirth period controlling for the covariates.

To test whether the potential treatment moderators (maternal education, family income, and family structure) were relevant I estimated OLS regressions interacting the treatment variables (types of non-maternal care) with the moderators and analysed the potentially heterogeneous effects of the treatment along the moderating variables.

Addressing selection biases

As previously stated, to address selection biases I estimate both OLS and PSM models. On the one hand, I estimate OLS models controlling for all previously mentioned covariates. On the other hand, I run PSM estimating the average treatment effect on the treated (ATT) using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours and using Imbens et al.'s (2014) 'nnmatch' command in Stata. I used the same covariates included in the OLS regressions to predict the matching's propensity score. The advantage of PSM over OLS models is that the former imposes fewer assumptions on the relation between the covariates, the key variable and the dependent variable. It is important to note that neither the OLS nor PSM models control for unobservable characteristics.

To evaluate the degree of similarity between the treated and control (matched) samples I perform a test of the balance of covariates in both samples. (For information about common support and balance, see Appendix 5.0).

## 5.4. Results

### *5.4.1. Descriptive statistics of child, family, and maternal characteristics for children in different types of care at age 6-12 months and child cognitive and socio-emotional outcomes*

Table 5.1 shows differences in key child, family, and maternal characteristics for children in different types of care during the first year of life (at age 6-12 months). I show these differences regressing each key characteristic (in each row) on the types of care (in each column). In this table, each regression appears in a separate row.

Mothers of children who were in maternal care during the 6-12 months period have some characteristics that are generally correlated with greater child development: they are more likely to be married, and less likely to present depression than mothers whose children were in non-maternal care during the same period. In contrast, mothers of children in maternal care during the first year after childbirth also have characteristics that could be correlated with lower child development scores. These mothers have fewer years of education, lower digit and vocabulary scores, are more likely to be below the poverty line and have lower family income (maternal and non-maternal income) than mothers of children who were in non-maternal care during the 6-12 months after childbirth period. This implies that I should control for these observable variables in the regression analysis and include these variables in the propensity score in the PSM analyses.

**Table 5.1. Differences in maternal, child, and family characteristics for children in different types of care (relative, grandparent, centre-based and non-relative care) at 6–12 months old relative to children in maternal care during the same period**

| | Maternal Care (1) | Relative Care (2) | Grandparent Care (3) | Centre-based Care(4) | Non-relative Care (5) | (1) versus (2) | (1) versus (3) | (1) versus (4) | (1) versus (5) |
|---|---|---|---|---|---|---|---|---|---|
| | N=5,521<br>71.8% | N=291<br>4.1% | N=964<br>13.1% | N=483<br>6.7% | N=305<br>4.3% | | | | |
| **Maternal characteristics** | | | | | | | | | |
| Age | 29.60 | 31.75 | 28.52 | 31.12 | 34.30 | *** | *** | *** | *** |
| | (0.10) | (0.37) | (0.19) | (0.29) | (0.33) | | | | |
| Married (%) | 73.5 | 71.1 | 54.9 | 65.7 | 80.4 | | *** | *** | *** |
| | (0.54) | (2.4) | (1.5) | (2.0) | (2.2) | | | | |
| Years of education | 11.03 | 11.84 | 12.95 | 12.67 | 14.52 | *** | *** | *** | *** |
| | (0.04) | (0.18) | (0.09) | (0.14) | (0.17) | | | | |
| Low education (high school or less) (%) | 79.9 | 69.32 | 58.3 | 59.8 | 29.3 | *** | *** | *** | *** |
| | (0.52) | (2.5) | (1.5) | (2.2) | (2.5) | | | | |
| Teenager Mother (less than 20) (%) | 7.6 | 3.3 | 7.3 | 5.9 | 1.8 | *** | | * | *** |
| | (0.32) | (0.91) | (0.76) | (0.95) | (0.18) | | | | |
| Mothers that present depression (%) | 10.6 | 14.5 | 12.8 | 12.2 | 13.9 | ** | ** | | |
| | (0.39) | (1.9) | (1.0) | (1.4) | (2.1) | | | | |
| Mother's WAIS digit score | -0.058 | -0.02 | 0.17 | 0.22 | 0.60 | | *** | *** | *** |
| | (0.01) | (0.06) | (0.03) | (0.05) | (0.08) | | | | |
| Mother's WAIS vocabulary score | -0.06 | 0.1 | 0.22 | 0.22 | 0.91 | *** | *** | *** | *** |
| | (0.01) | (0.06) | (0.03) | (0.05) | (0.07) | | | | |
| Extraversion | 3.49 | 3.55 | 3.62 | 3.57 | 3.7 | | *** | *** | *** |
| | (0.009) | (0.04) | (0.02) | (0.04) | (0.05) | | | | |
| Agreeableness | 3.83 | 3.85 | 3.82 | 3.84 | 3.99 | | | | *** |
| | (0.007) | (0.03) | (0.02) | (0.03) | (0.03) | | | | |
| Conscientiousness | 3.97 | 4.11 | 4.03 | 4.05 | 4.23 | *** | *** | ** | *** |
| | (0.007) | (0.03) | (0.02) | (0.03) | (0.03) | | | | |
| Neuroticism | 3.07 | 3.04 | 2.95 | 3.01 | 2.68 | | *** | | *** |
| | (0.01) | (0.05) | (0.03) | (0.04) | (0.05) | | | | |
| Openness | 3.78 | 3.8 | 3.83 | 3.83 | 3.99 | | ** | * | *** |
| | (0.01) | (0.03) | (0.02) | (0.03) | (0.04) | | | | |
| Breastfed (%) | 95.1 | 91.7 | 95 | 94.2 | 94.5 | ** | | | |
| | (0.3) | (1.5) | (0.7) | (0.9) | (1.4) | | | | |
| Difficult pregnancy (%) | 41.6 | 41.7 | 43.3 | 42.2 | 42.1 | | | | |
| | (0.6) | (2.8) | (1.6) | (2.2) | (3.2) | | | | |

| | Maternal Care (1) | Relative Care (2) | Grandparent Care (3) | Centre-based Care(4) | Non-relative Care (5) | (1) versus (2) | (1) versus (3) | (1) versus (4) | (1) versus (5) |
|---|---|---|---|---|---|---|---|---|---|
| | N=5,521 71.8% | N=291 4.1% | N=964 13.1% | N=483 6.7% | N=305 4.3% | | | | |
| **Child Characteristics** | | | | | | | | | |
| Female (%) | 49.4 | 48.1 | 51.33 | 50.9 | 43.6 | | | | |
| | (0.6) | (2.7) | (1.6) | (2.3) | (3.2) | | | | |
| Low birth weight (%) | 3.5 | 4.3 | 3.0 | 3.7 | 3.6 | | | | |
| | (0.2) | (1.1) | (0.6) | (0.8) | (1.0) | | | | |
| Premature (%) | 7.3 | 6.2 | 5.6 | 7.6 | 5.8 | | ** | | |
| | (0.3) | (1.3) | (0.8) | (1.1) | -1.5 | | | | |
| Has older sibling (%) | 56.4 | 57.9 | 36.8 | 53.3 | 59 | | *** | | |
| | (0.6) | (2.7) | (1.6) | (2.2) | (3.2) | | | | |
| **Family characteristics** | | | | | | | | | |
| Non-maternal income* (in pounds) | 454.27 | 409.01 | 494.36 | 517.64 | 766.54 | *** | *** | *** | *** |
| | (12.6) | (44.1) | (28.4) | (60.4) | (63.0) | | | | |
| Maternal income (in pounds) | 63.05 | 260.40 | 207.87 | 260.76 | 509.64 | *** | *** | *** | *** |
| | (2.7) | (18.8) | (8.9) | (18.2) | (44.8) | | | | |
| Family below poverty line (%) | 55.1 | 39.3 | 36.2 | 36.1 | 14 | *** | *** | *** | *** |
| | (0.6) | (2.7) | (1.6) | (2.1) | (1.9) | | | | |
| Number of people in household | 4.91 | 4.88 | 4.91 | 4.48 | 4.41 | | | *** | *** |
| Home Observation Measurement of the Environment Score | 14.24 | 14.65 | 14.94 | 14.93 | 15.95 | ** | *** | *** | *** |
| | (0.04) | (0.18) | (0.11) | (0.15) | (0.2) | | | | |
| Mother-child interaction | 4.85 | 4.71 | 4.68 | 4.87 | 4.97 | ** | *** | | |
| | (0.01) | (0.06) | (0.04) | (0.05) | (0.06) | | | | |

Notes: The reference category in Columns (1), (2), (3) and (4) is maternal care. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis. * Non-maternal income means household income minus maternal income during the same period.

Table 5.2 shows that children who experienced some type of non-maternal care 6-12 months after childbirth achieved higher TEPSI and PPVT cognitive scores (between 18% and 24% of a standard deviation higher) compared to children who only experienced maternal care during the same period. In addition, the former group of children present fewer socio-emotional behavioural problems than children who stayed at home with their mothers. Row (A) in Table 5.2 shows OLS regressions of child standardised cognitive and socio-emotional tests on a binary variable that equals one if the child attended non-maternal care 6-12 months after childbirth and zero if they stayed with their mothers during the whole period.

**Table 5.2. Differences in cognitive and socio-emotional outcomes for children aged 24 to 48 months old who attended different types of non-maternal care during their first year of life.**

| | Cognitive outcomes | | Socio-emotional outcomes |
|---|---|---|---|
| | TEPSI | PPVT | CBCL |
| | (1) | (2) | (3) |
| (A) All Non-maternal care first year | 0.189*** | 0.241*** | -0.174*** |
| | (0.026) | (0.032) | (0.028) |
| Observations | 7,487 | 5,615 | 7,558 |
| (B) Relative care | 0.078 | 0.127 | 0.032 |
| | (0.061) | (0.071) | (0.061) |
| (C) Grandparent care | 0.210*** | 0.237*** | -0.125*** |
| | (0.033) | (0.041) | (0.035) |
| (D) Centre-based care | 0.207*** | 0.225*** | -0.130** |
| | (0.049) | (0.063) | (0.052) |
| (E) Non-relative care | 0.224*** | 0.415*** | -0.590*** |
| | (0.064) | (0.089) | (0.070) |
| Observations | 7,482 | 5,611 | 7,553 |

Notes: The dependent variable in columns (1) and (2) is the cognitive tests score (TEPSI and PPVT) and in column (3), the CBCL socio-emotional test score. The reference category in rows (A), (B) (C), (D) and (E) is maternal care during 6-12 months (first year of life). I converted children's outcomes into Z scores. All OLS regressions control for children's age. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

Is the sign and magnitude of the previous association homogeneous for all types of care? The positive association between non-maternal care during the child's first year and child cognitive outcomes measured by the TEPSI test seems to be driven by all types of non-maternal care except relative care (see Table 5.2). In the socio-emotional domain, the positive association between non-maternal care and child outcomes is observed in grandparent care and non-relative care.

In the next section, I explore whether controlling for an extensive set of control variables modifies the association between non-maternal care and child development with respect to the analyses with no controls in Table 5.2.

### *5.4.2. Association between non-maternal care during the first year and child cognitive and socio-emotional development*

In this subsection I aim to address my first research question: whether there is any association between non-maternal care (versus maternal care) received by a child during her first year of life and child development.

Child cognitive outcomes: children's first year

Table 5.3 shows regression and propensity score models where the dependent variable is child cognitive performance (measured by the TEPSI and PPVT tests). In these regressions, I classify children as having experienced non-maternal care if this was their main mode of care 6 to 12 months after childbirth. I also run PSM analyses estimating the average treatment effect for the treated ("ATT") where the dependent variable is cognitive performance measured by the TEPSI and PPVT tests.

**Table 5.3. Association between non-maternal care during the child's first year of life and child cognitive development at age 24 to 48 months old**

| | TEPSI | | | | | | | | PPVT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | | Coordination | | Language | | Motor | | Total | |
| | OLS | PSM | OLS | PSM | OLS | PSM | OLS | PSM | OLS | PSM |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Non-maternal care first year | -0.033 | -0.085** | -0.026 | -0.078* | -0.060 | -0.112** | 0.009 | -0.011 | -0.084 | -0.032 |
| | (0.048) | (0.043) | (0.052) | (0.044) | (0.054) | (0.046) | (0.051) | (0.045) | (0.055) | (0.035) |
| Obs. | 5,946 | 5,946 | 5,946 | 5,946 | 5,968 | 5,968 | 5,946 | 5,946 | 4,651 | 4,651 |

Notes: The dependent variable in columns (1) through (8) is the TEPSI (cognitive) test score and in columns (9) and (10), the PPVT (cognitive) test score. The reference category is maternal care during the first year of life (between 6-12 months). PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates were included in all OLS regressions and PSM analyses. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

There is a negative association between non-maternal care and child cognitive development.[49] After controlling for all covariates (child, maternal, and family characteristics), attending exclusive non-maternal care during the first year is associated with lower child cognitive development. This association is significantly different from zero in three out of four domains according to the TEPSI test. Children in non-maternal care during their first year of life scored lower in the TEPSI total score, coordination score, and in language (9, 8, and 11 per cent of a standard deviation respectively) compared to children who stayed with their mother (see columns (2), (4) and (6) in Table 5.3). Finally, there is no association between non-maternal care at 6-12 months old and child cognitive development measured by the PPVT test. Although the OLS analysis shows that the previously described association is negative, this association is not significant. However according to the PSM analysis, this association is significant. Hence, I interpret this as the OLS estimator suffering from misspecification bias. While in the PSM analyses I calculate the average treat effect on the treated (ATT), OLS recovers the average treatment effect parameter. Therefore, while the ATT in PSM only analyses the effect of the treatment on the treated population (those children who experienced non-maternal care in each specific period), OLS analyses the effect of the treatment on treated and control subjects (those children who experienced non-maternal and maternal care during each period). Hence, another reason why the results could differ across methods is because the sample considered is different.

Child socio-emotional outcomes: children's first year

Attendance at non-maternal care 6-12 months after childbirth is not associated with more socio-emotional problems relative to children who stayed with their mothers (see Table 5.4). Although the analyses show an association with fewer socio-emotional problems, the results are not statistically significant.

[49] This negative association between non-maternal care and child cognitive development overturns the raw scores results.

**Table 5.4. Association between non-maternal care during the child's first year of life and child socio-emotional outcomes at age 24 to 48 months old**

| | CBCL Total | | CBCL Externalizing Problems | | CBCL Internalizing problems | |
|---|---|---|---|---|---|---|
| | OLS<br>(1) | PSM<br>(2) | OLS<br>(3) | PSM<br>(4) | OLS<br>(5) | PSM<br>(6) |
| Non-maternal care during the first year | -0.006<br>(0.046) | -0.030<br>(0.034) | 0.003<br>(0.049) | -0.035<br>(0.032) | -0.011<br>(0.045) | -0.046<br>(0.033) |
| Observations | 6,005 | 6,005 | 6,005 | 6,005 | 6,005 | 6,005 |

Notes: The dependent variable in columns (1) through (6) is the CBCL (socio-emotional) test score. The reference category) is maternal care during the first year of life (between 6-12 months). PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates were included in all OLS regressions and PSM analyses. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

In sum, controlling for all usual covariates, children who experienced early non-maternal care present lower cognitive development relative to children who only experienced maternal care. This association is significant in two out of the three sub-areas measured by the TEPSI test, but is not statistically significant in the PPVT measure. On the other hand, children who attended non-maternal care (relative to maternal care) during the first year do not present an association with more socio-emotional problems.

In the next subsection I explore whether the association between non-maternal care and child development is stronger for some sub-groups in the population.

<u>Moderators in the relationship between non-maternal care during first year and child development</u>

I analyse the relevance of some of the moderators in the relationship between non-maternal care and child development highlighted in the literature. In particular, I explore whether family income, maternal education, and family structure are significant moderators between non-maternal (versus maternal) care and child development.

***Moderators in the relation between non-maternal care and child cognitive outcomes***

I find that family structure is a relevant moderator in the association between non-maternal care (compared to maternal care) and child cognitive development. Controlling for child, family, and maternal characteristics, children from a single-parent family who attended non-maternal care during their first year have 14 per cent and 15 per cent of a standard deviation lower cognitive scores measured by the TEPSI's language domain and PPVT tests respectively relative to children who were in maternal care (see row (A) in Table 5.5).

In addition, there is heterogeneity along family structure in the association between non-maternal care during the first year and child development. This is because the coefficient on the interaction between early non-maternal care and two-parent family is significant (see row (C) in Table 5.5). The association between early non-maternal care and child cognitive development is negative for children in single-parent and in two-parent families; however, the effect is worse for children living in single-parent families relative to children living in two-parent families (especially in language and vocabulary skills).

Finally, maternal education and family income are not relevant moderators in the association between non-maternal care (compared to maternal care) and child cognitive development (see Appendix 5.1 and Appendix 5.2). This is because the coefficients on the interaction between the binary variable indicating whether the child attended non-maternal care and the described potential moderators are not statistically significant.

**Table 5.5. Association between non-maternal care and child cognitive skills mediated by family structure (one versus two-parent household)**

| | TEPSI | | | | PPVT |
|---|---|---|---|---|---|
| | (1) Total | (2) Coordination | (3) Language | (4) Motor | (5) Total |
| (A) Non-maternal care during first year | -0.093 | -0.052 | -0.138** | -0.036 | -0.153** |
| | (0.060) | (0.062) | (0.062) | (0.066) | (0.068) |
| (B) Two- parent family | -0.0006 | 0.015 | -0.006 | -0.007 | 0.068* |
| | (0.034) | (0.035) | (0.035) | (0.035) | (0.037) |
| (C) Non-maternal care during first year x Two-parent family | 0.093 | 0.040 | 0.119** | 0.068 | 0.108* |
| | (0.057) | (0.059) | (0.059) | (0.061) | (0.064) |
| Observations | 5,946 | 5,946 | 5,968 | 5,946 | 4,651 |
| R-squared | 0.167 | 0.116 | 0.172 | 0.105 | 0.168 |

Notes: Columns (1) through (5) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and the family structure reference category is one-parent family. Two-parent family mothers living with their partner (married or cohabiting). Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

***Moderators in the association between non-maternal care and child socio-emotional outcomes***

Controlling for child, family, and maternal characteristics, I find that maternal education, family income, and family structure are not relevant moderators in the association between non-maternal care (relative to maternal care) and child socio-emotional development (see Appendix.5.3, Appendix 5.4 and Appendix 5.5).

In sum, I find that child vulnerability—proxied by the variable 'family structure'—is a relevant moderator in the association between non-maternal care and child cognitive development but is not a relevant moderator in the association between non-maternal care and child socio-emotional development. I find that early maternal care is negatively associated with child cognitive development both in single and two-parent families but that the magnitude of this association is larger for children in single-parent families. In contrast, maternal education and family income are not relevant moderators in the association between early non-maternal care and child socio-emotional development.

*5.4.3. Type of non-maternal care and child cognitive and socio-emotional development*

There is a negative association between early non-maternal care and child cognitive development and a non-significant association between early non-maternal care and child socio-emotional development. To better understand the previous findings I allow the different specific types of non-maternal care to have heterogeneous effects on child development.

<u>Child cognitive outcomes by type of non-maternal care: children's first year</u>

Table 5.6 shows regression and propensity score models where the dependent variable is cognitive performance (measured by the TEPSI and PPVT tests). I find that the different types of non-maternal care 6–12 months after childbirth have different magnitudes of

association with child cognitive development compared to children in exclusive maternal care. Therefore, who cares after children during the first year of life, matters.

Although most of the literature aggregates care provided by any family member (e.g. aunts and grandparents) into relative care, in my analysis I allow the effect of relative care to vary for grandparents and other relatives (mainly aunts). This decision is driven by the fact that in Chile aunts who care for their nieces and nephews frequently also care for their own children, so the adult-child ratio is lower than in grandparent care. On the other hand, aunts are generally younger and have more years of education than grandparents have.

I find that the association between relative care—mainly aunts—versus maternal care and child cognitive development is negative. Controlling for the usual set of covariates, children in relative care at 6–12 months after childbirth perform lower in cognitive outcomes than children in maternal care. Children who attended relative care at 6–12 months after childbirth perform 24 per cent of a standard deviation lower in the TEPSI (cognitive) test relative to children in exclusive maternal care (see column (2) in Table 5.6). Specifically, children who attended relative care during the first year of life exhibited lower coordination and motor skills and coordination skills at 24 to 48 months old relative to children who attended maternal care (see columns (2) and (4) in Appendix 5.6.). This negative association is also observed when measured by the PPVT test: children who attended relative care during the first year of life present less vocabulary skills relative to children who attended maternal care at the same age (see column (5) in Appendix 5.6).

While the OLS model shows a negative but not statistically significant association between attendance at relative care 6 to 12 months after childbirth and child cognitive skills, the PSM model shows a negative and statistically significant association between the same two variables. There are at least two reasons why the results of the ATT in PSM and OLS may differ. First, the difference in the coefficients' significance may be due to the fact that PSM and OLS models consider different samples. As explained in the notes of the relevant tables, the sample size in PSM analyses comprises only the analysed category (each type of care) and the control category (children whose mother did not engage in early maternal employment). By contrast, the sample size in the OLS analyses comprises all categories of type of care in all regressions. To test whether the difference between the PSM and OLS estimates were due to differences in samples, I run my OLS models restricting the sample to the one in the PSM models. When doing this, the results did not change (see Appendix

5.11). Second, as explained in Chapter 3, I chose to calculate PSM's ATT parameter. This focuses the analysis on the treated population (each specific type of non-maternal care). By contrast, OLS focuses on the effect of the treatment on both the treated and control (children in exclusive maternal care) population. It is plausible that the association between type of care and child development varies across the groups in different types of care. For example, children that are cared after by their relatives could be more vulnerable than children in exclusive maternal care in unobservable characteristics such as the emphasis of mothers on stimulating their child. If this were the case, this would be a reason for discrepancy in the coefficients of PSM's ATT and OLS models.

Controlling for the usual set of covariates, children who experience early grandparent care during the first year after childbirth exhibit higher cognitive development than children who stayed in maternal care during the same period. The previous difference is 14 per cent of a standard deviation in the TEPSI test—see column (2) in Table 5.6. In addition, the association between early grandparent care (relative to exclusive maternal care) and cognitive development is driven by the TEPSI test's language domain (30 per cent of one standard deviation) (see Appendix 5.6.). This positive association between grandparent care and child cognitive outcomes is also measured by the PPVT (see column (4) in Table 5.6).

In addition, there is a negative association between children attending non-relative care 6–12 months after childbirth and child cognitive development. Controlling for the usual set of covariates, attendance at non-relative care 6–12 months after childbirth is negatively associated with general cognitive development according to the TEPSI total score and PPVT score (see row (D), column (2) and (4) in Table 5.6 .

Finally, controlling for all usual covariates, attendance at centre-based care shows a positive association with cognitive performance—measured by the TEPSI and PPVT tests—relative to exclusive maternal care. Underlying the previous result is the fact that children who attended centre-based care show a higher score in all sub-areas of the TEPSI test (see Appendix 5.6.). In addition, children who attended centre-based care 6–12 months after childbirth performed higher in vocabulary skills measured by the PPVT test compared to children in maternal care (39 per cent of a standard deviation; see column (4), row C in Table 5.6).

**Table 5.6. The association between type of non-maternal care 6–12 months after childbirth and child cognitive outcomes at age 24 to 48 months old**

| | TEPSI Total | | PPVT | |
|---|---|---|---|---|
| Type of care | OLS (1) | PSM (2) | OLS (3) | PSM (4) |
| (A) Relative care | -0.029 | -0.240** | -0.162 | -0.577*** |
| | (0.104) | (0.094) | (0.118) | (0.122) |
| Observations | 5,941 | 4,615 | 4,459 | 3,589 |
| (B) Grandparent care | 0.040 | 0.135*** | -0.069 | 0.183*** |
| | (0.064) | (0.041) | (0.074) | (0.053) |
| Observations | 5,941 | 5,141 | 4,459 | 3,993 |
| (C) Centre-based care | -0.107 | 0.255*** | 0.035 | 0.390*** |
| | (0.083) | (0.072) | (0.099) | (0.124) |
| Observations | 5,941 | 4,761 | 4,459 | 3,706 |
| (D) Non-relative care | -0.425*** | -0.523*** | -0.274 | -0.210*** |
| | (0.134) | (0.070) | (0.171) | (0.104) |
| Observations | 5,941 | 4,606 | 4,459 | 3,590 |

Notes: The dependent variable in columns (1) and (2) is the TEPSI test score and in columns (3) and (4), the PPVT test score. The type-of-care reference category is maternal care between 6-12 months. PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates are included in all OLS regressions and PSM analyses. The sample size in PSM comprises only the treated (each specific period of maternal employment initiation) and control (children whose mother did not engage in early maternal employment) subjects. By contrast, the sample size in OLS comprises all categories (all timings of early maternal employment initiation) in all regressions. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score).

Child socio-emotional outcomes by type of early non-maternal care

This subsection explores whether the type of non-maternal care that the child attended makes a difference in their socio-emotional development. The results in Table 5.7 show that, controlling for child, maternal, and family characteristics and running PSM-ATT analyses, being cared by a relative is associated with socio-emotional problems relative to children in exclusive maternal care. Children who attended relative care present 39 per cent of a standard deviation (at a significance level of 1 per cent) more socio-emotional problems relative to children in exclusive maternal care (see column (2), row (A) in Table 5.7). In addition, children in early non-relative care also have more socio-emotional, externalising and internalising problems (24, 10 and 33 per cent of a standard deviation respectively) relative to children in maternal care (see row D in Table 5.7). The results from the OLS and PSM models are not consistent. To explore whether these differences are driven by the fact that OLS considers all types of care in one single regression (as opposed to PSM where I must run different analyses for the different types of care), I run the OLS models using the PSM one-to-one type of care comparison. However, the difference in the coefficients of PSM and OLS was robust to this test (see Appendix 5.12)

By contrast, children who experienced early centre-based care (6–12 months after childbirth) exhibited 22 per cent of a standard deviation fewer externalising problems measured by the CBCL test relative to children who remained in exclusive maternal care (see row C, column (4) in Table 5.7). Finally, the association between attendance at grandparent care at 6–12 months old (relative to exclusive maternal care) and child socio-emotional outcomes is not statistically significant.

