

How Does Early Childcare affect Child Development?

Learning from the Children of German Unification

Christina Felfe, University of St. Gallen and CESifo*

Rafael Lalive, University of Lausanne, CEPR, CESifo and IZA †

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Abstract

This paper analyzes the effects of high quality care on child development. The analysis uses information on Germany – a country that is characterized by strong regional variation in child care offer rates. We combine information on regional offer rates with data on infants aged 2-5 years from the German Socio-Economic Panel and data on children aged 6-10 from the German Child Panel provide information on the full age range 2-10 years after birth. Results suggest that high-quality center-based care promotes child development only marginally for the average child placed in care. Interestingly, we find that the extra child that attends child-care because access is expanded benefits much more strongly from child care than the average child placed in child care. This is because the extra child is from a low educational background and corresponding high gains from child care whereas the average child is from a high educational background. We also find that the effects of child care dissipate for the average child but remain strong for the children gaining care because of expanded access.

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*We appreciate comments on previous drafts of the paper by seminar participants at Bergen, DIW Berlin, Pompeu Fabra, University of Lausanne and University of St. Gallen. Address: Christina Felfe, Varnbelstrasse 14 CH-9000 St. Gallen, Christina.Felfe@unisg.ch.

†Address: Rafael Lalive, Department of Economics, University of Lausanne, CH-1015 Lausanne-Dorigny, Rafael.Lalive@unil.ch.

1 Introduction

What role does child care play in the process of children’s skill acquisition during early life? Do potential differences between children exposed to center-based care and children being solely taken care of by their parents remain over time? Investigating these questions is important for at least two reasons. First, policies aiming to encourage female labor force participation via expanding the supply of institutionalized care need to take the potential effects on child development into account. Second, providing evidence on the specific role of the time of care provided by the mother in comparison with center based care is relevant for a better understanding of the process of skill acquisition early in life.

The focus of this study lies on the impact of shifting hours of care provided by the mother to hours of care provided exclusively by highly regulated center-based care on children’s short- and medium-run development.¹ Substitution of maternal care by center based care may change three potential margins: first, a child spends less time with her or his mother but more time in child care – a quantity effect of time –, second, the mother may focus on providing different types of care – a quality effect of time and third, as stressed in current policy debates, the mother may increase her labor force participation and hence contribute to the family income - an income effect.

Clearly, whether substitution generates positive or negative effects for child development depends on the mother’s quality of care relative to the care provided by the center. This is why we are particularly interested in understanding if there is heterogeneity in the gains from exposure to high-quality care. For this purpose, we distinguish between the three different effects of high-quality center-based care during early childhood (age 0-3). First, we compare children who spend some time in formal care to children who do not conditional on a rich set of individual and regional characteristics - the effect on the average child placed in childcare. Second, we estimate the overall effect of increasing the supply of center-based care independently of individual exposure – the intention to treat effect. Third, we are interested in the causal effect of exposure to non-parental care on the skill acquisition of children who only attend center-based care once access is less restricted – the effect on the extra child attending childcare because access is less restricted. These effects will differ depending on who places their child in childcare.

Our identification strategy relies on variation in the amount of childcare slots available to parents. We show that expanding access to care triggers strong substitution from care provided

¹Previous literature, such as Baker, Gruber, and Milligan (2008) and Havnes and Mogstad (2009b), rely mainly on reforms in the childcare system and hence, evaluate the effect of a drastic increase in the general supply of childcare facilities, without distinguishing between the mode and the quality of the care. Datta-Gupta and Simonsen (2010) explicitly distinguish between high- and low quality care, in their causal analysis, however, they do not relate these modes of care to care solely provided by the mother.

by the mother to high-quality childcare. In particular, we exploit both immense regional variation, (0 - 65 slots per 100 children aged 0-3) and time variation in the local availability of center based care (growth rates vary from -2% to 18% per year). The source of the regional variations is mainly historical and goes back to the different political regimes prior to German reunification. The German Democratic Republic (GDR) considered family policy a public issue and set up a comprehensive system of childcare to facilitation of female labor force participation (FLFP) and guarantee uniform national education. The Federal Republic of Germany (FRG) considered child care as a family responsibility and did not provide childcare. German reunification, in 1990, left these discrepancies largely untouched. Only quite recently have the childcare systems started to converge. Former East Germany reduced the supply of child care slots significantly because of financial problems and decreasing fertility. Former West Germany is expanding the supply of childcare facilities following a growing public awareness of the relevance of childcare (Kinder & Jugendhilfegesetz: SGB VIII).

There are two potential threats to this identification strategy. First, there may still remain regional differences in the pedagogical methods used in East and West Germany despite major integration efforts. We address this problem by taking the location of the childcare facility (including both East and West Germany and state fixed effects) into account. Doing so does not affect the main results. Second, there is a strong gap in socio-economic performance across German regions. This gap changes incentives for labor force participation and therefore also the demand for childcare. We address this potentially important problem by controlling for a vast set of regional demographic and socio-economic indicators. Again, considering these regional differences does not affect any of our main results.