**Table 5.7. Association between type of non-maternal care 6–12 months after childbirth and child socio-emotional outcomes at age 24 to 48 months old**

| | CBCL Total | | CBCL Externalising problems | | CBCL Internalising problems | |
|---|---|---|---|---|---|---|
| Type of care | OLS (1) | PSM (2) | OLS (3) | PSM (4) | OLS (5) | PSM (6) |
| (A) Relative care | 0.005 | 0.389*** | 0.029 | 0.040 | -0.054 | -0.051 |
| | (0.094) | (0.098) | (0.100) | (0.058) | (0.095) | (0.050) |
| Observations | 6,000 | 4,663 | 6,000 | 4,663 | 6,000 | 4,663 |
| (B) Grandparent care | 0.015 | -0.028 | 0.031 | -0.024 | 0.029 | 0.049 |
| | (0.064) | (0.082) | (0.067) | (0.081) | (0.064) | (0.067) |
| Observations | 6,000 | 5,191 | 6,000 | 5,191 | 6,000 | 5,191 |
| (C) Centre-based care | -0.030 | -0.089 | 0.032 | -0.223** | -0.041 | 0.011 |
| | (0.079) | (0.080) | (0.084) | (0.073) | (0.078) | (0.069) |
| Observations | 6,000 | 4,807 | 6,000 | 4,807 | 6,000 | 4,807 |
| (D) Non-relative care | -0.034 | 0.241*** | -0.061 | 0.098 | -0.085 | 0.325*** |
| | (0.124) | (0.074) | (0.122) | (0.058) | (0.139) | (0.139) |
| Observations | 6,000 | 4,653 | 6,000 | 4,653 | 6,000 | 4,653 |

Notes: The dependent variable in columns (1) through (6) is the CBCL (socio-emotional) test score. The reference category) is maternal care during the first year of life (between 6-12 months). PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates were included in all OLS regressions and PSM analyses. The sample size in PSM comprises only the treated (each specific period of maternal employment initiation) and control (children whose mother did not engage in early maternal employment) subjects. By contrast, the sample size in OLS comprises all categories (all timings of early maternal employment initiation) in all regressions. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score).*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

In the next section, I explore whether the association between type of care and child development is stronger for some sub-groups.

### *5.4.4. Moderators in the association between type of care and child cognitive and socio-emotional development*

In this subsection, I analyse the moderators between type of care and child development that have been highlighted in the literature and that were analysed in subsection 5.2.3: maternal education, family income, and family structure (one or two-parent families).

Moderators between type of care and child cognitive outcomes

There is some evidence that family income, maternal education, and family structure are relevant moderators in the association between type of care 6–12 months after childbirth and child cognitive outcomes. First, maternal education moderates the relation between type of care and child cognitive development. Attendance at centre-based care (relative to exclusive maternal care) for children whose mothers have less education is more negatively associated with child coordination skills and vocabulary relative to the same association for children whose mothers have more education (see row (H), columns (2) and (5) in Table 5.8).

**Table 5.8. Association between of non-maternal care 6–12 months after childbirth and child cognitive skills mediated by maternal education**

| | TEPSI Total (1) | TEPSI Coordination (2) | TEPSI Language (3) | TEPSI motor (4) | PPVT test (5) |
|---|---|---|---|---|---|
| (A) Relative Care | -0.031 | 0.052 | -0.068 | -0.046 | -0.135 |
| | (0.110) | (0.119) | (0.113) | (0.120) | (0.129) |
| (B) Grandparent care | 0.021 | 0.022 | -0.004 | 0.069 | -0.080 |
| | (0.066) | (0.071) | (0.069) | (0.069) | (0.078) |
| (C) Centre-based care | -0.085 | -0.006 | -0.134 | -0.073 | 0.083 |
| | (0.084) | (0.091) | (0.084) | (0.090) | (0.103) |
| (D) Non-relative care | -0.422*** | -0.531*** | -0.340** | -0.314** | -0.268 |
| | (0.135) | (0.159) | (0.139) | (0.137) | (0.172) |
| (E) Low maternal education | -0.235 | -0.413* | -0.198 | 0.049 | -0.134 |
| | (0.220) | (0.242) | (0.203) | (0.234) | (0.232) |
| (F) Relative Care × Low maternal education | 0.011 | -0.097 | 0.076 | -0.034 | -0.081 |
| | (0.151) | (0.147) | (0.154) | (0.162) | (0.149) |
| (G) Grandparent care× Low maternal education | 0.102 | 0.093 | 0.098 | 0.063 | 0.069 |
| | (0.095) | (0.096) | (0.098) | (0.109) | (0.097) |
| (H) Centre-based care × Low maternal education | -0.159 | -0.263** | -0.069 | -0.056 | -0.297** |
| | (0.120) | (0.114) | (0.133) | (0.131) | (0.126) |
| (I) Non-relative care × Low maternal education | -0.004 | 0.127 | -0.103 | 0.057 | 0.010 |
| | (0.202) | (0.218) | (0.208) | (0.166) | (0.234) |
| Observations | 5,941 | 5,941 | 5,963 | 5,941 | 4,648 |
| R-squared | 0.173 | 0.125 | 0.175 | 0.109 | 0.172 |

Notes: Columns (1) and (2) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type-of-care reference category is maternal care and maternal-education reference category is high maternal education. Low maternal education means mothers with high school degree or less. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Second, family income moderates the relation between type of care and child cognitive development. Attendance at centre-based care (relative to maternal care) for children from poor households is more negatively associated with child coordination skills relative to the same association for children from wealthier households (19 per cent of one standard deviation respectively at a significance level of only 10 per cent; see row (H), column (2) in Table 5.9). In addition, attendance at non-relative care (relative to maternal care) for children from poor households is more negatively associated with child cognitive outcomes in general and language skills (both measured by the TEPSI test) relative to the same association for children from wealthier households.

**Table 5.9. Association between type of care 6–12 months after childbirth and child cognitive skills mediated by household poverty**

| | TEPSI Total (1) | TEPSI Coordination (2) | TEPSI Language (3) | TEPSI Motor (4) | PPVT test (5) |
|---|---|---|---|---|---|
| (A) Relative Care | -0.048 | 0.018 | -0.055 | -0.099 | -0.182 |
| | (0.113) | (0.125) | (0.116) | (0.127) | (0.132) |
| (B) Grandparent care | 0.007 | 0.020 | -0.015 | 0.052 | -0.072 |
| | (0.070) | (0.075) | (0.073) | (0.072) | (0.080) |
| (C) Centre-based care | -0.063 | 0.010 | -0.107 | -0.055 | 0.083 |
| | (0.090) | (0.096) | (0.089) | (0.096) | (0.111) |
| (D) Non-relative care | -0.365*** | -0.485*** | -0.268* | -0.294** | -0.257 |
| | (0.137) | (0.167) | (0.142) | (0.140) | (0.177) |
| (E) Poor household | -0.037 | -0.025 | -0.038 | -0.031 | -0.080** |
| | (0.029) | (0.032) | (0.030) | (0.031) | (0.033) |
| (F) Relative Care × Poor household | 0.043 | 0.013 | 0.007 | 0.110 | 0.036 |
| | (0.137) | (0.138) | (0.140) | (0.140) | (0.154) |
| (G) Grandparent care× Poor household | 0.099 | 0.055 | 0.091 | 0.084 | 0.009 |
| | (0.076) | (0.079) | (0.079) | (0.085) | (0.087) |
| (H) Centre-based care × Poor household | -0.155 | -0.190* | -0.118 | -0.097 | -0.181 |
| | (0.099) | (0.104) | (0.105) | (0.107) | (0.111) |
| (I) Non-relative care × Poor household | -0.339* | -0.219 | -0.467*** | -0.094 | -0.058 |
| | (0.185) | (0.175) | (0.179) | (0.194) | (0.191) |
| Observations | 5,941 | 5,941 | 5,963 | 5,941 | 4,648 |
| R-squared | 0.174 | 0.125 | 0.177 | 0.11 | 0.173 |

Notes: Columns (1) and (2) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and the family's income reference category is non-poor households. Poor family means households with per capita income below the Chilean poverty line (100 pounds per capita per month or 72.000 Chilean pesos). Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score).. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Finally, attendance at centre-based (relative to exclusive maternal care) for children from two-parent families is more positively associated with child language skills and vocabulary relative to the same association for children from single-parent households (18 and 26 per cent of one standard deviation respectively at a significance level of 10 and 5 per cent respectively) (see row (H), columns (3) and (5) in Table 5.10).

**Table 5.10. Association between of non-maternal care 6–12 months after childbirth and child cognitive skills mediated by family structure**

| | TEPSI Total | TEPSI Coordination | TEPSI Language | TEPSI Motor | PPVT test |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| (A) Relative care | -0.139 | -0.008 | -0.203 | -0.184 | -0.287 |
| | (0.164 | (0.157) | (0.166) | (0.172) | (0.184) |
| (B) Grandparent care | 0.024 | 0.027 | -0.019 | 0.091 | -0.076 |
| | (0.076) | (0.080) | (0.080) | (0.081) | (0.090) |
| (C) Centre-based care | -0.201* | -0.080 | -0.260*** | -0.135 | -0.135 |
| | (0.104) | (0.108) | (0.101) | (0.113) | (0.111) |
| (D) Non-relative care | -0.571*** | -0.572*** | -0.504*** | -0.478** | -0.344* |
| | (0.176) | (0.168) | (0.181) | (0.187) | (0.184) |
| (E) Two-parent family | 0.004 | 0.021 | -0.006 | -0.001 | 0.075** |
| | (0.034) | (0.034) | (0.035) | (0.035) | (0.037) |
| (F) Relative Care × Two-parent family | 0.153 | 0.046 | 0.214 | 0.181 | 0.171 |
| | (0.163) | (0.156) | (0.163) | (0.168) | (0.175) |
| (G) Grandparent care× Two-parent family | 0.030 | 0.018 | 0.061 | -0.013 | 0.013 |
| | (0.072) | (0.075) | (0.076) | (0.080) | (0.087) |
| (H) Centre-based care × Two-parent family | 0.140 | 0.052 | 0.178* | 0.081 | 0.258** |
| | (0.100) | (0.104) | (0.099) | (0.109) | (0.108) |
| (I) Non-relative care × Two-parent family | 0.196 | 0.061 | 0.213 | 0.221 | 0.103 |
| | (0.160) | (0.148) | (0.163) | (0.176) | (0.162) |
| Observations | 5,941 | 5,941 | 5,963 | 5,941 | 4,648 |
| R-squared | 0.173 | 0.124 | 0.176 | 0.110 | 0.172 |

Notes: Columns (1) and (2) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and the family's structure reference category is single parent. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In sum, the association between attendance at centre-based care 6 to 12 months after childbirth and cognitive development is more positive for children from two-parent families relative to the same association for children from single-parent families. In addition, attendance at centre-based care is more negative in cognitive terms for children from poor households and with low maternal education relative to the same association for children from non-poor households and maternal high education respectively.

<u>Moderators between type of care and child socio-emotional outcomes</u>

Maternal education, household income, and family structure moderate the association between type of care and child socio-emotional development. Controlling for the usual set of covariates, being cared for by a non-relative was associated with more socio-emotional problems according to the CBCL test in children of mothers with low levels of education relative to the same association for children of mothers with high levels of education (see row (I) columns (1), (2) and (3) in Table 5.11).

**Table 5.11. Association between non-maternal care 6–12 months after childbirth and child socio-emotional development mediated by maternal education**

| Types of care | CBCL Total (1) | Externalizing problems (2) | Internalizing problems (3) |
|---|---|---|---|
| (A) Relative care | 0.006 | 0.031 | -0.069 |
| | (0.103) | (0.107) | (0.102) |
| (B) Grandparent care | 0.031 | 0.053 | 0.031 |
| | (0.065) | (0.069) | (0.066) |
| (C) Centre-based care | -0.023 | 0.033 | -0.030 |
| | (0.082) | (0.086) | (0.081) |
| (D) Non-relative care | -0.066 | -0.092 | -0.110 |
| | (0.125) | (0.124) | (0.139) |
| (E) Low maternal education | 0.082 | 0.023 | 0.155 |
| | (0.216) | (0.238) | (0.229) |
| (F) Relative care × Low maternal education | -0.006 | -0.016 | 0.059 |
| | (0.150) | (0.156) | (0.148) |
| (G) Grandparent care× Low maternal education | -0.096 | -0.124 | -0.024 |
| | (0.096) | (0.095) | (0.096) |
| (H) Centre-based care × Low maternal education | -0.056 | -0.020 | -0.087 |
| | (0.134) | (0.136) | (0.130) |
| (I) Non-relative care × Low maternal education | 0.495** | 0.488*** | 0.386* |
| | (0.206) | (0.187) | (0.199) |
| Observations | 6,000 | 6,000 | 6,000 |
| R-squared | 0.222 | 0.176 | 0.196 |

Notes: Columns (1) and (2) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type-of-care reference category is maternal care and maternal-education reference category is high maternal education. Low maternal education means mothers with high school degree or less Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

On the other hand, attendance at relative care is associated with fewer socio-emotional problems (27 per cent of a standard deviation in externalising problems respectively) for children living in poor households relative to the same association for children living in wealthier households (see row (F), column (2) in Table 5.12).

**Table 5.12. Association between of non-maternal care 6–12 months after childbirth and child cognitive skills mediated by household poverty**

| | CBCL Total<br>(1) | CBCL externalizing problems<br>(2) | CBCL internalizing problems<br>(3) |
|---|---|---|---|
| (A) Relative care | 0.063<br>(0.110) | 0.136<br>(0.116) | -0.008<br>(0.110) |
| (B) Grandparent care | 0.008<br>(0.069) | 0.032<br>(0.071) | 0.016<br>(0.070) |
| (C) Centre-based care | -0.040<br>(0.085) | -0.020<br>(0.087) | 0.005<br>(0.084) |
| (D) Non-relative care | -0.077<br>(0.133) | -0.108<br>(0.131) | -0.088<br>(0.145) |
| (E) Poor household | 0.008<br>(0.029) | 0.009<br>(0.030) | 0.016<br>(0.029) |
| (F) Relative care × Poor household | -0.143<br>(0.140) | -0.266*<br>(0.140) | -0.114<br>(0.136) |
| (G) Grandparent care× Poor household | 0.021<br>(0.075) | 0.0001<br>(0.079) | 0.041<br>(0.075) |
| (H) Centre-based care × Poor household | 0.029<br>(0.105) | 0.174<br>(0.110) | -0.150<br>(0.104) |
| (I) Non-relative care × Poor household | 0.271<br>(0.181) | 0.272<br>(0.172) | 0.063<br>(0.189) |
| Observations | 6,000 | 6,000 | 6,000 |
| R-squared | 0.222 | 0.176 | 0.195 |

Notes: Columns (1) and (2) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and the family's income reference category is non-poor households. Poor family means households with per capita income below the Chilean poverty line (70 pounds per capita per month or 64,000 Chilean pesos). Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, being cared for either a relative or a non-relative is associated with fewer socio-emotional problems. Being cared by a relative is associated with 24 per cent of a standard deviation fewer externalising problems respectively for children living in two-parent families relative to the same association for children living in single-parent families (see row F, column (2) in Table 5.13). In addition, being cared by a non-relative care is associated with fewer socio-emotional problems (34, 30, and 37 per cent of a standard deviation in general socio-emotional problems, externalising and internalising problems respectively) for children living in two-parent families relative to the same association for children living in single-parent families (see row (I), columns (1), (2) and (3) in Table 5.13).

**Table 5.13. Association between non-maternal care 6–12 months after childbirth and child socio-emotional skills moderated by family structure**

| | CBCL Total(1) | CBCL externalizing problems (2) | CBCL internalizing problems (3) |
|---|---|---|---|
| (A) Relative care | 0.136 | 0.200 | 0.032 |
| | (0.130) | (0.135) | (0.135) |
| (B) Grandparent care | -0.027 | -0.020 | 0.031 |
| | (0.076) | (0.080) | (0.075) |
| (C) Centre-based care | -0.037 | 0.031 | -0.065 |
| | (0.108) | (0.113) | (0.104) |
| (D) Non-relative care | 0.226 | 0.173 | 0.198 |
| | (0.151) | (0.152) | (0.167) |
| (E) Two-parent family | -0.067** | -0.056* | -0.059* |
| | (0.033) | (0.033) | (0.033) |
| (F) Relative Care × Two-parent family | -0.184 | -0.238* | -0.122 |
| | (0.134) | (0.138) | (0.135) |
| (G) Grandparent care× Two-parent family | 0.067 | 0.081 | -0.008 |
| | (0.072) | (0.075) | (0.073) |
| (H) Centre-based care × Two-parent family | 0.013 | 0.004 | 0.038 |
| | (0.099) | (0.104) | (0.098) |
| (I) Non-relative care × Two-parent family | -0.335** | -0.299** | -0.366*** |
| | (0.132) | (0.143) | (0.141) |
| Observations | 6,000 | 6,000 | 6,000 |
| R-squared | 0.222 | 0.176 | 0.196 |

Notes: Columns (1) and (2) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and family's structure reference category is single parent. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In sum, the association between being cared for by a relative and non-relative 6 to 12 months after childbirth and socio-emotional development is more positive for children from two-parent families than children from single-parent families. In addition, being care for by a relative is more positive for children from poor households than for children from non-poor households. In addition, being cared for by a non-relative is more negative for children whose mothers have low levels of education than for children whose mothers have higher levels of education.

In conclusion, I find that more vulnerable children (those from poor households and with mothers with low levels of education) benefit less in cognitive terms from centre-based care compared to less vulnerable children (from wealthier households and with mothers with higher levels of education). In addition, being cared for by a non-relative care for children of mothers with low levels of education is associated with more socio-emotional problems. By contrast, children from two-parent families benefit more from centre-based care in cognitive terms and from relative and non-relative care in socio-emotional terms relative to children from single-parent families.

*5.4.5. Robustness analysis*

One of the limitations of the ELPI 2010 and 2012 waves is that they do not contain household income before the child's birth. Given that household income could be correlated with both the key variables (childcare arrangements) and the outcome variables (child outcomes), I should control for household income in all my regressions. As I mention in section 5.3.1. the ELPI 2010 wave asked for maternal income before pregnancy. As a proxy for 'non-maternal income' before pregnancy (the other component of household income that is not maternal income), I use non-maternal income at the time of the survey in 2010. The latter variable is a good proxy for the former one under the assumption that non-maternal income (which is equal to paternal income in most cases) is relatively stable before and after childbirth. To calculate non-maternal income for the 2010 ELPI survey I subtract household income at the 2010 survey minus maternal income during the same period.

To test the robustness of my results, I run all my PSM models three times. Firstly, without any of the two previously mentioned income variables (this is, pre-birth maternal income and the 2010 non-maternal income) as covariates. Secondly, including only pre-birth maternal income as a covariate. Thirdly, including both pre-birth maternal income and non-maternal income at the 2010 survey as covariates. The results in these three different specifications are consistent. For the output of these three specifications, see Appendix 5.7 through Appendix 5.10.

## 5.5. Summary, conclusions and discussion

Given the increasing participation of women in the labour market, the question about the effect of early (first year after childbirth) non-maternal childcare on child development is more crucial than ever. Moreover, the previous evidence about this relation in developed countries is not conclusive. One of the aims of this study was to investigate whether non-maternal childcare in infancy (during the first year of life) is associated with child cognitive and socio-emotional outcomes in Chile. In addition, recent evidence indicates that the specific type of care matters in the previously described association (Bernal & Keane, 2011). Hence, I explored the association between each specific type of non-maternal care (relative, grandparent, centre-based, and non-relative care) and child cognitive and socio-emotional development.

I find that experience of early non-maternal care is associated with a negative impact on child cognitive development. This result is driven mainly by an association between non-maternal care and lower coordination and language skills at 24 to 48 months old (8 per cent and 11 per cent of a standard deviation respectively). Only a couple of previous studies explore the association between non-maternal care during the child's first year of life and child development and they conclude that early non-maternal care is not associated with cognitive achievement (Côté et al., 2013; Jaffee et al., 2011). The difference between the results in previous studies and my results could be because the previous studies use different cognitive tests relative to the ones used in this study. In this study, the negative association is measured by the TEPSI test, which measures child psychomotor development. Although there is a negative association measure by the PPVT test it is not statistically significant. Côté et al. (2013) use tests that measure academic skills (Bracken Basic Concept Scale–Revised (BBCS–R)) and cognitive abilities and educational achievements (the British Ability Scale (BAS)). In addition, Jaffee et al. (2011) measure child academic skills (the Peabody Individual Achievement Test (PIAT)).

In addition, I find that experience of non-maternal care is not associated with socio-emotional problems at 24 to 48 months old. This finding is in line with the literature that concludes that early non-maternal care is not associated with child socio-emotional problems (Jaffee et al., 2011; Lekhal, 2012). My findings contribute to the scarce evidence about the association between early non-maternal care and child development.

Looking at different subgroups, children from two-parent families benefit slightly more from non-maternal care during their first year of life in cognitive terms (specifically in language skills) relative to children from single-parent families who also attended early non-maternal care. This is not in line with the evidence that non-maternal care during the first year of life has more beneficial effects for children from disadvantaged backgrounds relative to the same effect for children from more advantaged backgrounds (Côté et al., 2008; Geoffroy et al., 2010). Nevertheless, given that maternal education and household income do not appear to have a moderating role in the association between non-maternal care and cognitive development, more work is needed to better understand whether there is a heterogeneous effect of non-maternal care on child development depending on children's level of disadvantage.

These findings provide a broad picture about the association between attendance at non-maternal care and child development. However, non-maternal care aggregates types of care of different characteristics. To have a more nuanced understanding about the association between non-maternal care and child development, I looked carefully at the association between each specific type of care and child development. When I disaggregate non-maternal care into its different types of care (relative, grandparent, centre-based, and non-relative care), I conclude that the type of care that infants receive matters.

First, attendance at centre-based care shows a positive association with child's cognitive development and child's socio-emotional development.. The previous finding is in line with the effects reported in previous studies that state that centre-based care is positively associated with child cognitive development (Abner, Gordon, Kaestner, & Korenman, 2013; Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007; Sylva et al., 2011). In addition, children who attended centre-based care 6-12 months after childbirth exhibit fewer externalizing problems relative to children who attended exclusive maternal care during the same period. This finding is not in line with the international evidence that usually has found that early non-maternal care increases child socio-emotional problems (Abner et al., 2013; Coley et al., 2013; Gregg et al., 2005; Sylva et al., 2011). My findings are also different from those of Noboa & Urzua (2010) who, using data from Chile, conclude that attendance at centre-based care during infancy has negative effects on children's ability to interact with adults.

Second, children in grandparent care 6–12 months after childbirth present 14 per cent of a standard deviation more cognitive development (measured by the TEPSI total score) relative to children in maternal care at 24 to 48 months old. It is difficult to contrast these results with the literature because there are very few studies that explore the association between grandparent care (versus exclusive maternal care) and child development. In particular, Hansen and Hawkes (2009) find that children in grandparent care at nine months had acquired 19 per cent of a standard deviation more vocabulary three years after childbirth relative to children in centre-based care. In this chapter, I find that children in grandparent care at 6-12 months old have 18 per cent of a standard deviation more vocabulary skills compared to children in maternal care during the same period. However, Hansen and Hawkes (2009)'s finding is significant only for more advantaged groups: children whose mothers are highly educated, who live in two-parent families, whose mothers are older, and those in households not claiming benefits. In the present study, none of these variables are significant moderators in the association between grandparent care and child development. In addition, attendance at grandparent care is not associated with socio-emotional problems at 24 to 48 months old relative to children who experienced only maternal care. This finding is not in line with Hansen and Hawkes (2009) who find that children cared by their grandparents present more socio-emotional problems relative to those in centre-based care.

Third, children in relative care 6–12 months after childbirth performed lower in the cognitive domain both in TEPSI and the PPVT test (cognitive and vocabulary outcomes) relative to children in maternal care during the same period. In addition, there is a tendency that children in relative care present more externalising problems at 24–48 months old relative to children in maternal care. The size of this association is 39 per cent of one standard deviation at a significance level of 1 per cent. Hence, there is some evidence that the association between grandparent care and child development is not the same as the association between relative care and child development. Hence, if suitable data is available, future studies should consider both categories of care separately.

The most popular type of non-maternal care during the first year (between 6-12 months old) after childbirth in ELPI's sample is grandparent care (13%). Despite its widespread use, grandparent care has received little attention in previous studies. This study shows that grandparent care (versus maternal care) during the first year after childbirth is positively associated with child cognitive outcomes and is not associated with child socio-emotional problems.

There are three potential explanations for the positive association between grandparent care and cognitive outcomes. First, the one-to-one interaction with the caregiver could be driving this positive association. A potential explanation for this association is that a higher adult–child ratio may be beneficial for the child's language acquisition process. (However, it is important to note that grandparent care exhibits a positive association with cognitive outcomes measured with the TEPSI test but the association with cognitive outcomes measured with the PPVT test was not statistically significant.) A second explanation is that older people may have better grammar and speak more slowly relative to younger people. This facilitates children's language acquisition (Griffin & Spieler, 2006). Third, grandparent care is given in an environment familiar to the child; this facilitates a warm relationship with the caregiver. The important question that remains open is what the structural differences between relative care and grandparent care that allow for such different results are. One hypothesis is that relative care implies that the relative (for example, an aunt) cares for her own children at the same time, so the care is not as individualised as in grandparent care.

In addition, what might explain these associations between centre-based care and child cognitive and socio-emotional development? On the one hand, this positive association between centre-based care and child cognitive and socio-emotional development could be explained in part by the quality of centre-based care. Dowsett et al. (2008) concludes that centre-based care in USA provides higher quality, more stimulating, and structured care than home settings. Although this may also be applicable to Chilean centre-based care, unfortunately, I cannot explore this hypothesis because the ELPI survey does not have type-of-care quality measures. As I explain in Chapter 2, this is a counterintuitive finding because Chile does not have a monitoring system that measures the quality of centre-based care centres. In addition, the adult–child ratio is high, preschool teachers earn low salaries relative to others professionals with the level of education, and preschool teachers do not improve their scores in teaching knowledge by the time they graduate relative to when they begin their teaching degrees.

Finally, attendance at early centre-based care for children of mothers with low levels of education or from poor households is associated with less cognitive development. This finding is not in line with Peisner-Feinberg et al. (2001) who state that children from disadvantaged backgrounds benefit more from centre-based care than children from more advantaged households.

The finding that children in centre-based care benefit in cognitive and socio-emotional development relative to children in maternal care is extremely relevant for social policy. While centre-based care coverage has experienced an explosive growth in the past years in Chile, the Government is planning further expansions. However, the most vulnerable children who were the main expected beneficiaries of the Chilean centre-based expansion are not the group of children who benefit the most from this type of care. Hence, a better understanding of the quality of centre-based care and the effects of attending at this type of non-maternal care is crucial before pushing Chilean infants into this type of care.

*Strengths and limitations*

To my knowledge, this is the first study that explores the relationship between types of non-maternal care during the first year of life and child outcomes in a middle-income country context. Many Latin American countries are discussing increasing public subsidies to early childhood education. In this context, the question of whether early childhood education could have different effects depending on the age of the child and the type of care is of great importance; this study addresses the previously described knowledge gap.

Future work should explore whether the associations shown in this study are causal. This study uses OLS regressions that deal with selection on observables (maternal, family, and child characteristics) and PSM analyses that are more robust than OLS to misspecification. However, these two methods are not robust to selection on unobservables. Unobservable factors such as parental educational beliefs could influence both the decision to use some type of childcare and child development, biasing my results.

The second wave of the ELPI survey will enable me to use individual fixed effect methods to verify my causal claims. (For more information, please see the next chapter.)

In addition, establishing the mechanisms by which childcare arrangement is linked to child cognitive and socio-emotional development is critical to understanding the nature of the previously stated associations and for proposing welfare-enhancing policies. Specifically, understanding the role of quality and quantity in the relation between type of care and child development is key. Unfortunately, the ELPI dataset does not have a measure of quality or intensity (in terms of hours per week) for any type of non-maternal care. Hence, I cannot test whether the association between type of care and child development is heterogeneous depending on the quality of centre-based care. If appropriate data is available in the future, studies should incorporate the potentially mediating role of quality in the association between type of care and child development.

Finally, this study only analyses the association between type of care during the first year of life and child development. However, this association could differ for the timing of different types of care. In the context of increasing use of non-maternal care, having a more comprehensive picture about the effects of non-maternal care at different ages is highly relevant for early childhood policies.

## 5.6. Appendices

**Appendix 5.0. Pre-treatment covariates and balance t-statistics for children who attended non-maternal care relative to children in maternal care. Dependent variable: TEPSI (cognitive) test**

| Variable | Unmatched Matched | Mean Treated | Control | reduction | %bias bias | t-test bias | p>t |
|---|---|---|---|---|---|---|---|
| Non-maternal care 12-18 months old | U | .91207 | .12729 | | 252.8 | 82 | 0 |
| | M | .91207 | .91271 | -0.2 | 99.9 | -0.06 | 0.949 |
| Non-maternal care 18-24 months old | U | .88768 | .19479 | | 174.1 | 56.09 | 0 |
| | M | .88768 | .91399 | -6.6 | 96.2 | -1.82 | 0.068 |
| Non-maternal care 18-24 months old | U | 1.0469 | .48505 | | 72.9 | 23.47 | 0 |
| | M | 1.0469 | 1.0905 | -5.7 | 92.2 | -1.63 | 0.104 |
| Female | U | .50128 | .48939 | 2.4 | | 0.8 | 0.424 |
| | M | .50128 | .53402 | | -181.8 | -1.83 | 0.068 |
| Have a older sibling | U | .47818 | .5634 | | -17.1 | -5.77 | 0 |
| | M | .47818 | .47433 | 0.8 | 95.5 | 0.22 | 0.83 |
| Child’s age (in months) | U | 1111.1 | 1105.4 | | 2.8 | 0.95 | 0.34 |
| | M | 1111.1 | 1093.5 | 8.7 | -206.2 | 2.45 | 0.014 |
| Child’s age (in months) squared | U | 1.3e+06 | 1.3e+06 | | 2.6 | 0.88 | 0.378 |
| | M | 1.3e+06 | 1.2e+06 | 8.7 | -233.5 | 2.47 | 0.013 |
| Premature | U | .06611 | .07112 | | -2 | -0.66 | 0.508 |
| | M | .06611 | .06033 | 2.3 | -15.3 | 0.66 | 0.508 |
| Low birth weight | U | .03402 | .03616 | | -1.2 | -0.39 | 0.697 |
| | M | .03402 | .03659 | | -21.1 | -0.39 | 0.698 |
| Mother’s age (log) | U | 3.3847 | 3.3609 | | 10 | 3.33 | 0.001 |
| | M | 3.3847 | 3.3833 | 0.6 | 94.0 | 0.17 | 0.863 |
| Married mother | U | .6303 | .74156 | | -24.1 | -8.31 | 0 |
| | M | .6303 | .60719 | 5.0 | 79.2 | 1.33 | 0.184 |
| Without formal education | U | .0353 | .09161 | | -23.2 | -7.17 | 0 |
| | M | .0353 | .02953 | 2.4 | 89.7 | 0.91 | 0.363 |
| Incomplete Primary | U | .05841 | .11596 | | -20.5 | -6.47 | 0 |
| | M | .05841 | .05777 | 0.2 | 98.9 | 0.08 | 0.939 |

| Variable | Unmatched Matched | Mean Treated | Control | reduction | %bias bias | t-test bias | p>t |
|---|---|---|---|---|---|---|---|
| Primary | U | .0905 | .19286 | | -29.7 | -9.35 | 0 |
| | M | .0905 | .09307 | -0.7 | 97.5 | -0.25 | 0.804 |
| Incomplete High School | U | .42426 | .41683 | | 1.5 | 0.51 | 0.612 |
| | M | .42426 | .40372 | 4.2 | -176.3 | 1.16 | 0.245 |
| High School | U | .17394 | .09981 | | 21.7 | 7.71 | 0 |
| | M | .17394 | .1932 | -5.6 | 74.0 | -1.39 | 0.165 |
| Vocational education | U | .20347 | .0704 | | 39.4 | 14.78 | 0 |
| | M | .20347 | .21887 | -4.6 | 88.4 | -1.05 | 0.292 |
| College Degree | U | .0122 | .00747 | | 4.8 | 1.71 | 0.088 |
| | M | .0122 | .00385 | 8.5 | -76.7 | 2.61 | 0.009 |
| Teenager mother | U | .06483 | .08365 | | -7.2 | -2.36 | 0.018 |
| | M | .06483 | .06547 | -0.2 | 96.6 | -0.07 | 0.942 |
| Mother depression | U | .13543 | .10125 | | 10.6 | 3.67 | 0 |
| | M | .13543 | .16624 | -9.5 | 9.9 | -2.4 | 0.016 |
| Work pre-pregnancy | U | .68164 | .24325 | | 97.9 | 33.57 | 0 |
| | M | .68164 | .69127 | -2.1 | 97.8 | -0.58 | 0.563 |
| Monthly maternal income pre-birth | U | 2.3e+05 | 55878 | | 77.9 30.81 0.000 | | |
| | M | 2.3e+05 | 2.4e+05 | -4.9 | 93.7 | -1.04 | 0.3 |
| Mother's numeracy level | U | 7.4525 | 6.75 | | 25.7 | 8.66 | 0 |
| | M | 7.4525 | 7.6547 | -7.4 | 71.2 | -2.09 | 0.037 |
| Mother's vocabulary level | U | 9.0481 | 7.8021 | | 35.1 | 11.74 | 0 |
| | M | 9.0481 | 9.215 | -4.7 | 86.6 | -1.31 | 0.192 |
| Mother's extraversion score | U | .07632 | -.07717 | | 15.2 | 5.16 | 0 |
| | M | .07632 | .04462 | 3.1 | 79.3 | 0.87 | 0.382 |
| Mother's agreeableness score | U | .03453 | -.00097 | | 3.6 | 1.21 | 0.227 |
| | M | .03453 | .07381 | | -14.6 | -1.13 | 0.258 |
| Mother's conscientiousness score | U | .10161 | -.00942 | | 11.2 | 3.76 | 0 |
| | M | .10161 | .13717 | -3.6 | 68.0 | -1.03 | 0.304 |
| Mother's neuroticism score | U | -.08036 | .05842 | | -13.9 | -4.69 | 0 |
| | M | | -0.10702 | -5.4 | 61.3 | -1.49 | 0.136 |
| Mother's openness score | U | .04776 | -.01766 | | 6.7 | 2.21 | 0.027 |
| | M | .04776 | .04883 | -0.1 | 98.4 | -0.03 | 0.974 |

| Variable | Unmatched Matched | Mean Treated | Mean Control | %reduction bias | bias | t-test bias | p>t |
|---|---|---|---|---|---|---|---|
| Mother interaction with child | U | 4.846 | 4.879 | | -2.4 | -0.82 | 0.411 |
| | M | 4.846 | 4.8055 | 2.9 | -22.5 | 0.82 | 0.411 |
| HOME score | U | 15.086 | 14.236 | | 25.4 | 8.44 | 0 |
| | M | 15.086 | 15.185 | -2.9 | 88.4 | -0.82 | 0.412 |
| Total people per family | U | 4.7798 | 4.8877 | | -6.6 | -2.25 | 0.024 |
| | M | 4.7798 | 4.7606 | 1.2 | 82.1 | 0.32 | 0.752 |
| Region | U | 9.0263 | 9.0612 | | -0.9 | -0.31 | 0.756 |
| | M | 9.0263 | 9.6707 | | -1762.4 | -4.65 | 0 |
| Area | U | 1.061 | 1.1299 | | -23.6 | -7.42 | 0 |
| | M | 1.061 | 1.0513 | 3.3 | 86.0 | 1.17 | 0.243 |

BEFORE MATCHING

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 0.915885 | 0.915885 | | |
| 5% | 1.164956 | 1.164956 | | |
| 10% | 1.505745 | 1.204023 | Obs | 37 |
| 25% | 2.844261 | 1.505745 | Sum of Wgt. | 37 |
| 50% | 13.92657 | | Mean | 29.91677 |
| | | Largest | Std. Dev. | 50.60936 |
| 75% | 25.72964 | 77.92043 | | |
| 90% | 77.92043 | 97.87263 | Variance | 2561.308 |
| 95% | 174.0636 | 174.0636 | Skewness | 3.093684 |
| 99% | 252.7506 | 252.7506 | Kurtosis | 12.77649 |

AFTER MATCHING

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 0.109595 | 0.109595 | | |
| 5% | 0.2067182 | 0.2067182 | | |
| 10% | 0.2449355 | 0.2286711 | Obs | 37 |
| 25% | 2.134982 | 0.2449355 | Sum of Wgt. | 37 |
| 50% | 3.589753 Mean | 4.202663 | | |
| | | Largest | Std. Dev. | 3.43212 |
| 75% | 5.659993 | 8.710109 | | |
| 90% | 8.710109 | 8.741458 | Variance | 11.77945 |
| 95% | 9.549085 | 9.549085 | Skewness | 1.432852 |
| 99% | 16.90251 | 16.90251 | Kurtosis | 6.151742 |

| Sample | Pseudo R2 | LR chi2 | p>chi2 | MeanBias | MedBias |
|---|---|---|---|---|---|
| Raw | 0.513 | 3430.81 | 0 | 29.9 | 13.9 |
| Matched | 0.015 | 63.94 | 0.001 | 4.2 | 3.6 |

**5.00. Rates (in Percentages) of Missing data for all variables for children 24-48 months old**

| Variables | Obs | Missings | Feq.Missings | NonMiss | Feq.NonMiss |
|---|---|---|---|---|---|
| No-maternal care first year | 7515 | 28 | 0.3726 | 7487 | 99.63 |
| Non-maternal care 0-3 | 7515 | 35 | 0.4657 | 7480 | 99.53 |
| Non-maternal care 3-6 | 7515 | 33 | 0.4391 | 7482 | 99.56 |
| Non-maternal care 12-18 | 7515 | 34 | 0.4524 | 7481 | 99.55 |
| non-maternal care 18-24 | 7515 | 90 | 1.198 | 7425 | 98.8 |
| Girls | 7515 | 0 | 0 | 7515 | 100 |
| Have a older sibling | 7515 | 0 | 0 | 7515 | 100 |
| Child's age (in months) | 7515 | 0 | 0 | 7515 | 100 |
| Child's age squared | 7515 | 0 | 0 | 7515 | 100 |
| Premature | 7515 | 0 | 0 | 7515 | 100 |
| Low birth weight | 7515 | 0 | 0 | 7515 | 100 |
| Mother's age (log) | 7515 | 87 | 1.158 | 7428 | 98.84 |
| Married mother | 7515 | 0 | 0 | 7515 | 100 |
| Without formal education | 7515 | 87 | 1.158 | 7428 | 98.84 |
| Incomplete Primary | 7515 | 87 | 1.158 | 7428 | 98.84 |
| Primary | 7515 | 87 | 1.158 | 7428 | 98.84 |
| Incomplete High School | 7515 | 87 | 1.158 | 7428 | 98.84 |
| High School | 7515 | 87 | 1.158 | 7428 | 98.84 |
| Vocational education | 7515 | 87 | 1.158 | 7428 | 98.84 |
| College Degree | 7515 | 87 | 1.158 | 7428 | 98.84 |
| Teenager mother | 7515 | 0 | 0 | 7515 | 100 |
| Mother's depression | 7515 | 0 | 0 | 7515 | 100 |
| Work pre-pregnancy | 7515 | 1009 | 13.43 | 6506 | 86.57 |
| Maternal income pre-birth | 7515 | 1013 | 13.48 | 6502 | 86.52 |
| Mother's numeracy level | 7515 | 3 | 0.0399 | 7512 | 99.96 |
| Mother's vocabulary level | 7515 | 3 | 0.0399 | 7512 | 99.96 |
| Mother's extraversion score | 7515 | 199 | 2.648 | 7316 | 97.35 |
| Mother's agreeableness score | 7515 | 199 | 2.648 | 7316 | 97.35 |
| Mother's conscientiousness score | 7515 | 199 | 2.648 | 7316 | 97.35 |
| Mother's neuroticism score | 7515 | 199 | 2.648 | 7316 | 97.35 |
| Mother's openness score | 7515 | 199 | 2.648 | 7316 | 97.35 |
| Mother interaction with child | 7515 | 0 | 0 | 7515 | 100 |

**Appendix 5.1. Association between non-maternal care and child cognitive skills at 24 to 48 months old mediated by household poverty.**

| | TEPSI | | | | PPVT |
|---|---|---|---|---|---|
| | (1)<br>Total | (2)<br>Coordination | (3)<br>Language | (4)<br>Motor | (5)<br>Total |
| (A) Non-maternal care during first year | -0.036 | -0.021 | -0.059 | -0.005 | -0.077 |
| | (0.052) | (0.057) | (0.054) | (0.056) | (0.061) |
| (B) Poor household | -0.038 | -0.028 | -0.037 | 0.032 | -0.079** |
| | (0.029) | (0.031) | (0.030) | (0.031) | (0.033) |
| (C) Non-maternal care during first year x Poor household | 0.007 | -0.017 | 0.005 | 0.037 | -0.025 |
| | (0.057) | (0.059) | (0.059) | (0.062) | (0.064) |
| Observations | 5,946 | 5,946 | 5,968 | 5946 | 4,651 |
| R-squared | 0.167 | 0.116 | 0.171 | 0.105 | 0.169 |

Notes: Columns (1) through (5) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and the family's income reference category is non-poor households. Poor family means households with per capita income below the Chilean poverty line (70 pounds per capita per month or 64,000 Chilean pesos). Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

**Appendix 5.2. Association between non-maternal care and child cognitive skills at 24-48 months old mediated by maternal education**

| | TEPSI | | | | PPVT |
|---|---|---|---|---|---|
| | (1) Total | (2) Coordination | (3) Language | (4) Motor | (5) Total |
| (A) Non-maternal care during first year | -0.041 | -0.024 | -0.072 | -0.00002 | -0.078 |
| | (0.050) | (0.054) | (0.052) | (0.053) | (0.058) |
| (B) Low maternal education | -0.027 | -0.047** | -0.021 | 0.031 | -0.017 |
| | (0.022) | (0.024) | (0.020) | (0.023) | (0.023) |
| (C) Non-maternal care during first year × Low maternal education | 0.0034 | -0.010 | 0.055 | 0.041 | -0.026 |
| | (0.066) | (0.066) | (0.069) | (0.073) | (0.069) |
| Observations | 5,946 | 5,946 | 5,968 | 5946 | 4,651 |
| R-squared | 0.167 | 0.116 | 0.171 | 0.105 | 0.167 |

Notes: Columns (1) through (5) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type-of-care reference category is maternal care and maternal-education reference category is high maternal education. Low maternal education means mothers with high school degree or less. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

**Appendix 5.3. Association between non-maternal care and child socio-emotional problems at 24-48 months old mediated by maternal education**

| | (1)<br>CBCL<br>Total | (2)<br>CBCL<br>Externalizing<br>Problems | (3)<br>CBCL<br>Internalizing<br>Problems |
|---|---|---|---|
| (A) Non-maternal care during first year | -0.004 | 0.007 | -0.014 |
| | (0.048) | (0.051) | (0.047) |
| (B) Low maternal education | 0.082 | 0.020 | 0.151 |
| | (0.22) | (0.24) | (0.23) |
| (C) Non-maternal care during first year × | -0.008 | -0.019 | 0.014 |
| Low maternal education | (0.069) | (0.069) | (0.068) |
| Observations | 6,005 | 6,005 | 6,005 |
| R-squared | 0.218 | 0.172 | 0.192 |

Notes: Columns (1) through (3) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and maternal education reference category is mother higher education. Mother high education means mothers with more than a high school degree. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score).Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

**Appendix 5.4. Association between non-maternal care and child socio-emotional problems at 24-48 months old mediated by family income**

| | (1)<br>CBCL<br>Total | (2)<br>CBCL<br>Externalizing<br>Problems | (3)<br>CBCL<br>Internalizing<br>Problems |
|---|---|---|---|
| (A) Non-maternal care during first year | -0.018 | -0.009 | -0.005 |
| | (0.051) | (0.053) | (0.050) |
| (B) Poor household | 0.001 | 0.0009 | 0.016 |
| | (0.029) | (0.030) | (0.030) |
| (C) Non-maternal care during first year × | 0.034 | 0.034 | -0.016 |
| poor household | (0.057) | (0.059) | (0.057) |
| Observations | 6,005 | 6,005 | 6,005 |
| R-squared | 0.218 | 0.172 | 0.192 |

Notes: Columns (1) through (3) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and family income reference category is above poverty. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

**Appendix 5.5. Association between non-maternal care and child socio-emotional problems mediated by family structure**

| | (1) CBCL Total | (2) CBCL Externalizing Problems | (3) CBCL Internalizing Problems |
|---|---|---|---|
| (A) Non-maternal care during first year | -0.003 | 0.006 | 0.010 |
| | (0.058) | (0.061) | (0.057) |
| (B) Two-parent family | -0.069** | -0.058* | -0.058* |
| | (0.033) | (0.033) | (0.034) |
| (C) Non-maternal care during first year × | -0.005 | -0.005 | -0.031 |
| Two-parent family | (0.056) | (0.058) | (0.056) |
| Observations | 6,005 | 6,005 | 6,005 |
| R-squared | 0.218 | 0.172 | 0.192 |

Notes: Columns (1) through (3) show regressions where the dependent variable is at the top of the column and the key variables are in the first column. The type of care reference category is maternal care and family's structure reference category is single-parent family. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score).. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

**Appendix 5.6. Association between type of non-maternal care 6–12 months after childbirth and child cognitive outcomes at 24 to 48 months old**

| | TEPSI | | | | PPVT |
|---|---|---|---|---|---|
| Type of care | Total<br>(1)<br>PSM | Coordination<br>(2)<br>PSM | Language<br>(3)<br>PSM | Motor<br>(4)<br>PSM | Total<br>(5)<br>PSM |
| (A) Relative care | -0.240** | -0.261** | -0.083 | -0.369*** | -0.577*** |
| | (0.094) | (0.095) | (0.124) | (0.126) | (0.122) |
| Obs. | 4,615 | 4,615 | 4,630 | 4,615 | 3,589 |
| (B) Grandparent care | 0.135*** | -0.083 | 0.299*** | 0.004 | 0.183*** |
| | (0.041) | (0.051) | (0.040) | (0.043) | (0.053) |
| Obs. | 5,141 | 5,141 | 5,160 | 5,141 | 3,993 |
| (C) Centre-based care | 0.255*** | 0.340*** | 0.197** | 0.169* | 0.390*** |
| | (0.072) | (0.054) | (0.077) | (0.096) | (0.124) |
| Obs. | 4,761 | 4,761 | 4,777 | 4,761 | 3,706 |
| (D) Non-relative care | 0.034 | -0.313 | -0.301** | 0.131 | -0.210** |
| | (0.167) | (0.260) | (0.121) | (0.123) | (0.104) |
| Obs. | 4,606 | 4,606 | 4,623 | 4,606 | 3,509 |

Notes: The dependent variable in columns (1) through (4) is the TEPSI test score and in column (5) the PPVT test score. The reference category is maternal care during the first year of life (between 6-12 months). PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al. (2004) nnmatch command in Stata. The following categories of covariates were included in all OLS regressions and PSM analyses. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

**Appendix 5.7. Association between type of non-maternal care 6–12 months after childbirth and child cognitive outcomes at 24 to 48 months old without both pre-birth maternal and 2010 non-maternal income, only with pre-birth maternal income and with both pre-birth maternal income and 2010 non-maternal income as covariates: PSM**

| | TEPSI Total (1) PSM | TEPSI Coordination (2) PSM | TEPSI Language (3) PSM | TEPSI Motor (4) PSM | PPVT (5) PSM |
|---|---|---|---|---|---|
| Without income | -0.083** | -0.106*** | -0.096*** | -0.009 | -0.043 |
| | (0.035) | (0.035) | (0.034) | (0.037) | (0.039) |
| | 5,950 | 5,950 | 5,972 | 5,950 | 4,653 |
| Non-maternal care first year maternal income | -0.085** | -0.078* | -0.112** | -0.011 | -0.032 |
| | (0.043) | (0.044) | (0.046) | (0.045) | (0.035) |
| Obs. | 5,946 | 5,946 | 5,968 | 5,946 | 4,651 |
| Non-maternal care first year paternal income | -0.109** | -0.098** | -0.141*** | -0.013 | -0.050 |
| | (0.046) | (0.045) | (0.047) | (0.048) | (0.036) |
| Obs. | 5,700 | 5,700 | 5,720 | 5,700 | 4,461 |

Notes: The dependent variable in columns (1) through (8) is the TEPSI (cognitive) test score and in columns (9) and (10), the PPVT (cognitive) test score. The reference category is maternal care during the first year of life (between 6-12 months). PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates were included in all OLS regressions and PSM analyses. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

**Appendix 5.8. Association between early non-maternal care and child socio-emotional outcomes (measure by CBCL test) at age 24 to 48 months old, relative to maternal care without both pre-birth maternal income and 2010 non-maternal income, only with pre-birth maternal income, and with both pre-birth maternal income and 2010 non-maternal income as covariates: PSM**

| | CBCL Total | CBCL Externalising problems | CBCL Internalising problems |
|---|---|---|---|
| | (1) | (2) | (3) |
| | PSM | PSM | PSM |
| Without income | -0.046 | -0.046 | -0.059* |
| | (0.030) | (0.031) | (0.032) |
| | 6,009 | 6,009 | 6,009 |
| Non-maternal care first year maternal income | -0.0299 | -0.0354 | -0.0457 |
| | (0.0340) | (0.0319) | (0.0333) |
| Obs. | 6,005 | 6,005 | 6,005 |
| Non-maternal care first year paternal income | -0.034 | -0.051 | -0.048 |
| | (0.035) | (0.033) | (0.033) |
| Obs. | 5,755 | 5,755 | 5,755 |

Notes: The dependent variable in columns (1) through (6) is the CBCL (socio-emotional) test score. The reference category is early maternal care (between ages 6 to 12 months old). I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates are included in all PSM analyses. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

**Appendix 5.9. Association between type of non-maternal care 6–12 months after childbirth and child cognitive outcomes at 24 to 48 months old without both pre-birth maternal and 2010 non-maternal income, only with pre-birth maternal income and with both pre-birth maternal income and 2010 non-maternal income as covariates: PSM models**

| | | TEPSI | | | | PPVT |
|---|---|---|---|---|---|---|
| Models | Type of care | Total (1) | Coordination (2) | Language (3) | Motor (4) | Total (5) |
| Without any income | (A1) Relative care | -0.520*** | -0.457*** | -0.427*** | -0.486*** | -0.517*** |
| | | (0.095) | (0.090) | (0.126) | (0.125) | (0.082) |
| | Obs. | 4,619 | 4,619 | 4,634 | 4,619 | 3,591 |
| With maternal income | (A2) Relative care | -0.250*** | -0.275*** | -0.0753 | -0.377*** | -0.577*** |
| | | (0.0936) | (0.0946) | (0.124) | (0.126) | (0.122) |
| | Obs. | 4,615 | 4,615 | 4,630 | 4,615 | 3,589 |
| With maternal income + non-maternal income | (A3) Relative care | -0.243** | -0.230** | -0.096 | -0.413*** | -0.815*** |
| | | (0.095) | (0.097) | (0.127) | (0.130) | (0.127) |
| | Obs. | 4,419 | 4,419 | 4,433 | 4,419 | 3,439 |
| Without income | (B1) Grandparent care | 0.151*** | -0.078 | 0.309*** | -0.002 | 0.148*** |
| | | (0.037) | (0.051) | (0.034) | (0.044) | (0.048) |
| | Obs. | 5,145 | 5,145 | 5,164 | 5,145 | 3,995 |
| With maternal income | (B2) Grandparent care | 0.135*** | -0.0830 | 0.299*** | 0.00355 | 0.184*** |
| | | (0.0414) | (0.0505) | (0.0402) | (0.0432) | (0.0528) |
| | Obs. | 5,141 | 5,141 | 5,160 | 5,141 | 3,993 |
| With maternal income + non-maternal income | (B3) Grandparent care | 0.202*** | 0.077 | 0.295*** | 0.037 | 0.034 |
| | | (0.049) | (0.052) | (0.047) | (0.050) | (0.058) |
| | Obs. | 4,924 | 4,924 | 4,942 | 4,924 | 3,830 |
| Without income | (C1) Centre-Based care | 0.307*** | 0.371*** | 0.237*** | 0.211** | 0.362*** |
| | | (0.074) | (0.055) | (0.084) | (0.096) | (0.085) |
| | Obs. | 4,765 | 4,765 | 4,781 | 4,765 | 3,708 |
| With maternal income | (C2) Centre-Based care | 0.255*** | 0.340*** | 0.197** | 0.169* | 0.390*** |
| | | (0.0715) | (0.0542) | (0.0773) | (0.0961) | (0.124) |
| | Obs. | 4,761 | 4,761 | 4,777 | 4,761 | 3,706 |
| With maternal income + Non-maternal income | (C3) Centre-Based care | 0.271*** | 0.372*** | 0.177** | 0.169* | 0.388*** |
| | | (0.074) | (0.055) | (0.080) | (0.098) | (0.121) |
| | Obs. | 4,565 | 4,565 | 4,580 | 4,565 | 3,555 |
| Without income | (D1)Non-relative care | -0.020 | -1.576*** | 1.130*** | -0.915*** | -1.189*** |
| | | (0.109) | (0.102) | (0.145) | (0.072) | (0.118) |
| | Obs. | 4,610 | 4,610 | 4,627 | 4,610 | 3,592 |
| With maternal income | (D2)Non-relative care | -0.523*** | -0.649*** | -0.568*** | -0.397*** | -0.217** |
| | | (0.070) | (0.108) | (0.072) | (0.068) | (0.104) |
| | Obs. | 4,606 | 4,606 | 4,623 | 4,606 | 3,590 |
| With maternal income + Non-maternal income | (D3Non-relative care | 0.034 | -0.313 | -0.301** | 0.131 | 1.500*** |
| | | (0.167) | (0.260) | (0.121) | (0.123) | (0.121) |
| | Obs. | 4,409 | 4,409 | 4,424 | 4,409 | 3,439 |

Notes: The dependent variable in columns (1) through (4) is the TEPSI test score and in column (5) the PPVT test score. The reference category is maternal care during the first year of life (between 6-12 months). PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates were included in all OLS regressions and PSM analyses. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Robust standard errors in parentheses.

**Appendix 5.10. Association between type of non-maternal care 6–12 months after childbirth and child socio-emotional outcomes at age 24 to 48 months old without income variables, only with pre-birth maternal income and with both pre-birth maternal income and 2010 non-maternal income as covariates: PSM**

| Models | Type of care | CBCL Total<br>PSM (1) | Externalising problems<br>PSM (2) | Internalising problems<br>PSM (3) |
|---|---|---|---|---|
| Without income | (A1) Relative care | 0.117 | 0.088* | -0.179** |
| | | (0.098) | (0.048) | (0.079) |
| | Observations | 4,667 | 4,667 | 4,667 |
| With maternal income | (A2) Relative care | 0.385*** | 0.040 | -0.051 |
| | | (0.098) | (0.058) | (0.050) |
| | Observations | 4,663 | 4,663 | 4,663 |
| With maternal income + and non-maternal income | (A3) Relative care | 0.156 | 0.086* | 0.007 |
| | | (0.098) | (0.046) | (0.077) |
| | Observations | 4,464 | 4,464 | 4,464 |
| Without income | (B1) Grandparent care | 0.072 | 0.046 | 0.030 |
| | | (0.130) | (0.092) | (0.123) |
| | Observations | 5,195 | 5,195 | 5,195 |
| With maternal income | (B2) Grandparent care | -0.029 | -0.024 | 0.049 |
| | | (0.082) | (0.081) | (0.067) |
| | Observations | 5,191 | 5,191 | 5,191 |
| With maternal income + and non-maternal income | (B3) Grandparent care | -0.498*** | -0.446*** | -0.464*** |
| | | (0.045) | (0.041) | (0.045) |
| | Observations | 4,971 | 4,971 | 4,971 |
| Without income | (C1) Centre-Based care | -0.056 | -0.162** | -0.033 |
| | | (0.056) | (0.058) | (0.059) |
| | Observations | 4,811 | 4,811 | 4,811 |
| With maternal income | (C2) Centre-Based care | -0.089 | -0.223*** | 0.011 |
| | | (0.080) | (0.073) | (0.069) |
| | Observations | 4,807 | 4,807 | 4,807 |
| Non—maternal income | (C3) Centre-Based care | -0.055 | -0.130** | 0.026 |
| | | (0.059) | (0.062) | (0.059) |
| | Observations | 4,608 | 4,608 | 4,608 |
| Without income | (D1) Non-relative care | 0.880*** | 1.035*** | 1.197*** |
| | | (0.111) | (0.101) | (0.136) |
| | Observations | 4,657 | 4,657 | 4,657 |
| With maternal income | (D2 Non-relative care | 0.241*** | 0.098* | 0.325*** |
| | | (0.074) | (0.058) | (0.139) |
| | Observations | 4,653 | 4,653 | 4,653 |
| Con maternal income + non-maternal income | (D3) Non-relative care | -0.191* | -0.271*** | 0.319*** |
| | | (0.112) | (0.105) | (0.081) |
| | Observations | 4,452 | 4,452 | 4,452 |

Notes: The dependent variable in columns (1) through (6) is the CBCL (socio-emotional) test score. The reference category) is maternal care during the first year of life (between 6-12 months). PSM stands for Propensity Score Matching. I run PSM estimating the average treatment effect on the treated using nearest neighbour matching with robust standard errors clustered around the four nearest neighbours using Imbens et al.'s (2004) 'nnmatch' command in Stata. The following categories of covariates were included in all OLS regressions and PSM analyses. Child controls: female child, child has older sibling, child's age at test time (linear and quadratic terms), premature baby, and child with low birth weight. Family controls include per non-maternal income, HOME test score, mother-child interact well, and number of people in the household. Maternal controls include: maternal age (log), maternal level of education, teenage mother, mother worked pre-pregnancy, maternal income pre-birth, mother had depression after childbirth, mother's abilities (WAIS test score) and personality traits (Big Five Inventory test score). *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

**Appendix 5.11. Association between type of non-maternal care 6–12 months after childbirth and child cognitive outcomes at age 24 to 48 months old restricting the sample of the OLS analysis to the sample in the PSM model**

| | TEPSI Total | | PPVT | |
|---|---|---|---|---|
| Type of care | (1) | (2) | (3) | (4) |
| | OLS | PSM | OLS | PSM |
| (A) Relative care | -0.024 | -0.240** | -0.143 | -0.577*** |
| | (0.110) | (0.094) | (0.122) | (0.122) |
| Observations | 4,615 | 4,615 | 3,589 | 3,589 |
| (B) Grandparent care | 0.044 | 0.135*** | -0.083 | 0.183*** |
| | (0.066) | (0.041) | (0.076) | (0.053) |
| Observations | 5,141 | 5,141 | 3,993 | 3,993 |
| (C) Centre-based care | -0.054 | 0.255*** | 0.141 | 0.390*** |
| | (0.088) | (0.072) | (0.103) | (0.124) |
| Observations | 4,761 | 4,761 | 3,706 | 3,706 |
| (D) Non-relative care | -0.469*** | -0.523*** | -0.267 | -0.210** |
| | (0.142) | (0.070) | (0.184) | (0.104) |
| Observations | 4,606 | 4,606 | 3,590 | 3,509 |

**Appendix 5.12. Association between type of non-maternal care 6–12 months after childbirth and child socio-emotional outcomes at age 24 to 48 months old restricting the sample of the OLS analysis to the sample in the PSM model**

| | CBCL Total | | CBCL Externalising problems | | CBCL Internalising problems | |
|---|---|---|---|---|---|---|
| Type of care | OLS (1) | PSM (2) | OLS (3) | PSM (4) | OLS (5) | PSM (6) |
| (A) Relative care | 0.004 | 0.389*** | 0.047 | 0.040 | -0.050 | -0.051 |
| | (0.099) | (0.098) | (0.105) | (0.058) | (0.098) | (0.050) |
| Observations | 4,663 | 4,663 | 4,663 | 4,663 | 4,663 | 4,663 |
| (B) Grandparent care | 0.004 | -0.028 | 0.015 | -0.024 | 0.008 | 0.049 |
| | (0.066) | (0.082) | (0.069) | (0.081) | (0.065) | (0.067) |
| Observations | 5,191 | 5,191 | 5,191 | 5,191 | 5,191 | 5,191 |
| (C) Centre-based care | -0.032 | -0.089 | 0.066 | -0.223** | -0.067 | 0.011 |
| | (0.085) | (0.080) | (0.091) | (0.073) | (0.081) | (0.069) |
| Observations | 4,807 | 4,807 | 4,807 | 4,807 | 4,807 | 4,807 |
| (D) Non-relative care | -0.062 | 0.241*** | -0.078 | 0.098 | -0.099 | 0.325*** |
| | (0.129) | (0.074) | (0.128) | (0.058) | (0.145) | (0.139) |
| Observations | 4,653 | 4,653 | 4,653 | 4,653 | 4,653 | 4,653 |

# Chapter 6

# Centre-based care in toddlerhood and child cognitive and socio-emotional development: Evidence from Chile

## 6.1. Introduction

In Chapter 5, I find that the type of care that the child experiences during the first year of life matters. Children who attended centre-based care during the first year of life present higher cognitive outcomes and fewer socio-emotional problems relative to children in maternal care. Motivated by this finding, in the present chapter I look at the association between attendance at centre-based care for slightly older children (between 24 and 36 months old) and child development. I look at attendance at centre-based care during toddlerhood for several reasons. First, because the age range where there is less evidence about the previously stated association is for children under three years of age. Second, before two years old, most children in the ELPI sample were either with their mothers or in an informal type of care (relative or grandparent care). From two years old onwards, centre-based care starts being a more prevalent type of care.

As discussed in Chapter 1, high-quality early childhood interventions set solid foundations for the future learning of children (EFA Global Monitoring Report, 2007), hence, facilitating children to experience intellectual stimuli early in life is a key challenge for policy makers who are in charge of expanding and improving early childhood education and care (ECEC) provision. The evidence from developed and developing countries on ECEC shows that attendance to high-quality preschool programs (relative to maternal care), has a positive impact on children's cognitive development (Burger, 2010; Camilli, Vargas, Sharon, & Barnett, 2010; Magnuson, Ruhm, & Waldfogel, 2007). However, the impact on children's socio-emotional or behaviour outcomes is unclear. Some studies have found a positive association between attendance at centre-based care (compared to maternal care) and socio-emotional development (Sylva et al., 2004). In contrast, other studies have found that attendance at centre-based care is associated with more dysfunctional behaviour in children (Abner, Gordon, Kaestner, & Korenman, 2013; Coley, Votruba-Drzal, Miller, & Koury, 2013; Magnuson, Ruhm, & Waldfogel, 2007). Most of this evidence is for children aged three to five years. Less is known about the association between early attendance at centre-based care—particularly in universal, publicly funded early childhood programs in infant and toddler years (under three years old)—and child development.

On the one hand, neuroscientists, psychologists and behavioural scientists have concluded that high-quality ECEC (during infant or toddler years) could enhance child development. One of the mechanisms underlying the previous prediction is that critical aspects of children's brain architecture are formed during the infant and toddler years (Knudsen, 2004; National Research Council and Institute of Medicine, 2000). In addition, a stimulating environment could enhance the child's acquisition of learning and social skills (Shonkoff, 2010; National Scientific Council on the Developing Child, 2007).

On the other hand, there is a concern about possible detrimental effects of centre-based care (relative to maternal care) for children who enrol at centre-based care before the age of three. This concern is probably driven by the attachment theory and the inference from this theory that non-maternal care could affect mother-child interaction (Belsky, 2001) and also by the learning theory and its questioning of whether non-maternal care gives adequate child stimulation ( Lamb & Ahnert, 2006). However, the evidence for or against the inferences from the two previously mentioned theories is thin and there is a lack of consensus on whether early centre-based care is detrimental to child development.

Some researchers have found that the impact of centre-based care on child developmental outcomes is heterogeneous depending on the age at which the child enters into this type of care (Lekhal, 2012; Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007). The association between early attendance at centre-based care and child development could also be heterogeneous depending on the time ('intensity') that the child spends in day care. For example, spending more hours in centre-based care is associated with more child behavioural problems (Belsky et al., 2007; NICHD Early Child Care Research Network, 1999, 2004; NICHD National Early Child Care Research, 2003). The level of vulnerability of the child's household could also be a relevant moderator in the relation between attendance at centre-based care and child development. Children from poor families or with mothers with a lower level of education benefit more from centre-based care than do their less vulnerable counterparts (Burger, 2010; NICHD Early Child Care Research Network., 2006; Peisner-Feinberg et al., 2001).

The aim of this study is to analyse the effect of centre-based care attendance at two years old on child cognitive and socio-emotional outcomes measured on children aged between three and four years old in Chile. I also explore whether the former relation varies according to the intensity of centre-based care (full-time or part-time) or the level of vulnerability of the child's family. In this study, I use the two available waves (2010 and 2012) of the dataset Longitudinal Survey of Early Childhood (Encuesta Longitudinal de Primera Infancia, or ELPI in Spanish). My analyses use multivariate regressions, propensity score matching, and individual fixed effects techniques.

This chapter is organised as follows. In Section 2, I review the results from previous studies about centre-based care and child development in children under three years old, state hypotheses about some moderators in this association, and identify the gaps in the literature. In Section 3, I describe the dataset and the estimation method. In Section 4, I present the results and in Section 5, I discuss the results and conclude.

## 6.2. Literature Review

An increasing amount of evidence highlights the positive impact of high-quality centre-based care on children's short-, medium-, and long-term development outcomes. In the USA, during the 1960s and 1970s, two small-scale field experiments called the HighScope Perry Preschool Program and the Abecedarian Project took place. Both experiments provide causal evidence that participation in such high-quality early childhood programs can improve children's future educational attainment, employment opportunities, and earnings and can decrease their probability of committing crimes (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; Heckman, Hyeok Moon, Pinto, Savelyev, & Yavitz, 2010; Heckman, 2006). Recent evaluations of large-scale universal preschool programs also in the US corroborate the previously found large effects of high-quality centre-based care—especially in cognitive outcomes (Weiland & Yoshikawa, 2013). In addition, international and UK-based observational studies also found that centre-based care improved child outcomes (Ruhm & Waldfogel, 2012; Sammons et al., 2007; Sylva et al., 2004).

Importantly, the quality of care provided by the centre is critical because attendance at low-quality early childhood educational programs can be detrimental to child development (Belsky, 2011; National Institute of Child Health and Human Development Early Child

Care Research Network, 2003). Moreover, as mentioned in the introduction, children from more disadvantaged backgrounds (less educated, low income, or immigrant parents) benefit more from centre-based care than their wealthier peers (for some examples, see Ruhm & Waldfogel, 2012).

Although there is a wide consensus that ECEC represents a unique opportunity to boost children's abilities and learning, much of this evidence is for children aged three and above; hence, the impact of centre-based care on infants and toddlers still remains unclear.

### *6.2.1 Does exposure to centre-based care at two years old improve child development?*

While in Chapter 5, I reviewed the literature on under ones, in this chapter I focus on attendance at centre-based care during toddlerhood (24 to 36 months of age). Whether attendance at centre-based care has an impact on child development is an empirical and theoretical question. Theory is inconclusive on whether early centre-based care attendance (before three years old) is positive or negative for child development. Given that from age two onwards, children start interacting with their peers more actively, entry into centre-based care at two years old could be associated with positive outcomes in the cognitive and socio-emotional domains. The surge in children's ability to interact provides a perfect opportunity to learn from social interactions and to learn to solve conflicts with peers (Hartup & Moore, 1990). At the same time, the development of a child's ability to interact with others helps the child to build more positive relationships with their care providers; the latter is a crucial element for children to benefit cognitively from the centre-based care experience (Pierrehumbert, Ramstein, Karmaniola, & Halfon, 1996). If this were the case, early entry into centre-based care could foster child social and cognitive skills and better equip children for entry into school (Lamb & Ahnert, 2006).

On the other hand, according to attachment theory, attendance at centre-based care for children between the ages of one and three may be problematic for their development. Attachment theory states that care by a single caregiver facilitates child development (Bowlby, 2008; Ainsworth & Bowlby, 1991). Given that centre-based care, especially early in life, implies separations for long hours from the child's primary attachment figure (mainly mothers) early intro into centre-based care may disrupt attachment bonds and, thus, have adverse effects on child socio-emotional development (Belsky & Rovine, 1988).

For children under three years old, the empirical evidence about the impact of centre-based care on child development is thin and inconclusive. Most of the evidence about the association between attendance at centre-based care and child development is for children aged three to five years old.

The evidence about the effect of attending centre-based care before three years old shows mixed results. One important source of evidence is the introduction in the province of Quebec (Canada) of publicly subsidised formal and informal care for children aged zero to four in 1997. Baker, Gruber, and Milligan (2008), used a differences-in-differences model where children in Quebec were the treatment group and children from the rest of Canada were the control group. They found that publicly funded centre-based care had a significantly negative effect on children between zero and three years old on child motor and social skills—a significant decline of more than 10 per cent of a standard deviation. The authors explain this finding, arguing that the provision of publicly funded centre-based care increased working mothers' employment rate; this could have implied a poorer adult-child relationship and worse parental health; in turn, both consequences are associated with lower child development indicators. In addition, Lefebvre, Merrigan, & Roy-Desrosiers (2011) concluded that Canadian centre-based care had a negative effect on children's vocabulary scores (using the Peabody Picture Vocabulary Test, or PPVT) measured at five years old. Their explanation for this negative effect is that perhaps children under three years old spent too much time in low-quality centre-based care.

In contrast, Felfe and Lalive (2012) using the German Socio-Economic Panel (GSOEP) found a small, positive effect of early centre-based care attendance (for children from zero to three years old) on language and social skills. They also found that younger children and children from lower socio-economic backgrounds benefitted more from centre-based care attendance compared to older and wealthier children respectively. To reach their conclusions, Felfe and Lalive (2012) exploited county-level differences in the availability of centre-based child care.

In addition, observational studies based in the USA and the UK found that attendance at early centre-based care is associated with better cognitive skills compared to children cared for by their mothers. Loeb et al. (2007), using data from the USA, found that on average, starting at centre-based care between zero and four years old is associated with positive effects on pre-reading and mathematics skills. Specifically, they found that children who start centre-based care between two and three years old are the ones who benefit the most in cognitive terms. Loeb et al. (2007) used data from the Early Childhood Longitudinal Study (ECLS-K) and performed their analysis using OLS, matching and instrumental variable models. Hansen and Hawkes (2009) using data from the Millennium Cohort Study—a longitudinal survey of around 19,000 children born in the UK—also found a positive association between early centre-based care (nine months) and child school-readiness test scores. Finally, Sammons et al. (2004), using data from the EPPE project in the UK, found that children who start preschool education before they were three years old presented higher cognitive achievement than those who start later; these gains continued through primary school.

On the other hand, there is an ongoing debate about the effects of centre-based care relative to maternal care during the first three years of life on child socio-emotional development. Studies show heterogeneous results such as negative as well as neutral effects of early attendance at centre-based care on child socio-emotional development.

Using data from the EPPE project, Loeb, Bridges, Bassok, Fuller, and Rumberger (2007) concluded that non-parental care during the first three years of a child's life is associated with detrimental effects on behavioural and social skills. Sammons et al. (2007) found that children who attended centre-based care before they were two years old had higher levels of antisocial behaviour than children who stayed at home. However, this relationship disappeared at the age of ten. In contrast, some European studies concluded that attendance at a publicly funded centre-based care before age three does not have a negative effect on children's social skills and school attainment. Barnes, Leach, Malmberg, Stein, and Sylva (2010) based on a sample of 1,016 families in England, concluded that there was no evidence of adverse consequences of attending non-parental care (versus maternal care) during the first three years of life on child socio-emotional development at the age of three. Similarly, Hansen and Hawkes (2009) found no association between formal group care at nine months and problematic behaviour at age three.

In addition, Gupta and Simonsen (2010) using the Danish Longitudinal Survey of Children (DALSC) found that being enrolled in publicly funded universal child care at age three versus being in maternal care does not have a significant effect on child behavioural skills. To reach this conclusion, Gupta and Simonsen (2010) exploited the variation in the take-up rate of preschools across municipalities. Additionally, in a recent study using data from the

USA, Jaffee, Van Hulle, & Rodgers, (2011) found no effect of attendance at centre-based care before three years old on children's behaviour problems.

Three studies using data from Chile found that attendance at publicly funded child care before the age of three has a positive relation to child cognitive development but mixed results on socio-emotional development. Noboa-Hidalgo and Urzua (2012) using the dataset from the JUNJI Longitudinal Study (JLS) found mixed results on the effect of publicly funded child care expansion on child development. According to these authors, attendance at centre-based care during the first two years of life has a positive impact on emotional regulation and motor skills, and a negative effect on child-adult interactions, reasoning, and memory. Noboa-Hidalgo and Urzua (2012) point out the possibility that the low quality of some centre-based care could negatively affect child development. To reach these conclusions, the authors used a longitudinal dataset from Chile of 482 children younger than two years old; they also used a variety of methods for the estimation of the effects including ordinary least squares, instrumental variables, and control function approaches. In addition, Arnold (2013) using only a single wave of data from the survey used in this chapter (ELPI 2010 survey) and a propensity score matching method, concluded that attendance at children aged two to five at publicly funded centre-based care enhances both psychomotor and language development; however, he did not find a significant association with child socio-emotional development. Finally, Cortazar (2011) based on a large administrative dataset from Chile found that children aged two to four who attended publicly funded centre-based care scored significantly higher on maths, reading, and social science tests at the age of 10 compared to children who did not attend centre-based care.

Based on the previously described theoretical and empirical evidence, there is no clear presumption about the effect of early childhood education and child development during the first three years of life. In the context of an increasing incorporation of women into the labour market, and hence a necessity for non-parental child care, it is crucial to have evidence about the effect of non-parental care—in particular centre-based care because of its prevalence—on infant and toddler development.

*6.2.2. Does the intensity of centre-based care matter for child development?*

There is no clear consensus about the effect of the amount of hours per day of attendance at centre-based care ('intensity of care') on child development. The main source of information about the previously stated question comes from the US-based, large-scale National Institute of Child Health and Human Development (NICHD) Study of Early Child Care (SECC). This study analyses the effects of intensity of care for children aged three months to four and a half years on child development. The conclusion of the NICHD Early Child Care Research Network (2004) is that more daily hours of exposure to centre-based care during the toddler years is associated with better language skills measured at four and a half years old.

On the other hand, Jacob, (2009) in a critical review of studies published between 1998 and 2006, emphasized that the quantity of non-maternal care is the strongest and most consistent predictor of child socio-emotional problems. Regardless of child care quality, children who spend more than 30 hours per week in centre-based care tend to be less sociable and have more behaviour problems than children who spend less than 30 hours per week in centre-based care (NICHD Early Child Care Research Network, 2003). This association is robust to long-term measurements of child development such as in Belsky et al. (2007) who had data until sixth grade. However, the previously mentioned association disappears by age 15 (Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010).

McCartney et al. (2010) highlighted that there is a non-robust association between centre-based care hours and child socio-emotional problems. In some specifications, they find that exposure to higher intensity of centre-based care (as opposed to lower intensity) is associated with more externalizing problems. McCartney et al. (2010) found that the association between centre-based care hours and externalizing behaviour was modest, but increased when children were in low-quality centre-based care and when children spent most of the time with a large group of peers. However, this finding was not robust to different functional forms.

The attachment theory predicts that more intensity of centre-based care (as opposed to less intensity) is associated with worse child socio-emotional development. Specifically, the attachment theory proposes that the quantity of attendance at ECEC, which is also time away from the mother, induces an insecure baby–mother attachment that could have a negative link with the child's ability to regulate her emotions (Belsky, 2002). However, the NICHD Early Child Care Research Network (2003) did not find evidence to support Belsky's (2002) assertion. Belsky (2001) also predicts that more hours per week of centre-based care pose risks for infant–parent relationships and child behavioural adjustment. If parents are away from their children for longer hours, it might be more difficult for them to get to know their children well and to respond adequately to their children's necessities. This argument is supported by the evidence that more hours in child care are correlated with less sensitive mothers and children less engaged with their mothers (NICHD Early Child Care Research Network, 1999).

### *6.2.3. Early centre-based care attendance and child vulnerability*

In line with Chapter 4 and Chapter 5, I analyse whether child vulnerability—proxied by household income, maternal education and family structure—are relevant moderating variables in the association between early centre-based care (relative to maternal care) and child development. High-quality early childhood programs have a greater positive link for children from disadvantaged backgrounds (low household income or low maternal education) compared to the link for children from advantaged households (Burger, 2010; Crosnoe et al., 2010; Felfe and Lalive 2012; Gilliam & Zigler, 2000; NICHD National Early Child Care Research Network & Duncan, 2003; Peisner-Feinberg et al., 2001). Moreover, Ruhm and Waldfogel (2012) concluded that only the most vulnerable children benefit from attending centre-based care. Similarly, Caughy, DiPietro, and Strobino (1994) reported that centre-based care attendance before the first year of life is associated with future higher reading scores and mathematics scores for children from less educated households.

In a related strand of literature, Liu and Skans (2010) conclude that children of highly educated parents benefit in cognitive terms from delaying entry into centre-based care from 12 to 15 months. Likewise, Felfe and Lalive (2012) found that children from more advantaged backgrounds are the ones who benefit least from centre-based care attendance. In contrast, Cortazar (2011) using Chilean data, concluded that children aged two to four and of middle socio-economic status are the ones who seem to benefit most from attending centre-based care programs. Hence, Cortazar (2011) concludes that the children of low- and upper-middle income groups benefit little or not at all from attending centre-based care. In addition, Bernal and Keane (2011) using the National Longitudinal Survey of

Youth (NLSY79) conclude that children of single mothers who attended at centre-based care have a positive effect on their cognitive achievement. To conduct their study, Bernal and Keane exploit what they argue is an exogenous increase in the probability of attendance at centre-based care due to more generous child benefits in some US states in 1996.

There are several hypotheses behind the findings about the heterogeneity of the impact of centre-based care attendance on child development by the child's level of vulnerability. The 'compensatory hypothesis' states that more vulnerable children could benefit more from high-quality early child care than wealthier children because child care could provide learning opportunities that more vulnerable children do not have at home (Geoffroy et al., 2010). In contrast, the 'lost-resources hypothesis' states that children from high- or middle-income households develop less when they attend centre-based care than when they are in maternal care because the environment is less stimulating in the former than in the latter type of care (Caughy et al., 1994; Desai, Chase-Lansdale, & Michael, 1989).

## 6.3. Chilean context: Early childhood education and care policies

As in most countries, the enrolment in centre-based care of children under the age of three is lower than the enrolment of children between the ages of three and five. In 2010, only 10 per cent of one-year-olds and 33 per cent of two-year-olds attended centre-based care in Chile (CASEN, 2011). In addition, the levels of centre-based care participation are unequal across income levels. For example, in 2009, while only 16 per cent of children under four years old in households within the poorest income quintile attended centre-based care, the same proportion in households within the wealthiest income quintile was 34 per cent (CASEN, 2009). Preschool provision in Chile is focused on children aged five and younger and it is organised in the following levels.

**Table 6.1. Age and preschool arrangement in the Chilean system of early childhood education and care**

| Educational level's formal name | Educational level's common name | Age |
|---|---|---|
| *Sala Cuna* | *Sala cuna* (Nursery)<br>*Sala cuna* (Nursery) | Three to eleven months old<br>Twelve to twenty-three months old |
| *Nivel Medio* | *Jardín infantil* (Day care)<br>*Jardín infantil* (Day care) | Twenty-four to thirty-five months old<br>Thirty-six to forty-seven months old |
| *Nivel de Transición* | Prekinder<br>Kinder | Forty-eight to fifty-nine months old<br>Sixty to seventy-one months old |

In the context of this chapter that analyses the association between centre-based care attendance at two years old and child development, my analysis is centred on attendance at the day care level (‘*jardin infantil*’).

In Chile, both the private and public sectors provide preschool education and care services to children between zero and five years old. Within this mixed provision of preschool education and care, depending on the type of administrator, there are three types of centre-based care: public, subsidised-private, which are administered privately but publicly funded, and non-subsidised private centres, which are administratively and financially independent of government. Almost 90 per cent of day care centres receive funding from the Chilean government. The two main public centre-based care providers are the National Board of Education (*Junta Nacional de Jardines Infantiles* or JUNJI) and the Integra Foundation; together, they account for about 50 per cent of preschool coverage in Chile. In addition, 40 per cent of the coverage is provided by subsidised-private entities and the remaining 10 per cent, by non-subsidised private (Ministerio de Educación de Chile, 2014).[50]

Despite Chile’s dramatic increase in preschool coverage during the period from 2006–2011, the improvement in quality is unknown and, most likely, limited (The Economist Intelligence Unit Starting Well Index, 2012). Chile does not have a national preschool curriculum, only national guidelines. In addition, the country has a lack of quality standards and regulations (OCDE, 2011). Moreover, the entry into preschool teacher training is one of the least selective within university degrees in Chile (Tokman, 2010). Finally, the results of the INICIA test, which is a voluntary test that measures disciplinary and pedagogical knowledge of recently graduated preschool teachers, indicate that more than 60 per cent of them obtained poor results (INICIA, 2012). Poor results in the INICIA test mean that preschool teachers do not have the knowledge or skills necessary to perform their duties. (See chapter 2 for more information about Chile’s context)

### 6.4. The Present Study

This chapter analyses three main research questions. The first research question is whether there is any association between entering into centre-based care at age two and child

[50] As a reference point: while in the UK a 71.2 per cent of preschool institutions are public, 11.1 per cent are subsidised-private and 17.7 per cent are non-subsidised private. In the US, while 55.2 per cent of preschool institutions are public, 44.8 per cent are private.

cognitive and socio-emotional development at ages three and four. Given that the theory has an ambiguous prediction about the effect of attendance at centre-based care at two years old on child development and that the empirical findings yield ambiguous conclusions, in this article, I want to contribute to the understanding and integration of the disparate predictions and findings in the context of a middle-income country.

The second research question is whether the impact of early centre-based care (relative to maternal care) on child outcomes differs according to the intensity of centre-based care (part-time versus fulltime). Based on previous evidence, I hypothesise that more intense attendance at centre-based care (full-time relative to part-time) could have a more negative effect on child development. Previous evidence that analyses the impact of early maternal employment on child development is in line with the hypothesis that the time that children spent away from their mother matters.

The third research question is whether the association between centre-based care and child development varies by child vulnerability. I use low level of maternal education, whether the child lives in a single-parent family and whether the child's household is poor under Chile's standards as proxy variables for child vulnerability. One of the Chilean government objectives underlying the provision of centre-based care to the 60 per cent most vulnerable children in Chile was to reduce socioeconomic-based educational inequalities. Hence, this study analyses whether there are differences in the association between centre-based care attendance and child development outcomes depending on the child's level of household vulnerability.

This chapter aims to get an unbiased estimate for all the previous questions. The individual fixed effects analysis allows me to control for unobserved fixed characteristics of the mother and the children, like innate ability, that could bias the cross-section estimates. In addition, the use of propensity score matching enables me to avoid bias because of not specifying correctly the correct functional relation between the covariates and the development outcomes. Moreover, the ELPI survey early childhood longitudinal dataset of 15,000 Chilean households permits me to control for an extensive set of baseline characteristics that could introduce bias in my estimates in cases when these initial characteristics are correlated with both attendance at centre-based care and future child development maintaining an adequate power to detect relevant effects.

## 6.5. Method

### 6.5.1. Sample and Procedure

I use data from the Chilean panel survey, Longitudinal Survey of Early Childhood or *Encuesta Longitudinal de la Primera Infancia* (or ELPI for its acronym in Spanish), a nationally representative sample of children between six months and five years old (born between 1st January, 2006 and 31st August, 2009). The ELPI dataset includes socio-demographic data with variables such as parental educational attainment, employment, socio-economic status, the child's characteristics at birth, and the child's history of child care. In addition, this dataset includes the caregiver and children's physical, cognitive and social-emotional development assessments (see the Measures section below).

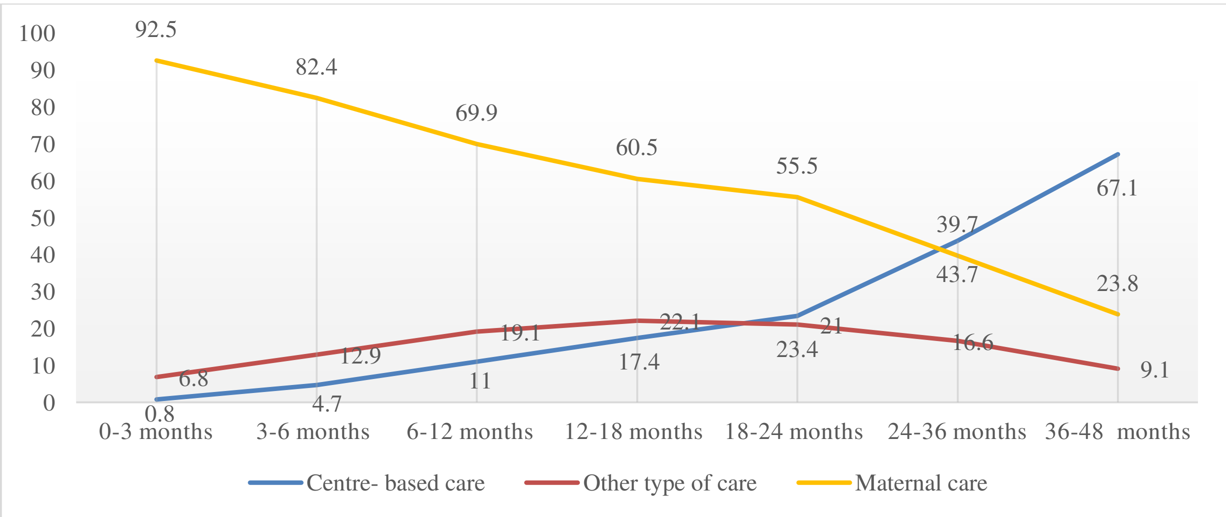
In this study, I use the two waves from the ELPI dataset currently available (2010 and 2012). The sample used for this analysis consists of children who were cared for full-time by their mothers until at least two years old, who were less than two years old in 2010, and whose information was collected in both waves of the ELPI longitudinal survey. As I mention in this chapter's introduction, I restrict my sample in the described way for several reasons. First, there is less evidence about the impact of entry at two years old at centre-based care on child development relative to the same impact at older age ranges. Second, before two years old most of the Chilean children were either with their mothers or in an informal type of care. Third, from two years old onwards, centre-based care starts being a more prevalent type of care. In total, this sample consisted of 1,589 children; however, depending on the missing values of the specific dependent variable (child development outcomes), the sample size fluctuates between 1,345 and 1,433 children. As depicted in Table 6.2, out of the previously described relevant sample, while 40 per cent of children were with their mothers, 44 per cent of children attended centre-based care, and 16 per cent attended other types of non-maternal care (grandparent, relative or non-relative care).

**Table 6.2. Timing of entry into centre-based and maternal care**

| Child's age entering care | Centre-based care | | Maternal care | | Other type of care | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| 0-3 months | 83 | 0.75 | 10,289 | 92.45 | 757 | 6.80 |
| 3-6 months | 524 | 4.71 | 9,168 | 82.36 | 1,440 | 12.94 |
| 6-12 months | 1,229 | 11.03 | 7,787 | 69.88 | 2,127 | 19.09 |
| 12-18 months | 1,945 | 17.44 | 6,745 | 60.49 | 2,460 | 22.06 |
| 18-24 months | 2,615 | 23.44 | 6,196 | 55.53 | 2,347 | 21.03 |
| 24-36 months | 4,873 | 43.69 | 4,425 | 39.68 | 1,855 | 16.63 |
| 36-48 months | 6,940 | 67.12 | 2,460 | 23.79 | 940 | 9.09 |

Notes: Timing of entry into child care is divided into seven groups: 1) children who started attending between 0 and 3 months old, 2) children who started attending between 3 and 6 months old 3) children who started attending between 6 and 12 months old 4) children who started attending between 12 and 18 months old, 5) children who started attending between 18 and 24 months old, 6) children who started attending between 24 and 36 months old and 7) children who started attending between 36 and 48 months old. There are three child care categories: 1) centre-based care that is in a group setting, 2) other types of care could be grandparent, relative, or non-relative care and 3) maternal care, in which the child stays with his or her mother all the time.

**Figure 6.1 Timing of entry into centre-based and maternal care**




Note: Author's calculation based on ELPI 2010 survey

### *6.5.2. Measures*

<u>Dependent variables: Children's cognitive and socio-emotional skills</u>

The present study uses the cognitive outcome measures taken in both waves of the ELPI survey. In 2010, the ELPI survey included the cognitive tests the Battelle Developmental Inventory and the Psychomotor Development Evaluation Scale (*Escala Evaluación Desarrollo Psicomotor*, or EEDP). In 2012, the ELPI survey included the Battelle Screening Test and the Child Development Cognitive Test (*Test de Aprendizaje de Desarrollo Infantil*, or TADI').

In addition, in the present study I use the socio-emotional outcome measures that are available in the 2010 ELPI survey for children aged 12 to 24 months and that were also passed to the same children in 2012. More than half of the children between 12 and 24 months old in 2010 were measured by the 'Child Behavior Checklist' (CBCL) test. The children who were evaluated in ELPI 2010 by the CBCL test were 18 to 24 months old at the time. The remaining 44 per cent of the children aged between 12 and 24 months in 2010 were measured in 2010 by the 'Ages & Stages Questionnaires: Social-Emotional (ASQ–SE)' test and in 2012 by the CBCL test. This group of children were aged 12 to 18 months in 2010.

To facilitate comparisons of my results with the rest of the literature, I work with standardised test scores. First, the Research Institute that runs the ELPI survey adjusted the raw test scores to account for the age of each child according to the conversion tables of each instrument. Second, I standardised these adjusted scores (zero mean and standard deviation unity).

**Table 6.3. Child outcomes in ELPI 2010 and ELPI 2012**

| | 2010 | Child's age range | 2012 | Child's age range |
|---|---|---|---|---|
| Cognitive development | Batelle Inventory | 12 to 23 months and 30 days | Battelle Screening Test | 36-48 months 30 days |
| | *Escala Evaluación Desarrollo Psicomotor* (EEDP) | 12 to 23 months and 30 days | TADI Tests | 36–48 months, 30 days |
| Socio-emotional development | Child Behavior Checklist (CBCL) | 18 to 24 months and 30 days | Child Behavior Checklist (CBCL) | 36-48 months 30 days |
| | Ages & Stages Questionnaires: Social-Emotional (ASQ–SE) | 9 to 17 months and 30 days | | |

Notes: The cognitive outcomes tests are the Battelle Inventory and Battelle Screening test which assess five domains: adaptive behaviour, personal/social skills, communication, motor ability, and cognitive skills. In addition the *Escala Evaluación Desarrollo Psicomotor* (EEDP) assesses the motor, language, social domain and coordination domains and the TADI (*Test de Aprendizaje de Desarrollo Infantil*, in English 'Child Development Cognitive Test') evaluates four dimensions: motor, language, cognitive, and social-emotional. One of the socio-emotional outcomes tests is the Child Behavior Checklist (CBCL) test that evaluates behavioural problems, externalizing problems, and internalising problems. This test was administered to children aged 18 to 24 months. The other socio-emotional outcomes test is the Ages & Stages Questionnaires: Social-Emotional (ASQ–SE) test that evaluates children's social and emotional behaviour through self-regulation, compliance, communication, adaptive functioning, autonomy, affect, and interaction with people. This test was administered to children aged 12 to 18 months.

Key variable: Early centre-based care attendance

The first focus in the analysis is exploring whether early centre-based care attendance is associated with child development. I exploit the fact that the ELPI survey has detailed information about the children's type-of-care history between zero and 60 months old. Using the question about the children's main type of care in each period between zero and 36 months old and whether the child attended centre-based care during the same period, I construct a variable that denotes transition from maternal care to centre-based care at 24 months old. See Appendix 6.1 for a detailed explanation of the previously mentioned variable construction.

Moderating variables: Intensity of care and child vulnerability

The second focus of this study is analysing whether the intensity of time (part-time or full-time) that the child spends in centre-based care at two years old moderates the association with child development. On average, full-time centre-based care implies a daily attendance at this type of care from 8:30 to 16:30. However, publicly funded centre-based care has an extended schedule for working mothers from 8.30 to 19:30. Based on this information, full-time attendance could imply between 40 and 55 hours per week of attendance at centre-based care. While 60 per cent of children in centre-based care attended this type of care on a full-time basis, the rest attended part-time51.

Finally, this study analyses whether child vulnerability is a relevant moderator in the association between centre-based care attendance and child development. I measure child vulnerability using three proxy variables: maternal education, household poverty level and household income. I consider that mothers with a low education level are those ones with less than twelve years of education (i.e. who did not achieve a high school degree). According to this criterion, 43 per cent of mothers in the ELPI survey have a low level of education.

I test whether household socio-economic status moderates the association between centre-based care attendance and child development. First, I dichotomise household per capita income into poor and non-poor. I use Chile's 2010 poverty line (less than £70 or 64.000 Chilean pesos per capita per month[52]) to define poor households. Using this criterion, 58 per cent of households in the sample classify as poor[53]. A greater proportion of families that include children tend to be in poverty, especially those with children younger than three years old. In Chile, 26 per cent of households with children under six belong to the lowest quintile (Herrera, Salinas, & Valenzuela, 2011). Second, to explore a potential heterogeneity in the impact of centre-based care depending on the whole income distribution, I divided family income into quintiles and performed separate analyses for children in each income quintile.

[51] Unfortunately, about intensity of care, the ELPI dataset only has information about attendance at part-time or full-time centre-based care. It does not include information about the number of hours per week spent in centre-based care.

[52] Implicitly, Chile uses an equivalence scale where each child weights the same as every adult in the calculation of income per capita. Chile's poverty line is consistent with this implicit equivalence scale.

[53] ELPI only selected families with at least one child between zero and six years old. Hence, the selected households have more children than the average Chilean household and, possibly, the breadwinners are younger than the average Chilean workers. Both factors imply a higher rate of poverty. In addition, due to underreporting of income in household surveys, household income in the ELPI survey is a lower bound for the real household income. It is worth mentioning that incomes in the ELPI survey were not rescaled to match the national accounts.

<u>Explanatory variables</u>

The regressions account for differences between children in different types of care across a comprehensive set of child, maternal, family, and geographic characteristics. All of them are predetermined because, while the outcome variable is from ELPI 2010 and 2012, I only use the explanatory variables from ELPI 2010. The set of child characteristics includes the child's gender, age, birth weight, whether she has an older sibling, or was born prematurely. Maternal characteristics include the mother's age, marital status, years of education, whether she worked or had depressive symptoms before birth. In addition, The Wechsler Adults Intelligence Scale ('WAIS') measured maternal cognitive abilities. The test has 7 verbal subtests and 7 performance subtests (Kaplan & Saccuzzo, 2009). The ELPI survey used only two out of the 14 subtests: vocabulary and digit span. Finally, I also controlled for maternal personality characteristics measured by the Spanish Big Five Inventory (henceforth, BFI). (John et al., 2008). In addition, I also included whether the mother drank alcohol or smoked during pregnancy, was a teenage mother, had difficulties during pregnancy or breastfeeding as regressors in the analysis.

In addition, I also control for family characteristics such as the child's home learning environment measured in ELPI 2010 with the Home Observation for Measurement of the Environment ('HOME'). Higher total HOME scores indicate a more enriched home environment. I also controlled for average household income over the last twelve months from all sources of income. Finally, I also controlled for geographic variables such as region where the child lives and whether the area is rural or urban; both variables are intended to capture part of the heterogeneity of centre-based care coverage in different zones of the country. The coverage of centre-based care is higher in urban areas relative to rural areas. Centre-based care coverage is also higher in Santiago's Metropolitan area relative to the coverage in the north and south of Chile. (Ministerio de Educacion de Chile, 2014)

*6.5.3. Data Analysis*

To address the research questions stated in section 6.4, I estimate the association between early centre-based care attendance and short-term effect on child development, controlling for a broad set of explanatory variables. To do this, I conduct two main sets of analyses: a cross-sectional and a longitudinal one. Firstly, I analyse the development outcomes of children who started centre-based care at two years old compared with those who stayed full-time with their mothers during the same period.

$$D_{it} = \beta C_{it} + f_t + \alpha_i + \varepsilon_{it} \qquad i = 1,..,N \qquad (1)$$

Where

$D_i$= Child $i$'s development outcome in 2012 at time $t$. This is the dependent variable. It varies depending on the test used to measure child cognitive or socio-emotional development. For information about the different measures, see Table 6.3.

The independent variables are:

$C_i$= Dummy variable for centre-based care attendance at time $t$. Equals 1 if the child $i$ entered centre-based care between 24 and 36 months old, 0 otherwise.

$f_t$= Time effect, representing common shocks to child development affecting all children at time $t$.

$\alpha_i$ = Unobserved fixed characteristics of the child or her context (mother, family, geographic area) that do not change in time.

$\varepsilon_i$ = Child $i$'s development outcome error term (i.e. factors determining the child's development outcome that are unobserved to the researcher).

The coefficient of interest is $\beta$. I interpret this coefficient as the effect on child development of entry into centre-based care relative to continuing in maternal care.

The problem with equation (1) is that the unobserved (to the researcher) individual fixed effects $\alpha_i$ such as paternal intellectual ability or child temperament could be correlated with both the option for centre-based care and the child's development outcome. If this were the case, the coefficient of interest $\alpha_i$ would be biased. Given that I have information for two periods, I can control for individual fixed effects. This way, I am able to control for unobserved fixed characteristics of children and the contexts that do not change in time, such as child temperament or genetic endowment.

Therefore, in a second set of regressions, I use a longitudinal approach to investigate the association between attendance at centre-based care (relative to maternal care) and child development outcomes using a difference in differences approach. When the researcher has two periods of data (in my case, t=2010 for the first period and t=2012 for the second period), a convenient way to rewrite equation (1) is in first differences:

$$D_{i2012} - D_{i2010} = \beta(C_{i2012} - C_{i2010}) + (f_{2012} - f_{2010}) + X'_{i2010}\,\gamma + \varepsilon_{i2012} - \varepsilon_{i2010} \qquad i = 1,..,N\ ; \quad (2)$$

The advantage of equation (2) over (1) is that, while the coefficient of interest $\beta$ is still present, thanks to the first differences, the unobserved fixed-effects parameter $\alpha_i$ that was probably introducing omitted variable bias in equation (1) has been accounted for in equation (2). I also introduce predetermined fixed effects in equation (2), $X'_{i2010}$, which allow differential pre-existing development outcome trends along all previously mentioned child, maternal, family, and geographic characteristics. Some authors include other potentially relevant covariates in first differences in equation (2). The advantage of doing this is that if there are time-varying shocks to one of these covariates that could be biasing my results (such as, for example, changes in income for the treated or control populations between the first and second period), the covariates in first differences would control for these shocks. The disadvantage of doing this is that, if part of the effect of the treatment is through these specific covariates (for example, if the availability of centre-based care increases earnings by increasing the likelihood of maternal employment), the key coefficients (the effect of centre-based care on child outcomes) would be biased. Because I consider that the latter story is more feasible than the former one, I do not include the potentially relevant covariates in first differences, but only in their pre-treatment level.[54]

Equation (2) assumes that the effect of centre-based care is homogeneous for all children. However, as explained before in subsection 2.1.3, there is evidence that such effect is more positive for disadvantaged children compared to wealthier children. Therefore, I investigate the moderating role of child's socioeconomic status on the association between attendance at centre-based care and child development outcomes. The empirical specification of the test on the moderators is as follows:

[54] This is analogous to including the covariates in equation (1) interacted with a period-specific dummy variable that takes a value of one for the first period, zero otherwise.

$$D_{i2012} - D_{i2010} = \beta_m M_{i2010}(C_{i2012} - C_{i2010}) + \beta_r(1 - M_{i2010})(C_{i2012} - C_{i2010}) + (f_{2012} - f_{2010}) + X'_{i2010}\gamma + \varepsilon_{i2012} - \varepsilon_{i2010}$$

$$i = 1, .., N ; \quad (3)$$

The independent variable not previously described is:

$M_{i2010}$ = Dummy variables for the two different moderators. For maternal level of education, equals one if mother has low education (less than high school), zero if she has a high level of education. For household poverty, equals one if the child's household is below the poverty line, zero if it is above poverty line.

For both types of moderators, the coefficient of interest is the effect of early centre-based care attendance on child development for the different subgroups, $\beta_m$ for children of mothers who are high school dropouts or poor children and $\beta_r$ for children of mothers who are high school graduates or non-poor children. The magnitude of $\beta_m - \beta_r$ is the degree of heterogeneity in the effect of early centre-based care attendance on child development.

Equation (3) imposes strong parametric assumptions of additive linearity and lack of interactions in the relation between the covariates and child development (the model's dependent variable). Similarly, in an OLS regression I could be comparing children who experience early centre-based care with children in maternal care regardless of how 'comparable' these children are. For example, given that they would have no counterparts in centre-based care, it would not be reasonable to include extremely poor children in the previous comparison if all the extremely poor children stay in maternal care. If this were the case, an OLS regression would be extrapolating the predicted relation between the treatment variable and the child development outcomes out of what statisticians call the 'common support'.

To avoid the previous issues of assuming a specific functional form between the covariates and the outcome variable, I will use propensity score matching to compare the outcomes in first differences for those children who started child care early (the treated group) with those who remained in maternal care (the control group).

Hence, my final empirical specification combines the data in first differences with an analysis using Propensity Score Matching to create a 'counterfactual' group to the group of children who entered into early centre-based care out of the group of children who remained in maternal care. My preferred matching specification uses nearest neighbour matching to reduce bias. In addition, I check whether the treated and matched-counterfactual group are balanced in the mean of the covariates (Appendices 6.3 through 6.5).

Hence, the assumption to get to a causal estimate of the effect of early centre-based care on child development outcomes is that, controlling for differential development outcome trends along child, maternal, family and geographic characteristics, there are no differential development trends for children who attended early centre-based care relative to those children who stayed with their mother.

## 6.6. Results

### *6.6.1. Descriptive statistics of child, family and maternal characteristics for children who assist centre-based care at age two and child cognitive and socio-emotional outcomes*

Table 6.4 shows differences between mothers of children who, at two years of age, had moved into centre-based care and those who remained in maternal care. Mothers of children who remained in maternal care are older, more likely to be married, have lower education, lower mathematics and vocabulary skills, and were less likely to work before pregnancy compared to mothers of children who moved into centre-based care at the age of two. Similarly, children in the former group come from lower-income families and a less stimulating home environment (measured by the HOME test score). On the other hand, children in the sample who entered at centre-based care between two and three years old have mothers who were more likely to have presented depression or to have smoked during pregnancy compared to children who remained in exclusive maternal care during the same period. The differences in these characteristics underline the importance of controlling for observed characteristics in the analyses.

**Table 6.4. Differences in maternal, child, and family characteristics for children in centre-based care at two years old compared to maternal care.**

| | Maternal care only (1) | Centre-based care (2) | (1) versus (2) |
|---|---|---|---|
| Maternal characteristics | | | |
| Age | 28.77 | 27.75 | *** |
| Married (%) | 77.4 | 65.9 | *** |
| Years of education | 10.68 | 11.86 | *** |
| Low level of education (%) | 43.9 | 30.7 | *** |
| Teenager (less than 20 years old) (%) | 13.77 | 17.25 | *** |
| Presented depression during pregnancy (%) | 13.9 | 18.7 | *** |
| Worked before pregnancy (%) | 23.4 | 45.5 | *** |
| Ability with numbers | 6.59 | 7.10 | *** |
| Ability with vocabulary | 7.47 | 8.43 | *** |
| Extraversion | 3.50 | 3.61 | *** |
| Agreeableness | 3.83 | 3.81 | |
| Conscientiousness | 3.94 | 3.97 | |
| Neuroticism | 3.07 | 3.05 | |
| Openness | 3.75 | 3.85 | *** |
| Breastfed her children (%) | 95.4 | 95.3 | |
| Difficult pregnancy (%) | 43.2 | 45.5 | |
| Presented mental health problems during pregnancy (%) | 14.47 | 19.55 | *** |
| Drank alcohol during pregnancy (%) | 7.4 | 8.1 | |
| Smoked during pregnancy (%) | 8.6 | 11.5 | ** |
| Child characteristics | | | |
| Female (%) | 49.0 | 49.7 | |
| Low birth weight (%) | 5.9 | 4.3 | * |
| Premature (%) | 7.5 | 5.9 | |
| Had common disease (%) | 53.2 | 59.1 | *** |
| Has older sibling (%) | 62.6 | 50.7 | *** |
| Family characteristics | | | |
| Income per capita (£) | 101.8 | 134.9 | *** |
| Family in poverty (%) | 64.0 | 49.5 | *** |
| Number of people in household | 5.03 | 4.84 | *** |
| Family below Chile's poverty line (%) | 56.7% | 41.5% | |
| HOME1 Score | 14.98 | 15.36 | *** |
| Sample size | 1,120 | 1,438 | |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. (1) Home Observation Measurement of the Environment (HOME)

Table 6.5 shows the means and standard errors of unconditional regressions of child cognitive and socio-emotional development on whether those children entered into centre-based care at the age of two. Children who remained with their mothers exhibit lower test scores (Batelle Inventory 2010, Battelle Screening 2012, and TADI 2012 test scores) in the cognitive domain compared to children who went to centre-based care. On the other hand, children who remained in maternal care present lower levels of socio-emotional (CBCL 2012) and externalising problems (CBCL externalising 2010) compared to children who moved into centre-based care. Interestingly, children who attended centre-based care present fewer internalising problems compared to children who remained in maternal care at the age of two.

**Table 6.5. Differences in cognitive and socio-emotional outcomes for children who experienced maternal care and centre-based care between 24 and 36 months old.**

| | (1) Maternal care only | (2) Centre-based care | (3) (1) versus (2) |
|---|---|---|---|
| | Cognitive development | | |
| Battelle Inventory 2010 | -0.138 | -0.045 | ** |
| | (0.967) | (0.998) | |
| EEDP 2010 | -0.067 | -0.085 | |
| | (0.967) | (1.02) | |
| Battelle Screening Test 2012 | -0.580 | -0.325 | *** |
| | (0.030) | (0.028) | |
| TADI 2012 | -0.297 | -0.079 | *** |
| | (0.026) | (0.023) | |
| | Socio-emotional development | | |
| CBCL Total 2010 | 0.011 | 0.010 | |
| | (0.964) | (0.950) | |
| Externalising problems score 2010 | -0.017 | 0.087 | ** |
| | (0.985) | (0.990) | |
| Internalising problems score 2010 | -0.073 | -0.183 | ** |
| | (0.973) | (0.960) | |
| ASQ-SE 12 months 2010 | 0.009 | -0.032 | |
| | (1.04) | (1.00) | |
| ASQ-SE 18 months 2010 | 0.026 | 0.008 | |
| | (1.02) | (1.05) | |
| CBCL Total 2012 | 0.069 | 0.074 | |
| | (0.029) | (0.027) | |
| Externalising problems score 2012 | 0.084 | 0.130 | |
| | (0.029) | (0.027) | |
| Internalising problems score 2012 | 0.054 | 0.009 | |
| | (0.029) | (0.027) | |

Notes: The cognitive outcomes tests are: the Battelle Inventory and Battelle Screening tests which assess five domains: adaptive behaviour, personal/social skills, communication, motor ability, and cognitive skills. The TADI (*Test de Aprendizaje de Desarrollo Infantil*, in English 'Child Development Cognitive Test') that evaluates four dimensions: motor, language, cognitive, and social-emotional. One of the socio-emotional outcomes tests is the Child Behavior Checklist (CBCL) that evaluates behavioural problems, internalising problems (for example, anxious, depressive, and over-controlled behaviours), and externalising problems (for example, aggressive, hyperactive behaviours). This test was administered to children aged 18 to 24 months. The other socio-emotional outcomes test is the Ages & Stages Questionnaires: Social-Emotional (ASQ–SE) test that evaluates children's social and emotional behaviour through self-regulation, compliance, communication, adaptive functioning, autonomy, affect, and interaction with people. This test was administered to children aged 12 to 18 months. I converted children's outcomes into Z scores. For cognitive tests, a positive coefficient means higher cognitive development in contrast with socio-emotional outcomes for which a negative coefficient means fewer socio-emotional problems. The comparison in column (3) controls for children's age in a linear fashion proportional to months. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

*6.6.2. Does attendance at centre-based care at two years old improve child development?*

Table 6.6. presents results from OLS models that examine the association between attendance at centre-based care at two years old and child cognitive and socio-emotional development. I present four models with increasing control variables to address potential selection effects. Column (1) in Table 6.6 exhibits unconditional regressions of child development on the attendance at centre-based care at the age of two. The results in this column suggest that attendance at centre-based care is strongly associated with positive child cognitive development. Children that attended centre-based care at two years old have 18 per cent of one standard deviation (measured by the TADI test) and 17 per cent of one standard deviation (measured by the Battelle Screening test) higher cognitive skills compared to children who are not in centre-based care. Models 2 through 4 show that adding more covariates to the regression reduces the magnitude of the association between centre-based care and child cognitive development, especially after adding spatial characteristics (region and area where the child lives).

The covariates in column (4) include mother, child, family, and spatial characteristics. In this case, there is a small positive association between centre-based care attendance and child cognitive development. The effect size of this association is 12 per cent (measure by the TADI test) and 10 per cent of one standard deviation (measured by the Battelle Screening test).

However, attendance at centre-based care (relative to maternal care) at two years old is not associated with higher or lower child socio-emotional development. The addition of covariates has no effect on the association between attendance at centre-based care and socio-emotional and externalising problems.

**Table 6.6. The association between centre-based care attendance at two years old and child outcomes at three and four years old: OLS estimates.**

| | Cognitive development | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | TADI test | | | | Battelle test | | | |
| Variables | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| Centre-based two-years old | 0.178*** | 0.139*** | 0.128*** | 0.117** | 0.169*** | 0.122** | 0.117** | 0.104* |
| | (0.048) | (0.048) | (0.048) | (0.048) | (0.057) | (0.055) | (0.056) | (0.056) |
| Demographic | | X | X | X | | X | X | X |
| Home environment | | | X | X | | | X | X |
| Region and urban | | | | X | | | | X |
| Observations | 1,465 | 1,338 | 1,281 | 1,281 | 1,473 | 1,346 | 1,289 | 1,289 |
| R-squared | 0.011 | 0.114 | 0.133 | 0.141 | 0.007 | 0.124 | 0.133 | 0.140 |

| | Socio-emotional development | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CBCL test total | | | | Internalising problems | | | |
| Variables | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| Centre-based two-years old | 0.059 | 0.086 | 0.090 | 0.092 | 0.012 | 0.066 | 0.067 | 0.073 |
| | (0.053) | (0.056) | (0.057) | (0.057) | (0.054) | (0.056) | (0.057) | (0.057) |
| Demographic | | X | X | X | | X | X | X |
| Home environment | | | X | X | | | X | X |
| Region and urban | | | | X | | | | X |
| Observations | 1,509 | 1,376 | 1,318 | 1,318 | 1,509 | 1,376 | 1,318 | 1,318 |
| R-squared | 0.001 | 0.095 | 0.097 | 0.099 | 0.000 | 0.080 | 0.083 | 0.087 |

Notes: All OLS regressions control for children's age. All columns show the magnitude of the key coefficient with s.e. in parentheses. Column (1) shows the results of a regression without controls. Column (2) shows the results of a regression controlling for demographic characteristics such as maternal characteristics: age (linear and square); years of education, low level of education, marital status, work status, teen pregnancy, difficulties during pregnancy, mental health problems during pregnancy, breastfeeding, alcohol consumption and smoking, depression, numeracy and vocabulary abilities, and personality. In addition, this regression controls for the child's characteristics: gender; presence of older sibling, premature birth; low weight; common disease, and age (linear and square). Colum (3) shows the result of regression in column (2) plus controls for home environment characteristics: family income per capita (linear and square), family under poverty line, and HOME test score. Column (4) shows the results for the regression in column (3) plus region and area (urban or rural) controls. The cognitive outcomes tests are the TADI (*Test de Aprendizaje de Desarrollo Infantil*, in English 'Child Development Cognitive Test') that evaluates four dimensions: motor, language, cognitive, and social-emotional and the Battelle Screening test that assesses five domains: adaptive behaviour, personal/social skills, communication, motor ability, and cognitive skills. One of the socio-emotional outcomes tests is the Child Behavior Checklist (CBCL) test that evaluates behavioural problems, internalising problems (for example, anxious, depressive, and over-controlled behaviours), and externalising problems (for example, aggressive, hyperactive behaviours). For cognitive tests a positive coefficient means higher cognitive development in contrast with socio-emotional outcomes for which a negative coefficient means fewer socio-emotional problems. I converted children's outcomes into Z scores. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses

All regressions only consider observations with no missing values in any included covariate. However, selection on missing values could be driving my results. In Table 1 in Appendix 6.2, I run the same analysis as in Table 6.6 but restricting my covariates to those with no missing values. This Table shows that the magnitudes (and statistical significance) of my coefficients do not change using the whole sample. This evidence supports the assumption that my results in Table 6.6 are not due to selection on missing values.

Individual fixed effects and propensity score matching

OLS model estimates suggest that centre-based care attendance is positively associated with child cognitive development but is not associated with child socio-emotional development. In order to address possible selection on fixed unobservable characteristics and misspecification bias, I conducted two alternative specifications analyses: individual fixed effects (FE) and FE plus Propensity Score Matching (PSM).

For ease of comparison, while the first row in Table 6.7 repeats the results of the most complete OLS model in Table 6.6, the second row presents the individual FE model. In column (1), where the dependent variable is the Battelle test score, the key coefficient is smaller (and not statistically significant) in the FE analysis compared to the OLS estimates. However, in column (2), where the dependent variable is the TADI test score, the coefficient of 23 per cent of one standard deviation suggests that, after controlling for unobserved fixed variables, centre-based care attendance is positively associated with child cognitive development. In addition, the fixed effects coefficient continues suggesting that attendance at centre-based care at two years old is not associated with child socio-emotional development at three and four years old.

Finally, the results for the FE plus PSM model analysis are presented in the third row of Table 6.7. The PSM creates an experimental counterfactual group to the group of children who experienced early centre-based care. Hence, checking whether the distribution of the covariates in the matched sample is similar to the covariates in the treated group is vital. Appendices 6.3, 6.4 and 6.5 show that there are no significant differences in the means of the covariates between the treated and control groups. In this model of FE plus PSM, the association between centre-based care attendance and child cognitive outcomes is even larger than in the OLS and FE analyses. Children who experienced early centre-based care have cognitive scores 13 per cent and 19 per cent of one standard deviation higher relative to children who remained in maternal care, measured by the Battelle and TADI tests respectively. This positive association between attendance at centre-based care and child cognitive development is robust to different types of analyses. This positive association is observed in the OLS, FE, and FE+PSM models. In addition, the same tendency is corroborated estimating both the average treatment effect (ATE) and average treatment effect on the treated (ATT) models. My preferred estimate (and the one I put in the table) is the calculation of the ATT because its unbiased estimation requires a weaker assumption than the assumption required for an unbiased estimation of the ATE (Blundell & Costas Dias, 2009)[55.]

On the other hand, early centre-based care attendance (relative to maternal care) is not associated with child socio-emotional problems. This result is not robust when I calculated the treatment effects on different sub-populations. The ATE yields a small negative association (7 per cent of one standard deviation more socio-emotional problems) between attendance at centre-based care at two years old and child socio-emotional development (results non-shown, available on request). In addition, a subsample analysis of all children measured with the CBCL test in both 2010 and 2012 suggests that children who attended centre-based care at two years old (relative to children in maternal care during the same period) showed fewer externalising and internalising problems at age three to four (for more information see appendix 6.6)[56.]

[55] While identification of the ATT requires that conditional on the set of observables the non-treated outcomes are independent of the treatment status, identification of the ATE requires that conditional on the set of observables both the treated and non-treated outcomes are independent of the treatment status (Blundell and Costa-Diaz, 2009)

[56] To analyse the specific socio-emotional sub-area I must refer to the subsample of children who took the CBCL test in both periods because children who took the ASQ-SE test in 2010 only have a general score.

**Table 6.7. The association between centre-based care attendance at two years old and child outcomes at three and four years old. OLS, individual fixed effect and propensity score matching estimates.**

| | Cognitive development | | Socio-emotional development |
|---|---|---|---|
| | (1) Battelle | (2) TADI | (3) CBCL Total |
| OLS | 0.104* | 0.117** | 0.092 |
| | (0.056) | (0.048) | (0.057) |
| Observations | 1,289 | 1,281 | 1,318 |
| R-squared | 0.140 | 0.141 | 0.099 |
| Individual fixed effects (FE) | 0.066 | 0.225*** | 0.086 |
| | (0.079) | (0.069) | (0.069) |
| Observations | 1,169 | 1,163 | 1,304 |
| R-squared | 0.082 | 0.076 | 0.051 |
| Individual FE + propensity score matching (PSM) | 0.132** | 0.185*** | -0.066 |
| | (0.058) | (0.054) | (0.051) |
| Observations | 1,169 | 1,163 | 1,304 |

Notes: All regressions in this table control for demographic, home environment, and regional characteristics. The cognitive outcomes tests are the TADI (*Test de Aprendizaje de Desarrollo Infantil*, in English ‘Child Development Cognitive Test’) that evaluates four dimensions: motor, language, cognitive, and social-emotional and the Battelle Screening test that assesses five domains: adaptive behaviour, personal/social skills, communication, motor ability, and cognitive skills. One of the socio-emotional outcomes tests is the Child Behavior Checklist (CBCL) test that evaluates behavioural problems. In the case of Individual fixed effects (FE) and the Individual FE + propensity score matching (PSM) models, TADI means TADI score minus EDDP score, Battelle means Battelle Screening test score minus Battelle Inventory score; and CBCL means CBCL 2012 score minus CBCL 2010 score. For cognitive tests, a positive coefficient means higher cognitive development in contrast with socio-emotional outcomes for which a negative coefficient means fewer socio-emotional problems. I converted children’s outcomes into Z scores. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Robust standard errors in parentheses.

Taking the three analyses together, centre-based care attendance at two years old is positively associated with child cognitive development and not significantly associated with child socio-emotional development.

*6.6.3 Does the association between centre-based care and child outcomes differ according to the intensity of centre-based care?*

Based on previous evidence, this study analyses whether the intensity of centre-based care attendance affects child development. Table 6.8 shows that part-time attendance (relative at maternal care) at centre-based care is positively associated with cognitive outcomes measure by the EEDP and TADI tests. The magnitude of this association is 17 per cent of one standard deviation. In addition, full-time attendance at centre-based care relative to maternal care is positively associated with cognitive outcomes (25 per cent of one standard deviation) but negatively associated with socio-emotional problems (17 per cent of one standard deviation). Children who attended full-time centre-based care present higher cognitive outcomes but more socio-emotional problems relative to children in maternal care.

**Table 6.8. The association between centre-based care attendance and child outcomes by intensity of care: part-time, full-time compared with maternal care. PSM+FE estimates.**

| | (1)<br>Battelle | (2)<br>EEDP/TADI | (3)<br>CBCL total |
|---|---|---|---|
| Part-time centre-based care at 2 years old | 0.017<br>(0.103) | 0.173**<br>(0.087) | -0.011<br>(0.090) |
| Full-time centre-based care at 2 years old | 0.092<br>(0.100) | 0.246***<br>(0.090) | 0.173**<br>(0.084) |
| Observations | 1,169 | 1,163 | 1,304 |
| R-squared | 0.088 | 0.087 | 0.056 |

Notes: The reference category is maternal care. All regressions in this table control for demographic, home environment, and regional characteristics. Battelle means Battelle Screening test score minus Battelle Inventory score; EEDP/TADI means TADI score minus EDDP score and CBCL means CBCL 2012 scores minus CBCL 2010 score. For cognitive tests a positive coefficient means higher cognitive development in contrast with socio-emotional outcomes for which a negative coefficient means fewer socio-emotional problems. . I converted children’s outcomes into Z scores. All OLS regressions control for children’s age. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

Table 6.9 shows the differential impact of part-time and full-time attendance at centre-based care. The analysis shows that full-time (relative to part-time) attendance at centre-based care is positively associated with cognitive outcomes but is not associated with socio-emotional problems. In the present study, the association between attendance at centre-based care and cognitive development is between 35 and 37 per cent of one standard deviation higher for children who attended centre-based care full-time relative to children who attended part-time. In addition, children who attended full-time at centre-based care show more socio-emotional problems relative to children who attended part-time; however, this association is not statistically significant.

**Table 6.9. The association between enter at centre-based care between 24 and 36 months and child outcomes by intensity of care: part-time and full-time. PSM+FE estimates.**

| | (1)<br>Battelle | (2)<br>EEDP/TADI | (3)<br>CBCL total |
|---|---|---|---|
| Full time centre-based care at two years old | 0.371***<br>(0.097) | 0.353***<br>(0.093) | 0.034<br>(0.092) |
| Observations | 437 | 436 | 489 |

Notes: The reference group is part-time attendance at centre-based care. All regressions in this table control for demographic, home environment, and regional characteristics. Battelle means Battelle Screening test score minus Battelle Inventory score; EEDP/TADI means TADI score minus EDDP score, and CBCL means CBCL 2012 scores minus CBCL 2010 score. For cognitive tests a positive coefficient means higher cognitive development in contrast with socio-emotional outcomes for which a negative coefficient means fewer socio-emotional problems. I converted children's outcomes into Z scores. All OLS regressions control for children's age. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

### *6.6.4. Does the association differ for disadvantaged children?*

In this study, I analyse the potentially moderating effect of child vulnerability using three proxy variables to 'vulnerability': whether the child has a mother with a low level of education (less than high school education), whether the child's household is in poverty (below Chile's poverty line) and whether the child lives in a single-parent family. The only two significant interactions indicate that the effect of centre-based care attendance (relative to maternal care) at two years old on child socio-emotional development (measured by the CBCL test) varies as a function of the family's level of poverty and the family's structure. Panel B in Table 6.10, shows that the association between attending centre-based care at two years old and socio-emotional problems is significantly more negative for children from poor households than for children from non-poor households. The association between attendance at centre-based care at age two and child behavioural problems at age three to four was 26 per cent higher for children in poor households compared to children from non-poor households. However, the association between centre-based care attendance at age two and child cognitive outcomes at age three to four does not differ depending on the level of poverty of the children's household. Finally, Panel C in Table 6.10, shows that attendance at centre-based care at two years old is associated with more socio-emotional problems at age three to four for children in single-parent families relative to the same association for children in two-parent families. (30 per cent of a standard deviation).

**Table 6.10. The association between centre-based care attendance and child outcomes by child vulnerability. Difference-in-differences estimates.**

| | Cognitive development | | Socio-emotional development |
|---|---|---|---|
| | (1) Battelle n=1061 | (2) EEDP/ TADI n=1055 | (3) CBCL total n=1188 |
| Panel A | | | |
| Centre-base care at two years old | 0.109 | 0.177* | 0.065 |
| | (0.120) | (0.098) | (0.091) |
| Low maternal education | 0.107 | -0.465 | 0.442 |
| | (0.626) | (0.546) | (0.729) |
| Centre-base care at two years old X Low maternal education | -0.108 | 0.063 | 0.081 |
| | (0.176) | (0.153) | (0.146) |
| Panel B | | | |
| Centre-base care at two years old | 0.207* | 0.248** | -0.0382 |
| | (0.124) | (0.106) | (0.100) |
| Poor family | -0.057 | 0.004 | -0.192* |
| | (0.115) | (0.105) | (0.099) |
| Centre-base care at two years old × Poor family | -0.262 | -0.085 | 0.255* |
| | (0.176) | (0.148) | (0.145) |
| Panel C | | | |
| Centre-base care at two years old | 0.005 | 0.155* | 0.030 |
| | (0.100) | (0.084) | (0.080) |
| Single parent family | -0.212* | -0.416*** | -0.188* |
| | (0.125) | (0.113) | (0.109) |
| Centre-base care at two years old × single -parent family | 0.258 | 0.208 | 0.303* |
| | (0.218) | (0.184) | (0.179) |

Notes: All regressions in this table control for demographic, home environment, and regional characteristics. In Panel A, the reference category is maternal care and maternal high education. In Panel B, the reference category is maternal care and non-poor families. In Panel C, the reference category is maternal care and two-parent families. The cognitive outcomes tests are the TADI (*Test de Aprendizaje de Desarrollo Infantil*, in English 'Child Development Cognitive Test') that evaluates four dimensions: motor, language, cognitive, and social-emotional and the Battelle Screening test that assesses five domains: adaptive behaviour, personal/social skills, communication, motor ability, and cognitive skills. One of the socio-emotional outcomes tests is the Child Behavior Checklist (CBCL) test that evaluates behavioural problems, internalising problems (for example, anxious, depressive, and over-controlled behaviours), and externalising problems (for example, aggressive, hyperactive behaviours). Battelle means Battelle Screening test score minus Battelle Inventory score; EEDP/TADI means TADI score minus EDDP score, and CBCL means CBCL 2012 scores minus CBCL 2010 score. For cognitive tests, a positive coefficient means higher cognitive development in contrast with socio-emotional outcomes for which a negative coefficient means fewer socio-emotional problems. I converted children's outcomes into Z scores. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Robust standard errors in parentheses.

I performed separate analyses estimating the impact of centre-based care on child development for each household income quintile. Household income quintiles are described as low, middle-low, middle, upper-middle, and upper. I decided to perform this analysis to provide information about which children are particularly affected by attendance at centre-based care, focusing specifically on children from more vulnerable households (low and middle-low groups).

Table 6.11 presents the effects of centre-based care by quintiles. I find that children from the second poorest quintile who attended centre-based care at age two have a significantly more negative impact on their socio-emotional development (measured by the CBCL test) compared to children from the richest quintile. The magnitude of the previously described heterogeneity in the effect of attendance at centre-based care is 43 per cent of one standard deviation. A sub-sample analysis with children who were measured with the same instrument in the socio-emotional domain in 2010 and 2012 (the CBCL test), also shows the previously described heterogeneous effect (results not shown, available on request).

**Table 6.11: The association between centre-based care attendance and child outcomes by family socio-economic quintile. Individual fixed effects estimates**

| | Cognitive development | | Socio-emotional development |
|---|---|---|---|
| | (1) Battelle | (2) EEDP/TADI | (3) CBCL total |
| Centre-based care at two-years old X 1st income quintile | -0.292 | -0.261 | 0.242 |
| | (0.297) | (0.251) | (0.218) |
| Centre-based care at two-years old X 2nd income quintile | -0.065 | -0.210 | 0.426** |
| | (0.272) | (0.239) | (0.187) |
| Centre-based care at two-years old X 3rd income quintile | -0.232 | -0.230 | 0.199 |
| | (0.254) | (0.212) | (0.181) |
| Centre-based care at two-years old X 4th income quintile | 0.155 | -0.073 | 0.152 |
| | (0.233) | (0.221) | (0.175) |
| Observations | 1,159 | 1,152 | 1,291 |

Notes: The reference category is attendance at centre-based care for the fifth quintile. All regressions in this table include the main effects (income quintiles and attendance at centre-based care at two years old) and control for demographic, home environment, and regional characteristics. The cognitive outcomes tests are the TADI (*Test de Aprendizaje de Desarrollo Infantil*, in English 'Child Development Cognitive Test') that evaluates four dimensions: motor, language, cognitive, and social-emotional and the Battelle Screening test that assesses five domains: adaptive behaviour, personal/social skills, communication, motor ability, and cognitive skills. One of the socio-emotional outcomes tests is the Child Behavior Checklist (CBCL) test that evaluates behavioural problems, internalising problems (for example, anxious, depressive, and over-controlled behaviours), and externalising problems (for example, aggressive, hyperactive behaviours). Battelle means Battelle Screening test score minus Battelle Inventory score; EEDP/TADI means TADI score minus EDDP score, and CBCL means CBCL 2012 scores minus CBCL 2010 score. For cognitive tests a positive coefficient means higher cognitive development in contrast with socio-emotional outcomes for which a negative coefficient means fewer socio-emotional problems. I converted children's outcomes into Z scores. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

Hence, the previously described analyses suggest that there is some evidence that attendance at centre-based care at two years old has a more detrimental effect on the socio-emotional development of more vulnerable children than the same effect for more advantaged children.

*6.6.5. Does the association between centre-based care and child development differ depending on the type of provision?*

Given Chile and many other developing countries are decidedly increasing their centre-based care coverage, uncovering the effects of publicly funded centre-based care is extremely relevant. Unfortunately, the ELPI dataset does not have information about centre-based care quality. However, the analysis about the impact of different types of centre-based care could provide some guidance about the quality of private and publicly funded centre-based care.

I create the ‘type of provision’ variable depending on the administrative entity of the centre-based care. The five more common administrative entities are non-subsidised private (16%), subsidized private (8.7%), municipal (13.3%), JUNJI (41.3%) and INTEGRA (17.4%). (For more information about the type of provision, see Chapter 2.)

I divided type of centre-based care into two categories: publicly and privately run centre-based care institutions. I found that the type of administrative entity of the centre-based care institution is not a relevant moderator in the association between centre-based care and child cognitive or socio-emotional development. (Results not shown but available on request.)

### 6.7. Summary, conclusions, and policy implications

The present study provides evidence about the short-term effects of centre-based care for two years old on children's cognitive and socio-emotional development in Chile. Even though this is not the first study that addresses the question of whether centre-based care has an effect on child development, it is the first to focus on children who started attending centre-based care at 24 months old and remained in this type of care at least until 36 months old. I chose this age range because research is inconclusive about the benefits of early childhood intervention for children under three years old (Gambaro et al., 2014). In addition, at 24 months old many Chilean families start sending their children to centre-based care. Before this age, most children are cared for by exclusively by their mothers or attend other types of informal care such as relative or non-relative care.

Even though Chile has greatly increased its centre-based care coverage, the coverage for children under three years old continues to be low: 10 per cent for children under two years old, and 41 per cent for two-year-olds (CASEN, 2011). In this context, before increasing early centre-based care coverage to the standard of most OECD countries, it is extremely relevant to consider information about the effects of centre-based care attendance on child development.

The main finding of this study is that attending centre-based care at two years old is positively associated with child cognitive development and is not associated with child socio-emotional development. In the FE and PSM models, the (positive) effect of attending centre-based care on child cognitive development ranges between 13 to 19 per cent of one standard deviation (depending on the cognitive test) relative to children who stayed with their mothers. The magnitude of the previously mentioned effect in the literature is 34 per cent of one standard deviation (Nores & Barnett, 2010). According to Nores and Barnett (2010), the average effect size of attending early childhood interventions (relative to not attending early childhood interventions) is lower in low- and middle-low-income countries (average effect size of 25 per cent of one standard deviation) compared to the same effect in middle- and middle-high income countries (average effect size of 31 per cent of one standard deviation). Nores and Barnett, (2010) also note that studies that used propensity score matching techniques have smaller effect sizes (an average effect size of 13 per cent of one standard deviation) compared with randomized experiments (average effect size of 28 per cent of one standard deviation).

Hence, my findings in the cognitive domain are consistent with the effects found in previous international studies (Felfe & Lalive, 2012; Loeb et al., 2007; Sammons et al., 2004). More specifically, Ruzek, Burchinal, Farkas, and Duncan (2013) found that the effect of centre-based care relative to maternal care was 17 and 38 per cent of one standard deviation in medium-quality and high-quality centre-based care respectively. My findings in the cognitive domain are also consistent with Chilean studies that have found similar effect sizes when evaluating the relationship between preschool attendance and child attainment. Cortazar (2011) found that the effect of attending centre-based care (relative to not attending centre-based care) at age two to four on cognitive standardised tests in fourth grade was positive. In addition, Arnold (2013), using the first wave of Chile's ELPI survey, found that the effect size of attending centre-based care between two and four years old was 12 to 23 per cent of one standard deviation depending on the specific dimension of child cognitive outcome.

When exploring a potentially heterogeneous effect of centre-based attendance (relative to maternal care) on child development, I find that, controlling for the usual covariates, children who attended centre-based care full-time benefit more on the cognitive domain (36 per cent of one standard deviation) than children who attended part-time. This finding is in line with the NICHD ECCRN study that found that more daily hours in centre-based care is positively associated with the development of language skills (NICHD Early Child Care Research Network, 2004).

Secondly, I found that, controlling for a rich set of covariates and individual fixed effects, attendance at centre-based care at the age of two is not associated with socio-emotional problems. This finding is in line with previous international studies that found a neutral effect of centre-based care attendance on child socio-emotional development and behaviour (Barnes et al., 2010; Gupta & Simonsen, 2010; Jaffee et al., 2011). Moreover, my finding in the socio-emotional domain is also in line with other Chilean studies. For example, Arnold (2013) did not find an association between attendance at centre-based care and child socio-emotional development. In contrast, Noboa-Hidalgo and Urzua (2012) found a positive association between centre-based care and child socio-emotional skills. The difference between my finding and Noboa-Hidalgo and Urzua's findings could be explained because both studies use different child socio-emotional outcomes. Noboa-Hidalgo and Urzua (2012) found that the most significant effect of early centre-based attendance is in children's capacity to express feelings (1.15 standard deviations). In contrast, in the present study, the child socio-emotional outcomes measure socio-emotional problems.

Fathoming out the association between early centre-based care attendance and socio-emotional problems is relevant because even though I did not find a significant average effect, there is some evidence of a heterogeneous effect. Children who attended centre-based care full-time experienced more socio-emotional problems than children who stayed at home with their mothers. This suggests that the negative association with child socio-emotional development may not be with the centre-based care experience itself but with the numbers of hours per day that children spend in centre-based care. This is related to the NICHD National Early Child Care Research's (2003) result indicating that children who spend more than 30 hours per week in centre-based care tend to be less sociable and have more behavioural problems than children who spend less than 30 hours per week in child care. Unfortunately, my data does not include the exact number of hours that children stayed in centre-based care or the quality of the centre-based care they attended. These two structural parameters of centre-based care could provide some insights about the channels through which centre-based care is affecting children's socio-emotional development.

A large number of studies have concluded that early education programs have a larger positive effect on more vulnerable children's cognitive development (Burger, 2010; Crosnoe et al., 2010; Felfe and Lalive (2012); Gilliam & Zigler, 2000; NICHD National Early Child Care Research Network & Duncan, 2003; Peisner-Feinberg et al., 2001). According to my analyses, my findings are contrary to the previously cited studies. First, low level of maternal education is not a relevant moderator in the association between centre-based care attendance and child cognitive or socio-emotional development. Second, I find that household poverty is not a relevant moderator in the association between centre-based care attendance and child cognitive outcomes. Conversely, I find that the effect of attendance at centre-based care for children between 24 and 36 months old on socio-emotional development is significantly more negative for children from poor households compared to the same effect for children from non-poor households. Similarly, the effect of attendance at centre-based care in the socio-emotional domain was significantly more negative for children in the second income quintile (second poorest quintile) compared to children in the fifth income quintile. One potential mechanism underlying the previous finding is if the quality of centre-based care attended by children that are more vulnerable is worse compared to the quality of centre-based care attended by children that are more affluent. Unfortunately, I do not have data on centre-based care quality to test the relevance of this potential mechanism. Hence, even though attendance at a high-quality centre-based care can compensate for less stimulating and more stressful environments of vulnerable children (Peisner-Feinberg et al., 2001) low-quality centre-based care could worsen developmental delays of disadvantaged children (Votruba-Drzal, Coley, Maldonado-Carreño, Li-Grining, & Chase-Lansdale, 2010). Given that Chile is rolling out childcare in the interest of child development, this may be an area of urgent further research.

### *6.7.1 Strengths and limitations*

One of the strengths of this study is that it uses a novel panel survey from Chile. Its large sample size provides sufficient power to analyse the potentially heterogeneous association between centre-based care and child development depending on children's level of vulnerability. In addition, the ELPI dataset has both cognitive and socio-emotional assessments that offer a more complete picture about the impact of attendance at centre-based care on child development. Moreover, the ELPI survey samples children born between 2006 and 2009. In contrast with most other panel surveys that use cohorts born in previous decades, the ELPI survey enables us to have a recent view of the previously mentioned association. A second strength of this study is that it uses a credible empirical strategy to control for fixed unobservable individual characteristics and to avoid misspecification bias.

This study also has limitations. First and more importantly, the ELPI dataset does not include information about centre-based care quality. More research about the quality of Chile's centre-based care provision is needed to know, for example, whether children from more vulnerable backgrounds have access to lower quality centre-based care compared to the quality of centres accessed by wealthier children. Due to the lack of information about quality of centre-based care, my current results regarding the association between centre-based care and child development are for centre-based care of average quality for Chile. Unfortunately, due to data constraints, my results are silent about the mechanisms underlying the previous association (for example, group size, quality of adult-child interactions etc.). Second, my research design is not able to exploit an exogenous source of variation in the selection into centre-based care. However, if the children or their families had unobservable characteristics that changed over time and that influenced both the decision of entry into centre-based care and the children's outcomes, this would induce a bias in my estimates. Although I cannot find any theoretical variable that meets the previously mentioned criteria, this is still a potential source of bias.

Even though this study contributes to an understanding of the relationship between early centre-based care attendance and child cognitive and socio-emotional development in middle-income countries, some important questions remain unanswered. The long-term implications of this positive association between centre-based attendance and child cognitive development are unclear. Barnett (2011) shows that attendance at a preschool program could have a fade-out effect over time. However, the magnitude and persistence of this effect on child cognitive outcomes differs greatly. Magnuson et al. (2007) concluded that part of the long-term effects of early childhood education depends on classroom experiences during the first years of school. More importantly, studying the long-term effects of early centre-based care attendance on child socio-emotional development is crucial. Children's ability to learn is closely related to their socio-emotional skills, which enable them to be in a classroom and interact with their peers and teachers (Thompson, Raikes, & Perry, 2007). In this study, I do not find that attendance at centre-based care is associated with socio-emotional problems. Hence, to uncover the long-term impact of early centre-based care on adult outcomes, the ELPI survey should follow the children into adulthood.

Considering the Chilean context of a dysfunctional institutional setting and not ideal structural quality standards, the fact that attendance at centre-based care at two years old has a positive effect on child cognitive development and no effect on socio-emotional development relative to maternal care, is an encouraging result.

## 6.8. Appendices

### Appendix 6.1: Data cleaning process

Two variables provide complementary information about the children's type of care when they were aged 24 to 36 months old. Variable j9 has information on each type of care (including maternal care and centre-based care). In addition, variable j10 has information on whether the mother sent her child to centre-based care in each specific period. While many mothers (31 per cent) stated that they were their child's main caregiver (variable j9), they also stated that they had sent their child to centre-based care during the same period (variable j10). I categorised those children whose mother stated that their child's main type of care was centre-based care (variable j9) and those whose mothers stated they sent their children to centre-based care (variable j10) as having attended centre-based care. I categorised those children whose mothers stated she was the main caregiver of her child (j09) and who stated they did not send their child to centre-based care (variable j10) as children in maternal care.

**Appendix 6.2: The impact of entry into centre-based care at two years old on child cognitive and socio-emotional development: OLS estimates. (Sample restricted)**

| | TADI | | | | Battelle | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| Centre-based 2 years old | 0.172*** | 0.137*** | 0.128*** | 0.117** | 0.171*** | 0.123** | 0.117** | 0.105* |
| | (0.051) | (0.049) | (0.048) | (0.048) | (0.062) | (0.057) | (0.056) | (0.056) |
| Demographics | | X | X | X | | X | X | X |
| Home environment | | | X | X | | | X | X |
| Region and urban | | | | X | | | | X |
| Observations | 1,281 | 1,281 | 1,281 | 1,281 | 1,289 | 1,289 | 1,289 | 1,289 |
| R-squared | 0.010 | 0.117 | 0.133 | 0.141 | 0.007 | 0.123 | 0.132 | 0.139 |
| | **CBCL Total** | | | | **Internalising problems** | | | |
| Variables | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| Centre-based two years old | 0.082 | 0.087 | 0.089 | 0.091 | 0.043 | 0.062 | 0.064 | 0.070 |
| | (0.058) | (0.057) | (0.057) | (0.057) | (0.058) | (0.057) | (0.057) | (0.057) |
| Demographics | | X | X | X | | X | X | X |
| Home environment | | | X | X | | | X | X |
| Region and urban | | | | X | | | | X |
| Observations | 1,318 | 1,318 | 1,318 | 1,318 | 1,318 | 1,318 | 1,318 | 1,318 |
| R-squared | 0.002 | 0.095 | 0.096 | 0.098 | 0.000 | 0.080 | 0.082 | 0.086 |

Notes: All OLS regressions control for children's age. All columns show the magnitude of the key coefficient with se. in parentheses. Column (1) shows the results of a regression without controls. Column (2) shows the results of a regression controlling for demographic characteristics such as maternal characteristics: age (linear and square); years of education, low level of education, marital status, work status, teen pregnancy, difficulties during pregnancy, mental health problems during pregnancy, breastfeeding, alcohol consumption and smoking, depression, numeracy and vocabulary abilities, and personality. In addition, this regression controls for child characteristics: gender; presence of older sibling, premature birth; low weight; common diseases, and age (linear and square). Column (3) shows the result of regression in column (2) plus controls for home environment characteristics: family income per capita (linear and square), family under poverty line and HOME test score. Column (4) shows the results for the regression in column (3) plus region and area (urban or rural) controls. The cognitive outcomes tests are the TADI (*Test de Aprendizaje de Desarrollo Infantil*, in English 'Child Development Cognitive Test') that evaluates four dimensions: motor, language, cognitive, and social-emotional and the Battelle Screening test that assesses five.

**Appendix 6.3: Balance of covariates in the PSM analyses using the Battelle cognitive test as dependent variable**

| Variable | Unmatched Matched | Mean Treated | Control | bias | % bias reduction | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Mother's age | U | 27.902 | 28.731 | -11.5 | | -1.72 | 0.09 |
| | M | 27.929 | 28.358 | -5.9 | 48.3 | -0.76 | 0.45 |
| Mother's years of education | U | 11.158 | 10.492 | 20.8 | | 3.14 | 0 |
| | M | 11.156 | 11.236 | -2.5 | 88 | -0.34 | 0.74 |
| Married mother | U | 0.74462 | 0.80165 | -13.6 | | -2.08 | 0.04 |
| | M | 0.74691 | 0.79012 | -10.3 | 24.2 | -1.3 | 0.19 |
| Teenager mother | U | 0.2 | 0.14601 | 14.3 | | 2.19 | 0.03 |
| | M | 0.19753 | 0.17284 | 6.5 | 54.3 | 0.81 | 0.42 |
| Difficulties during pregnancy | U | 0.40308 | 0.4146 | -2.3 | | -0.35 | 0.73 |
| | M | 0.40432 | 0.35185 | 10.7 | -355.3 | 1.38 | 0.17 |
| Drank alcohol during pregnancy | U | 0.07077 | 0.07025 | 0.2 | | 0.03 | 0.98 |
| | M | 0.07099 | 0.07099 | 0 | 100 | 0 | 1 |
| Smoked during pregnancy | U | 0.12615 | 0.09229 | 10.9 | | 1.67 | 0.1 |
| | M | 0.12654 | 0.14198 | -4.9 | 54.4 | -0.58 | 0.57 |
| Mother's depression | U | 0.16923 | 0.0978 | 21.1 | | 3.31 | 0 |
| | M | 0.16667 | 0.17284 | -1.8 | 91.4 | -0.21 | 0.84 |
| Mother's numeracy level | U | 6.7538 | 6.511 | 9.3 | | 1.41 | 0.16 |
| | M | 6.7531 | 6.5648 | 7.2 | 22.5 | 0.91 | 0.36 |
| Mother's vocabulary level | U | 7.8092 | 7.4848 | 9.4 | | 1.42 | 0.16 |
| | M | 7.8056 | 7.821 | -0.4 | 95.2 | -0.06 | 0.96 |
| Mother's extraversion score | U | 3.5681 | 3.4578 | 15.3 | | 2.29 | 0.02 |
| | M | 3.5656 | 3.6015 | -5 | 67.5 | -0.63 | 0.53 |
| Mother's agreeableness score | U | 3.8448 | 3.7946 | 8.4 | | 1.25 | 0.21 |
| | M | 3.844 | 3.8165 | 4.6 | 45.3 | 0.59 | 0.56 |

| Variable | Unmatched Matched | Mean Treated | Control | bias | % bias reduction | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Mother's conscientiousness score | U | 3.9528 | 3.9294 | 4 | | 0.6 | 0.55 |
| | M | 3.9527 | 3.9599 | -1.2 | 69.2 | -0.16 | 0.87 |
| Mother's neuroticism score | U | 3.1092 | 3.0935 | 1.9 | | 0.29 | 0.77 |
| | M | 3.1073 | 3.1489 | -5.1 | -169.8 | -0.65 | 0.52 |
| Mother's openness score | U | 3.808 | 3.7315 | 12 | | 1.8 | 0.07 |
| | M | 3.8074 | 3.8475 | -6.3 | 47.5 | -0.84 | 0.4 |
| Female | U | 0.46462 | 0.49862 | -6.8 | | -1.02 | 0.31 |
| | M | 0.46605 | 0.48148 | -3.1 | 54.6 | -0.39 | 0.7 |
| Have a older sibling | U | 0.53846 | 0.62948 | -18.5 | | -2.79 | 0.01 |
| | M | 0.54012 | 0.57407 | -6.9 | 62.7 | -0.87 | 0.39 |
| Premature | U | 0.06462 | 0.05647 | 3.4 | | 0.52 | 0.61 |
| | M | 0.06481 | 0.05556 | 3.9 | -13.7 | 0.49 | 0.62 |
| Low birth weight | U | 0.04615 | 0.0551 | -4.1 | | -0.6 | 0.55 |
| | M | 0.0463 | 0.01543 | 14.1 | -245.1 | 2.28 | 0.02 |
| Child's common diseases | U | 0.48923 | 0.50689 | -3.5 | | -0.53 | 0.6 |
| | M | 0.48765 | 0.49383 | -1.2 | 65 | -0.16 | 0.88 |
| Child's age (in months) | U | 17.994 | 17.771 | 7 | | 1.05 | 0.29 |
| | M | 17.988 | 18.139 | -4.8 | 32 | -0.6 | 0.55 |
| Monthly household income per capita | U | 96405 | 81397 | 12.9 | | 2.03 | 0.04 |
| | M | 96523 | 91134 | 4.6 | 64.1 | 0.59 | 0.55 |
| Monthly household income per capita squared | U | 2.60E+10 | 1.70E+10 | 9 | | 1.43 | 0.15 |
| | M | 2.60E+10 | 1.80E+10 | 7.8 | 13.1 | 1.04 | 0.3 |
| Region | U | 8.4985 | 8.5358 | -1 | | -0.15 | 0.89 |
| | M | 8.5 | 8.8642 | -9.3 | -875.1 | -1.18 | 0.24 |
| Area (urban or rural) | U | 1.1169 | 1.1928 | -21.1 | | -3.04 | 0 |
| | M | 1.1173 | 1.1173 | 0 | 100 | 0 | 1 |

| Variable | Unmatched Matched | Mean Treated | Control | bias | % bias reduction | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Breastfeeding | U | 0.96615 | 0.95868 | 3.9 | | 0.58 | 0.56 |
| | M | 0.96605 | 0.97531 | -4.9 | -23.9 | -0.7 | 0.49 |
| Worked before pregnancy | U | 0.18462 | 0.18044 | 1.1 | | 0.16 | 0.87 |
| | M | 0.18519 | 0.24383 | -15.2 | -1304.7 | -1.82 | 0.07 |
| Home Observation Measurement of the Environment score | U | 15.357 | 15.189 | 5.3 | | 0.8 | 0.43 |
| | M | 15.349 | 15.216 | 4.2 | 21.1 | 0.54 | 0.59 |

Summary of the distribution of the absolute bias

BEFORE MATCHING

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 0.2034027 | 0.203403 | | |
| 5% | 0.9522294 | 0.952229 | | |
| 10% | 1.079532 | 1.079532 | Obs | 28 |
| 25% | 3.727678 | 1.912002 | Sum of Wgt. | 28 |
| 50% | 8.673983 | | Mean | 9.020963 |
| | | Largest | Std. Dev. | 6.397225 |
| 75% | 13.27307 | 18.52355 | | |
| 90% | 20.84867 | 20.84867 | Variance | 40.92449 |
| 95% | 21.07771 | 21.07771 | Skewness | .4989247 |
| 99% | 21.0934 | 21.0934 | Kurtosis | 2.203762 |

AFTER MATCHING

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 0 | 0 | | |
| 5% | 0 | 0 | | |
| 10% | 0.4463933 | .4463933 | Obs | 28 |
| 25% | 2.799395 | 1.233394 | Sum of Wgt. | 28 |
| 50% | 4.906601 | | Mean | 5.442983 |
| | | Largest | Std. Dev. | 3.855709 |
| 75% | 7.069152 | 10.3295 | | |
| 90% | 10.66157 | 10.66157 | Variance | 14.86649 |
| 95% | 14.06613 | 14.06613 | Skewness | .7956407 |
| 99% | 15.16449 | 15.16449 | Kurtosis | 3.359271 |

| Sample | Pseudo R2 | LR chi2 | p>chi2 | Mean Bias | Median Bias |
|---|---|---|---|---|---|
| Raw | 0.04 | 51.54 | 0.003 | 9 | 8.7 |
| Matched | 0.025 | 22.2 | 0.727 | 5.4 | 4.9 |

**Appendix 6.4. Balance of covariates in the PSM analyses using the TADI cognitive test as dependent variable**

| Variable | Unmatched Matched | Mean Treated | Control | bias | % bias reduction | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Mother's age | U | 27.929 | 28.8 | -12 | | -1.8 | 0.072 |
| | M | 27.947 | 28.231 | -3.9 | 67.5 | -0.5 | 0.615 |
| Mother's years of education | U | 11.213 | 10.491 | 22.7 | | 3.4 | 0.001 |
| | M | 11.174 | 10.966 | 6.6 | 71.1 | 0.86 | 0.391 |
| Married mother | U | 0.75 | 0.80139 | -12.3 | | -1.87 | 0.061 |
| | M | 0.75078 | 0.76012 | -2.2 | 81.8 | -0.28 | 0.783 |
| Teenager mother | U | 0.19753 | 0.14722 | 13.3 | | 2.04 | 0.042 |
| | M | 0.19626 | 0.17445 | 5.8 | 56.7 | 0.71 | 0.478 |
| Difficulties during pregnancy | U | 0.40123 | 0.4125 | -2.3 | | -0.34 | 0.732 |
| | M | 0.40498 | 0.38318 | 4.4 | -93.6 | 0.56 | 0.573 |
| Drank alcohol during pregnancy | U | 0.07407 | 0.06806 | 2.3 | | 0.35 | 0.725 |
| | M | 0.07165 | 0.06854 | 1.2 | 48.2 | 0.15 | 0.877 |
| Smoked during pregnancy | U | 0.11728 | 0.08889 | 9.3 | | 1.43 | 0.153 |
| | M | 0.11838 | 0.13084 | -4.1 | 56.1 | -0.48 | 0.633 |
| Mother's depression | U | 0.16975 | 0.09722 | 21.4 | | 3.35 | 0.001 |
| | M | 0.16199 | 0.14642 | 4.6 | 78.5 | 0.55 | 0.585 |
| Mother's numeracy level | U | 6.7438 | 6.4917 | 9.7 | | 1.47 | 0.142 |
| | M | 6.7383 | 6.4486 | 11.1 | -14.9 | 1.45 | 0.147 |
| Mother's vocabulary level | U | 7.8426 | 7.4583 | 11.1 | | 1.67 | 0.094 |
| | M | 7.8224 | 7.8037 | 0.5 | 95.1 | 0.07 | 0.944 |
| Mother's extraversion score | U | 3.5575 | 3.4608 | 13.5 | | 2.01 | 0.045 |
| | M | 3.5479 | 3.6807 | -18.5 | -37.3 | -2.42 | 0.016 |
| Mother's agreeableness score | U | 3.8512 | 3.8062 | 7.5 | | 1.12 | 0.263 |
| | M | 3.8501 | 3.9671 | -19.5 | -160 | -2.51 | 0.012 |
| Mother's conscientiousness | U | 3.9592 | 3.9312 | 4.8 | | 0.72 | 0.473 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| score | M | 3.956 | 4.0125 | -9.7 | -101.4 | -1.28 | 0.202 |
| Mother's neuroticism score | U | 3.1057 | 3.0911 | 1.8 | | 0.27 | 0.788 |
| | M | 3.1016 | 3.0401 | 7.5 | -322.5 | 0.98 | 0.33 |
| Mother's openness score | U | 3.8114 | 3.7368 | 11.7 | | 1.76 | 0.079 |
| | M | 3.8037 | 3.805 | -0.2 | 98.3 | -0.03 | 0.98 |
| Female | U | 0.4784 | 0.51111 | -6.5 | | -0.98 | 0.328 |
| | M | 0.47975 | 0.44548 | 6.8 | -4.7 | 0.87 | 0.385 |
| Have a older sibling | U | 0.54321 | 0.63194 | -18.1 | | -2.72 | 0.007 |
| | M | 0.54829 | 0.57632 | -5.7 | 68.4 | -0.72 | 0.475 |
| Premature | U | 0.0679 | 0.05556 | 5.1 | | 0.78 | 0.435 |
| | M | 0.06854 | 0.07477 | -2.6 | 49.5 | -0.31 | 0.76 |
| Low birth weight | U | 0.04321 | 0.05417 | -5.1 | | -0.75 | 0.456 |
| | M | 0.04361 | 0.01869 | 11.6 | -127.5 | 1.82 | 0.069 |
| Child's common diseases | U | 0.49383 | 0.50833 | -2.9 | | -0.43 | 0.665 |
| | M | 0.4891 | 0.50467 | -3.1 | -7.4 | -0.39 | 0.694 |
| Child's age (in months) | U | 18.031 | 17.786 | 7.7 | | 1.15 | 0.25 |
| | M | 18.003 | 18.118 | -3.6 | 52.9 | -0.47 | 0.641 |
| Monthly household income per capita | U | 97030 | 81050 | 13.7 | | 2.15 | 0.032 |
| | M | 96362 | 95830 | 0.5 | 96.7 | 0.05 | 0.958 |
| Monthly household income per capita squared | U | 2.60E+10 | 1.70E+10 | 9 | | 1.43 | 0.153 |
| | M | 2.60E+10 | 2.60E+10 | 0.1 | 99.2 | 0.01 | 0.993 |
| Region | U | 8.463 | 8.5208 | -1.5 | | -0.22 | 0.822 |
| | M | 8.4579 | 8.4984 | -1 | 30 | -0.13 | 0.897 |
| Area (urban or rural) | U | 1.1204 | 1.1931 | -20.1 | | -2.9 | 0.004 |
| | M | 1.1215 | 1.1651 | -12 | 40 | -1.58 | 0.115 |
| Breastfeeding | U | 0.96605 | 0.95972 | 3.3 | | 0.49 | 0.623 |
| | M | 0.96573 | 0.95639 | 4.9 | -47.7 | 0.61 | 0.541 |
| Worked before pregnancy | U | 0.18519 | 0.17778 | 1.9 | | 0.29 | 0.773 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | M | 0.18692 | 0.18069 | 1.6 | 15.9 | 0.2 | 0.839 |
| Home Observation Measurement of the Environment score | U | 15.349 | 15.149 | 6.2 | | 0.93 | 0.351 |
| | M | 15.333 | 15.246 | 2.7 | 56.4 | 0.34 | 0.731 |

Summary of the distribution of the abs(bias)

BEFORE MATCHING

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 1.475946 | 1.475946 | | |
| 5% | 1.784041 | 1.784041 | | |
| 10% | 1.919846 | 1.919846 | Obs | 28 |
| 25% | 4.076144 | 2.290806 | Sum of Wgt. | 28 |
| 50% | 8.351745 | | Mean | 9.181748 |
| | | Largest | Std. Dev. | 6.15314 |
| 75% | 12.83125 | 18.07871 | | |
| 90% | 20.07407 | 20.07407 | Variance | 37.86113 |
| 95% | 21.42242 | 21.42242 | Skewness | .646932 |
| 99% | 22.66697 | 22.66697 | Kurtosis | 2.536698 |

AFTER MATCHING

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 0.075177 | 0.075177 | | |
| 5% | 0.195887 | 0.195887 | | |
| 10% | 0.457091 | .4570907 | Obs | 28 |
| 25% | 1.928513 | .541125 | Sum of Wgt. | 28 |
| 50% | 4.266059 | | Mean | 5.58153 |
| | | Largest | Std. Dev. | 5.11104 |
| 75% | 7.193359 | 11.57138 | | |
| 90% | 12.04516 | 12.04516 | Variance | 26.12273 |
| 95% | 18.5208 | 18.5208 | Skewness | 1.314652 |
| 99% | 19.50529 | 19.50529 | Kurtosis | 4.185822 |

| Sample | Pseudo R2 | LR chi2 | p>chi2 | Mean Bias | Median Bias |
|---|---|---|---|---|---|
| Raw | 0.038 | 49.78 | 0.005 | 9.2 | 8.4 |
| Matched | 0.026 | 23.17 | 0.676 | 5.6 | 4.3 |

**Appendix 6.5: Balance of covariates in the PSM analyses using the CBCL socio-emotional test as dependent variable**

| Variable | Unmatched Matched | Treated | Control | bias | % reduce bias | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Mother's age | U | 27.873 | 28.685 | -11.2 | | -1.8 | 0.072 |
| | M | 27.87 | 28.215 | -4.8 | 57.5 | -0.63 | 0.532 |
| Mother's years of education | U | 11.098 | 10.508 | 18.4 | | 2.94 | 0.003 |
| | M | 11.082 | 10.841 | 7.5 | 59.2 | 1.08 | 0.281 |
| Married mother | U | 0.75068 | 0.80149 | -12.2 | | -1.97 | 0.049 |
| | M | 0.75 | 0.75272 | -0.7 | 94.7 | -0.09 | 0.932 |
| Teenager mother | U | 0.20325 | 0.14392 | 15.7 | | 2.56 | 0.01 |
| | M | 0.2038 | 0.21739 | -3.6 | 77.1 | -0.45 | 0.652 |
| Difficulties during pregnancy | U | 0.42005 | 0.41563 | 0.9 | | 0.14 | 0.887 |
| | M | 0.4212 | 0.41848 | 0.6 | 38.5 | 0.07 | 0.941 |
| Drank alcohol during pregnancy | U | 0.07046 | 0.067 | 1.4 | | 0.22 | 0.827 |
| | M | 0.07065 | 0.0462 | 9.7 | -606.2 | 1.41 | 0.158 |
| Smoked during pregnancy | U | 0.12466 | 0.08809 | 11.9 | | 1.94 | 0.052 |
| | M | 0.125 | 0.10326 | 7.1 | 40.6 | 0.93 | 0.354 |
| Mother's depression | U | 0.17073 | 0.10546 | 19 | | 3.14 | 0.002 |
| | M | 0.16848 | 0.17663 | -2.4 | 87.5 | -0.29 | 0.77 |
| Mother's numeracy level | U | 6.7588 | 6.5037 | 9.8 | | 1.58 | 0.115 |
| | M | 6.7609 | 6.587 | 6.7 | 31.8 | 0.92 | 0.358 |
| Mother's vocabulary level | U | 7.8564 | 7.4963 | 10.5 | | 1.68 | 0.093 |
| | M | 7.8505 | 7.5652 | 8.3 | 20.8 | 1.13 | 0.259 |
| Mother's extraversion score | U | 3.5505 | 3.4572 | 13.1 | | 2.07 | 0.039 |
| | M | 3.5465 | 3.6019 | -7.7 | 40.6 | -1.04 | 0.297 |
| Mother's agreeableness score | U | 3.8455 | 3.816 | 5 | | 0.79 | 0.432 |
| | M | 3.8466 | 3.8222 | 4.1 | 17.3 | 0.58 | 0.564 |

| Variable | Unmatched Matched | Treated | Control | bias | % reduce bias | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Mother's conscientiousness score | U | 3.941 | 3.9369 | 0.7 | | 0.11 | 0.91 |
| | M | 3.9408 | 3.9094 | 5.4 | -662.3 | 0.71 | 0.476 |
| Mother's neuroticism score | U | 3.107 | 3.0889 | 2.2 | | 0.36 | 0.722 |
| | M | 3.1067 | 3.0567 | 6.1 | -174.6 | 0.85 | 0.396 |
| Mother's openness score | U | 3.8027 | 3.737 | 10.5 | | 1.67 | 0.096 |
| | M | 3.7995 | 3.8332 | -5.4 | 48.7 | -0.8 | 0.426 |
| Female | U | 0.47154 | 0.49752 | -5.2 | | -0.83 | 0.409 |
| | M | 0.47283 | 0.48641 | -2.7 | 47.7 | -0.37 | 0.713 |
| Have a older sibling | U | 0.54472 | 0.63275 | -17.9 | | -2.87 | 0.004 |
| | M | 0.5462 | 0.53533 | 2.2 | 87.7 | 0.3 | 0.768 |
| Premature | U | 0.06233 | 0.06079 | 0.6 | | 0.1 | 0.919 |
| | M | 0.0625 | 0.06793 | -2.3 | -253.7 | -0.3 | 0.766 |
| Low birth weight | U | 0.04607 | 0.05583 | -4.4 | | -0.69 | 0.488 |
| | M | 0.0462 | 0.0462 | 0 | 100 | 0 | 1 |
| Child's common diseases | U | 0.50678 | 0.51489 | -1.6 | | -0.26 | 0.796 |
| | M | 0.50543 | 0.51902 | -2.7 | -67.5 | -0.37 | 0.713 |
| Child's age (in months) | U | 18.648 | 18.304 | 9.8 | | 1.57 | 0.117 |
| | M | 18.641 | 18.679 | -1.1 | 88.9 | -0.15 | 0.883 |
| Monthly household income per capita | U | 93411 | 85542 | 6.4 | | 0.98 | 0.328 |
| | M | 92691 | 92849 | -0.1 | 98 | -0.02 | 0.985 |
| Monthly household income per capita squared | U | 2.10E+10 | 2.50E+10 | -2.4 | | -0.34 | 0.735 |
| | M | 2.10E+10 | 2.30E+10 | -1.2 | 51.8 | -0.31 | 0.757 |
| Region | U | 8.5447 | 8.5881 | -1.1 | | -0.18 | 0.859 |
| | M | 8.5326 | 8.6087 | -1.9 | -75.4 | -0.26 | 0.794 |
| Area (urban or rural) | U | 1.1057 | 1.1824 | -22 | | -3.36 | 0.001 |
| | M | 1.106 | 1.0978 | 2.3 | 89.4 | 0.37 | 0.715 |

| Variable | Unmatched Matched | Treated | Control | bias | % reduce bias | t-test t | p>t |
|---|---|---|---|---|---|---|---|
| Breastfeeding | U | 0.96206 | 0.95906 | 1.5 | | 0.24 | 0.808 |
| | M | 0.96196 | 0.97283 | -5.6 | -262 | -0.83 | 0.407 |
| Worked before pregnancy | U | 0.18428 | 0.17494 | 2.4 | | 0.39 | 0.698 |
| | M | 0.18478 | 0.1712 | 3.5 | -45.4 | 0.48 | 0.63 |
| Home Observation Measurement of the Environment score | U | 15.244 | 15.091 | 4.8 | | 0.76 | 0.445 |
| | M | 15.231 | 15.37 | -4.3 | 9.6 | -0.59 | 0.555 |

| Summary of the distribution of the abs(bias) | | | | |
|---|---|---|---|---|
| BEFORE MATCHING | | | | |
| | Percentiles | Smallest | | |
| 1% | 0.638654 | 0.638654 | | |
| 5% | 0.70901 | 0.70901 | | |
| 10% | 0.895596 | .8955963 | Obs ……. | 28 |
| 25% | 1.921421 | 1.101912 | Sum of Wgt. | 28 |
| 50% | 5.780251 | | Mean | 7.953267 |
| | | Largest | Std. Dev. | 6.493992 |
| 75% | 12.0347 | 17.94584 | | |
| 90% | 18.36939 | 18.36939 | Variance | 42.17193 |
| 95% | 18.98465 | 18.98465 | Skewness | .5686723 |
| 99% | 21.95293 | 21.95293 | Kurtosis | 2.134566 |
| AFTER MATCHING | | | | |
| | Percentiles | Smallest | | |
| 1% | 0 | 0 | | |
| 5% | 0.127827 | 0.127827 | | |
| 10% | 0.550428 | .5504275 | Obs | 28 |
| 25% | 2.074319 | .6524095 | Sum of Wgt. | 28 |
| 50% | 3.565439 | | Mean | 3.926215 |
| | | Largest | Std. Dev. | 2.688452 |
| 75% | 5.839841 | 7.493919 | | |
| 90% | 7.746248 | 7.746248 | Variance | 7.227773 |
| 95% | 8.334558 | 8.334558 | Skewness | .3627755 |
| 99% | 9.657468 | 9.657468 | Kurtosis | 2.122922 |

| Sample | Pseudo R2 | LR chi2 | p>chi2 | Mean Bias | Median Bias |
|---|---|---|---|---|---|
| Raw | 0.036 | 52.58 | 0.002 | 8 | 5.8 |
| Matched | 0.015 | 15.67 | 0.959 | 3.9 | 3.6 |

**Appendix 6.6: The association between centre-based care attendance and child socio-emotional outcomes with the sample restricted to children that have the CBCL test measure in both 2010 and 2012: OLS, individual fixed effect and propensity score matching estimates**

| | Socio-emotional development | | |
|---|---|---|---|
| | CBCL Total | CBCL Externalising | CBCL Internalising |
| OLS | 0.079 | 0.043 | 0.080 |
| | (0.079) | (0.081) | (0.077) |
| Observations | 728 | 728 | 728 |
| R-squared | 0.118 | 0.130 | 0.104 |
| Individual fixed effects (FE) | 0.097 | 0.084 | 0.114 |
| | (0.091) | (0.092) | (0.094) |
| Observations | 728 | 728 | 728 |
| R-squared | 0.076 | 0.079 | 0.078 |
| Individual FE + propensity score matching (PSM) | -0.147** | -0.185** | -0.123* |
| | (0.074) | (0.075) | (0.073) |
| Observations | 728 | 728 | 728 |

Notes: All regressions in this table control for demographic, home environment, and regional characteristics. The socio-emotional outcomes test is the Child Behavior Checklist (CBCL) test that evaluates behavioural problems, emotional problems, internalising problems (for example, anxious, depressive, and over-controlled behaviours), and externalising problems (for example, aggressive, hyperactive behaviours). I converted children's outcomes into Z scores. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

# Chapter 7
# Conclusions

This thesis has examined the association between two crucial maternal decisions—early maternal employment and type of early childcare—and child development in Chile. In this chapter I summarize the main findings of this study, provide hypotheses that could explain these findings, present implications of my findings for family policies, and offer recommendations for future studies.

## 7.1. What have we learned about the association between two crucial maternal decisions—early maternal employment and type of early childcare—and child development?

Important changes in early childhood policies implemented by the Chilean government during the last decade motivate this thesis. Early childhood policies have extremely important effects on children's contexts. The extension of maternity leave from three to six months after childbirth—given that it is mandatory for mothers who qualify for this benefit—ensures that working mothers in the formal sector increase the length of time during which they dedicate themselves exclusively to childcare. In contrast, the aim behind the explosive increase of government-funded centre-based care coverage for the 60 per cent most vulnerable children in Chile is to increase the female employment rate—especially for mothers of children aged three months to five years old. The provision of government-funded centre-based care is a policy that, indirectly, decreases the average length of time during which mothers exclusively care for their young children. Hence, implicitly, the government is nudging working mothers to exclusively care for their children for six months after childbirth and then to send the children to centre-based care. What are the consequences for child development of this design of early childhood policies? Is it optimal from the point of view of child development? Are there better options from the point of view of child development?

The starting point of this thesis is that the evidence about the association between both timing of early maternal employment or type of care and timing before three years old and child development is inconclusive.[57] Moreover, most of the existing literature on these topics uses data from developed countries. Hence, the evidence on these topics in middle-income countries is extremely scarce. Based on the existing literature, it is not possible to provide an informed answer to whether Chile's two main early childhood policies during the last decade have been well directed, in terms of child development.

Based on the findings of this thesis, I conclude that both Chile's extension of maternity leave and the expansion of centre-based care coverage go in the right direction. However, my findings point out that the association between both centre-based care or early maternal employment and child development is slightly more detrimental for vulnerable children relative to the same association for advantaged children. In contrast, the previous evidence states that the previous association is slightly more beneficial for vulnerable children relative to the same association for advantaged children.

In line with previous studies using data from developed countries, I find that maternal employment during the first year after childbirth has a detrimental effect on child development at 12–24 months and 24–36 months old (two different cohorts). However, the magnitude of this detrimental effect depends on the timing when the mother initiated employment within the first year (between zero and three, three and six, six and twelve, or twelve and 18 months after childbirth). Controlling for an extensive set of covariates, my OLS and propensity score matching (PSM) models show that children whose mothers initiated employment between zero and three, three and six, or six and 12 months after childbirth show worse cognitive and mixed socio-emotional outcomes relative to children whose mother did not engage in early maternal employment. In addition, maternal initiation of employment between 12 and 18 months after childbirth is associated with mixed child cognitive outcomes and does not exhibit a significant association with child socio-emotional outcomes. Additionally, if a mother initiates employment between 12 and 18 months after childbirth, my results suggest that it is slightly better for her child's cognitive development if the mother works part-time (relative to full-time). Finally, delaying maternal employment initiation from between three and six to six and 12 months is associated with less detrimental child cognitive development in some sub-dimensions.

[57] It is important to clarify that there is a large literature regarding early maternal employment and child development. However, only a few of those studies explore a potentialy heterogeneous association between the different timings of maternal employment within the first year (for example, for different quarters).

Mothers who wish to return to work after childbirth do not make decisions about the timing of early maternal employment in a vacuum. As Contreras and Plaza (2010) show, mothers make their decisions about early employment taking into account the options of care available in their household, extended family, private and public providers. This thesis finds heterogeneous effects in the association between maternal employment during the first year after childbirth and child development depending on the type of care (formal or informal care) attended by the child. Controlling for an extensive set of covariates, children in informal care during the first year after childbirth present more detrimental socio-emotional outcomes relative to children in formal care. This result led me to deepen the association between type of care during the first year after childbirth and cognitive or socio-emotional outcomes.

Controlling for an extensive set of covariates, I found that attendance at non-maternal care at six to twelve months old (relative to exclusive maternal care) is associated with lower child cognitive development; however, the association with child socio-emotional development is not significant. Nevertheless, when non-maternal care is decomposed into the different types of care, I found that the specific type of care that infants receive matters. First, there is a positive association between grandparent care and child cognitive development relative to exclusive maternal care. Second, there is a negative association between relative care and child cognitive and socio-emotional development relative to exclusive maternal care. Third, there is a positive association between centre-based care and child cognitive development and a slightly positive association with child socio-emotional development.

The explosive increase in public centre-based care coverage and the extremely thin evidence for middle-income countries about the benefit of early attendance at centre-based care—especially universal early childhood programs for under-three-year-olds—on child development motivated me to study the association between two-year-olds' attendance at day care and child development. In Chapter 5, I found a positive association between attendance at centre-based care (relative to exclusive maternal care) at 6 to 12 months after childbirth and child cognitive and socio-emotional development. Given that Chile's centre-based care programs score low on structural indicators of quality (Seguel et al., 2007; Strasser et al., 2009; Strasser & Lissi, 2009; Villalon et al., 2002) and that the country's regulations and governance of ECEC are unclear and not well implemented (Rolla et al., 2011), my findings are counterintuitive.

The findings in Chapter 5 motivated me to explore the association between attendance at centre-based care at 24 to 36 months after childbirth and child development. Using individual fixed effects, PSM and OLS models, I found that attendance at centre-based care (versus maternal care) between the ages of 24 and 36 months is positively associated with child cognitive development and shows no significant association with child socio-emotional development. In addition, more daily hours in centre-based is positively associated with cognitive outcomes, but negatively associated with socio-emotional outcomes.

Together, these findings indicate that children who attended centre-based care at 6 to 12 months old and 24 to 36 months old present higher cognitive development and higher (for those children who attended at 6 to 12 months) or neutral (for children who attended at 24 to 36 months old) socio-emotional development relative to children in exclusive maternal care. As I mention in Chapter 5 and Chapter 6, some previous studies have concluded that attendance at centre-based care before three years old is negatively associated with child cognitive development (Baker et al., 2008; Lefebvre et al., 2011) and socio-emotional development (Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007). Hence, my finding of a positive association between centre-based care and cognitive or socio-emotional development is positive news for Chile's centre-based care institutions.

## 7.2. Should the Chilean government encourage vulnerable families to enrol their children in early centre-based care?

Non-maternal care choice decisions depends both on macro and micro contexts. National family policies like maternity leave or childcare policies influence families' decisions about type of care arrangements. However, these decisions also depend on family characteristics (Sylva, Stein, Leach, Barnes, & Malmberg, 2011). For example, children from disadvantaged families (lower educational levels or low income) start non-maternal care earlier, are more likely to use relative care, and less likely to use centre-based care relative to their more advantaged counterparts (Sylva, Stein, Leach, Barnes, & Malmberg, 2007).

As discussed in Chapter 2, one of the goals of Chile's expansion of centre-based care coverage has been to decrease the inequality in access to centre-based care by vulnerable and advantaged families. In OECD countries, disadvantaged children are disproportionately less likely to attend at ECEC relative to their more advantaged counterparts (Gambaro et al., 2014). However, the provision of government-funded centre-based care to the 60 per cent most vulnerable population in Chile has increased the accessibility of centre-based care to vulnerable families. As I describe in Chapter 2, the difference in access to centre-based care between poor and wealthy families in Chile has been narrowing over the last two decades. In 1990, the proportion of children under the age of three in centre-based care in the poorest and richest fifths was four and thirteen per cent respectively. By contrast, in 2011, this same proportion for children in the poorest and richest fifths was 24 and 29 respectively. Hence, the difference in the ratio of the proportion in centre-based care of the richest fifth to the poorest fifth narrowed from 3.3 in 1990 to 1.2 in 2011.

In Chapter 5 and Chapter 6, I conclude that the association between early centre-based care and cognitive or socio-emotional outcomes is more negative for vulnerable children relative to advantaged children. First, attendance at early centre-based care during the first year of life (6 to 12 months old) for vulnerable children (with mothers with low levels of education or from poor households) is associated with lower cognitive development relative to the same association for children of advantaged children (with well-educated mothers or from wealthier households). Second, the association between attendance at centre-based care at 24 to 36 months old and socio-emotional outcomes is more negative for children of lower income households relative to the same association for children of higher income households.

The previous findings are not in line with the findings in previous studies—all of them using data from developed countries. Previous studies have found that the association between early education programs and child cognitive development is more positive for vulnerable children relative to same association for advantaged children (Burger, 2010; Crosnoe et al., 2010; Felfe and Lalive (2012); Gilliam & Zigler, 2000; NICHD National Early Child Care Research Network & Duncan, 2003; Peisner-Feinberg et al., 2001). One hypothesis that could explain the difference between my finding and the one in previous studies is that the difference in quality of centre-based care attended by disadvantaged and advantaged children may be much higher in Chile relative to this same difference in the USA and the UK (where the previous studies have been conducted). This difference in quality in favour of centre-based care attended by advantaged children has been previously documented in high-income countries (Gambaro et al., 2014).

The association between early maternal employment and child development is also heterogeneous depending on children's vulnerability. The previously described association is slightly more detrimental in both cognitive and socio-emotional development for more vulnerable children. Early maternal employment three months after childbirth is associated with more negative child cognitive and socio-emotional development for children in single-parent families relative to the same association for children in two-parent families. This is also not in line with the evidence from the USA and the UK where the association between early maternal employment and child cognitive development is more negative for children in two-parent families relative to the same association for children in single-parent families (Brooks-Gunn et al., 2002; Goldberg et al., 2008).

There are two main hypotheses that would explain the finding of previous studies using data from the UK and the USA that early maternal employment is more negative for children in two-parent families relative to single-parent families. First, in single-parent families, maternal earnings due to maternal employment would represent a higher proportion of household income relative to the share of maternal earnings in household income for two-parent families. Second, maternal earnings could decrease the level of stress due to low household income in single-parent families more than the same decrease in two-parent families. Are there any potential reasons why the association I found and the association in developed countries have opposite signs? One hypothesis is based on differences in the labour market conditions between in Chile relative to conditions in the labour markets of developed countries. The monthly labour earnings in Chile are much lower than the ones in developed countries (BBC, 2014). Hence, it is less likely that maternal earnings in single-parent families outweigh the negative effects of less maternal time due to maternal employment on child development. In addition, as discussed in Chapter 2, Chilean workers work many more hours (45 hour per week) than workers in OECD countries (OECD, 2012) and working conditions are precarious because jobs in Chile often are long workdays, informal and unstable (Lee et al., 2007; Leiva, 2000).

These precarious working conditions in Chile could affect mothers' well-being increasing their level of stress because of being unable to balance work and family responsibilities.

## 7.3. What are the implications of my findings for social policy?

In light of this study's evidence, it is relevant to study how to improve the effect of centre-based care on the most vulnerable children. At the same time, it would be interesting to explore the effects of alternative types of interventions such as technical support to those providing maternal and informal types of care, such as relative, grandparent, and non-relative care. Based on the findings of this thesis, I would like to outline four areas of policy implications.

First, my results suggest that Chile's extension of maternity leave from three to six months is positive for child development. However, as I discuss in Chapter 2, despite the increase in maternity leave, parents in Chile do not have any kind of support to improve their parenting skills. Social policy should not ignore the needs of parents who choose to take care of their child exclusively during the first year after childbirth. Strengthening parenting skills could be a complementary policy that could help to boost the positive association between maternal care and child cognitive or socio-emotional development. For example, during the mid-2000s in the UK there was an expansion of services such as 'stay-and-plays', drop-in centres, and health visits. Many of these programs are funded by the central government and are offered by local authorities (Lewis, 2011). Chile has been implementing the intersectoral comprehensive childhood protection system Chile Grows with you (in Spanish, '*Chile Crece Contigo*'). However, until now, this program focuses on the 60 per cent most vulnerable population and on children with development problems. Hence, home visits and parent workshops are not available to the whole population. Given their complementarity with maternal, relative, grandparent, and non-relative care, it would be important to evaluate the effectiveness of these services in the context of middle-income countries like Chile.

Second, the results of this study suggest that grandparent care has a positive impact on both child cognitive and socio-emotional development. In the ELPI 2010, after maternal care, grandparent care was the second most prevalent early type of care in Chile. However, the Chilean government provides no help or training to grandparents who care after their grandchildren. One policy response to the findings in this study could be to pilot and evaluate a program of support and training for grandparents who care after their grandchildren.

An alternative way to support parents and other caregivers could be to provide cash payments to mothers who care exclusively for their children[58] or informal caregivers such as grandmothers. The rationale behind these cash transfers is that they could help identify grandparents and informal caregivers and provide them with training to help them better stimulate and care after the children.

Third, this thesis suggests that the expansion of centre-based care was a good decision in terms of its impact on child development. However, although this expansion was aimed at boosting the development of the most disadvantaged children, it seems that the most positive impact has been on less vulnerable children. Currently, the Chilean government does not know the quality of the different specific providers of centre-based care or the quality of the interactions in the different types of informal care. Hence, policy makers in Chile do not have information about the current quality of ECEC in Chile. This information is essential for the implementation of the best policies to boost child development and equality of opportunity in Chile. Therefore, Chile needs an institution whose mandate would be to evaluate and monitor the progress of the quality of Chilean early childhood provisions. Currently, the information is so poor that the Chilean government does not even know the number of children in private centre-based care or in informal care.

In 2011, the Chilean Congress enacted the law that created the *Agencia de Calidad de la Educación* ('Education Quality Agency'). The goal of this institution is to evaluate the different levels of Chile's education system to improve its quality and the equity of educational opportunities the system provides. Currently, the evaluation of centre-based care programs has not yet being designed, so it will take time to have an early year's evaluation system in place. This evaluation system will only take into account publicly-funded centre-based care programs. The exclusion of the non-publicly funded centre-based care programs is obviously a weakness in the mandate of Chile's Education Quality Agency.

[58] A small cash transfer implemented during Bachelet's 2006–2010 administration to non-working mothers was a one-off £220 pounds cash transfer and a contribution to each mother's individual pension account per childbirth.

Improving children' well-being implies policy designs that need to be rigorous evaluated to assess their effectiveness. In the next sub-section, I suggest future studies that could help to better understand the findings of this study and to determine the best portfolio of future social policies to maximise childhood well-being and development.

### 7.4. Areas of future research

In this thesis, I examine the association between early maternal employment and non-maternal care on children's development. To my knowledge, this is the first study to do this in the context of middle-income country. Even though this study contributes to a better understanding of the relationship between early maternal employment and non-maternal care attendance on child cognitive and socio-emotional development in middle-income countries, some important questions remain unanswered.

First, an important next step is to understand what mechanisms underlay the findings of this research. To improve family policies, understanding what drives the positive or negative associations is crucial. To have a better understanding of the mechanisms shown in Chapter 6 it would be extremely useful if the future early childhood datasets include measures of quality of the centre-based programs attended by the sampled children. This would enable us to understand to what extent quality of centre-based care mediates the association between centre-based care attendance and child development. For the same purpose applied to other caregivers, it would be useful if future datasets would include information about the quality of the interactions between the sampled children and their main caregivers (like, for example, the UK-based Millennium Cohort Study dataset).

Second, the positive associations between centre-based care and child cognitive or socio-emotional development suggest further exploration of the characteristics of centre-based care attendance that affect cognitive and social outcomes. Is there a type of centre-based care that maximizes cognitive effects while minimizing the negative social-emotional effects? Little is known about the quality of centre-based care in Chile. Chilean early childhood policies are based on the evidence that high quality ECEC intervention improve child outcomes, and reduce inequality in later life (Gertler, et al., 2014; Heckman & Raut, 2013; Ruhm & Waldfogel, 2012). Narrowing the achievement gap that has been observed between the poorest and wealthiest children as early as 36 months old in Chile (Schady et al., 2014) has been a central point in Chilean social policies. To identify childcare models and programs that optimally support both cognitive and behavioural aspects of child development, it is crucial to know the level of quality of centre-based care. The first step is to define what quality means in the Chilean context.

Third, given the nature of the ELPI dataset, I could not analyse the long-term (i.e. after ten years of more) association between early maternal employment or type of care and child development. Barnett (2011) shows that attendance at a preschool program could have a fade-out effect over time. However, the magnitude and persistence of this effect on child cognitive outcomes differs greatly. Magnuson et al. (2007) concluded that part of the long-term effects of early childhood education depends on classroom experiences during the first years of school. More importantly, studying the long-term effects of early centre-based care attendance on child socio-emotional development is crucial. Children's ability to learn is closely related to their socio-emotional skills. These socio-emotional skills enable them to be in a classroom and to interact with their peers and teachers (Thompson et al., 2007). In this study, I do not find that attendance at centre-based care is associated with short-term socio-emotional problems. However, to uncover the long-term impact of early care on adult outcomes, the ELPI or other early childhood surveys should follow the children into adulthood.

Fourth, the literature about the association between informal types of care such as grandparent, relative, and non-relative care and child development is extremely thin. In Chapter 4, I found that the most prevalent type of non-maternal care under the age of three in Chile is informal care, and that grandparent care has a positive association with child development. Firstly, one future venue of research is to understand the characteristics of families that choose each type of informal carel. Second, data about the quality of each type of informal care could provide us which more information about how social policy could improve the care and support families that choose this type of care.

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