The empirical analysis draws upon two different datasets, providing information for different cohorts. The first is the German Child Panel (GCP), which contains information on 1148 children born 1996/97 and being interviewed at age 5 to 10. Moreover we use data recently collected by the German Socioeconomic Panel (GSOEP) on 858 children born between 2002 and 2005 and being surveyed at age 0 to 1 and 2 to 3. Both datasets contain a rich set of child development measures such as independence, social skills, behavior and personality. The GSOEP also asks about children's language and motoric skills; the GCP contains information on children's grades obtained in primary school. Both datasets also provide information on the use of center-based care during early childhood as well as on the individual background. Regional statistics are then used to add information on the local availability of center-based care as well as on features of the county where the family resides. Hence, both datasets allow discussing the impact of center-based care prior to the age of 3 on a wide range of child development outcomes

at age 2-10. Further information provided by the GSOEP, namely a rich module on the hours of non-maternal childcare (i.e. provided by the partner, the extended family, informal childcare and formal childcare such as day care centers) as well as information on a broad range of activities between mothers and children allows discussing the different channels through which exposure to center-based care may affect child development.

Our empirical analysis identifies three important results. We first study the effects of child care on the average child exposed to child care using a simple least squares identification strategy. We find child care improves non-cognitive skills for the average child care in childcare. In the short run (at age 2-3) children in child care are more independent and have better social skills than their peers. Children exposed to child care also benefit in terms of the main cognitive skill we observe; they are more articulate and form more complex sentences than their peers who are not in child care. However, in the medium-run (at age 5-10) these advantages are no longer present, children who were exposed to child care at age 0-3 even do worse in terms of their school grades in the core subjects at primary school. Second, children who enter child care because the supply of center-based care increases benefit even more strongly from child care than the average child. This finding comes mainly from the fact that children who are enrolled in center-based only when access is less restricted, benefit even more from exposure to high-quality care. In addition to benefitting more in the short run, marginal children also benefit in the medium-run: they are less dependent on their parents and obtain (marginally significantly) better grades in school. These findings are consistent with rationing favoring children from advantaged background.

This paper is related to three main strands of the literature on child development. The first strand has paid much attention to understanding the consequences of maternal employment, especially employment during early childhood, on children's achievement. While some of these studies show that maternal employment may improve intellectual performance through increasing household incomes Blau and Grossberg (1992), others have also shown that it is associated with lower outcomes among children (Baum (2003), James-Burdumy (2005)). Still others suggest that the effects may depend on the characteristics of mothers and families (see Ruhm (2004) and Brooks-Gunn, Han, and Waldfogel (2002) for full review of the literature). This research, however, does not distinguish between the alternative modes of non-parental care.

The second strand focuses on the effects of pre-school interventions targeted at disadvantaged children. With respect to these specialized programs, there is basically consensus in the literature about its beneficial impact on the development of the participating children. One, if not the most well-known of these pre-school interventions, is Head Start, reviewed in detail in Currie

(2001), Blau and Currie (2006) or Heckman (2007). Other examples are the Perry Preschool Project, The Abecedarian Program, and the Chicago Child-Parent Centers; for an overview please refer to Blau and Currie (2006) or Heckman and Materov (2007).

A third strand of literature investigates the effect of universally accessible childcare on children's skill acquisition. There is a fairly large body of research on the effects of non-parental care during pre-school ages (4-6 years old) (e.g. Magnuson, Ruhm, and Waldfogel (2004), Fitzpatrick (2008), Gormley Jr., Phillips, and Gayer (2008), Berlinski, Galiani, and Gertler (2009), Cascio (2009), Havnes and Mogstad (2009b)). In contrast to this, the body of research on the effects of non-parental care during early ages (0-3 years) is fairly small.²Baker, Gruber, and Milligan (2008), for instance, evaluate the introduction of universal childcare in the Canadian province of Quebec. Their findings indicate that lowering the out-of-pocket cost of childcare increases the use of childcare by 14.6 percentage points but lowers child well-being (increases anxiety, decreases health) and leads to more hostile parenting styles. Datta-Gupta and Simonsen (2010) concentrate on the effect of exposure to different types of childcare (low quality (home) care and high quality (center-based) care in Denmark). Carneiro, Loken, and Salvanes (2010) study the long-run effects of expanding parental leave immediately after birth on educational and labor market outcomes at age 25 in Norway finding some positive effects of maternal care. Baker and Milligan (2010) focus on changes in parental leave in Canada on child development outcomes of children aged 2 to 4 years finding no effects.

Our study contributes to the existing literature in at least three respects. First, we discuss explicitly the role of expanding access to high-quality center-based care versus motherly care in the process of skill acquisition during early childhood (0-3 years old). This expansion triggers a strong shift from maternal care directly to high-quality care. Second, we examine the impact of non-parental care on children's short and medium run (age 2-10 years old) development with respect to a comprehensive set of cognitive and non-cognitive outcomes. This allows us to shed some light on different dimensions of children's development at the same time, and to address the open question if differences dissipate over time. Third, we highlight the tremendous differences in the effects of child care on the average child and the effect on the extra child attending childcare only because access is less restricted. This is important in discussing the incidence of expanding high quality care on society.

The remainder of this paper is structured as follows. Section 2 discusses the institutional

²There is some earlier literature in the child development field providing descriptive evidence on the relation between non-parental childcare during early childhood and children's skill acquisition. Belsky, Vandell, Burchinal, Clarke-Stewart, McCartney, and Owen (2007), for instance, find that the amount of time spent in non-parental childcare throughout a child's first 4.5 years predicts higher vocabulary scores whereas Belsky (2001) finds that it is associated with development risks.

background. Section 3 provides information on the data sources and a set of key descriptive statistics. Section 4 discusses our two main identification strategies. Section 5 presents the main results, and section 6 provides a summary and implications of our findings.

2 Institutional Background

This section provides an overview of the German childcare system. In particular it discusses historical differences in the childcare system across the two former German countries, the GDR and the FRG, changes in the childcare systems after German reunification, as well as key evidence on remaining regional differences.³

The central aspect of the German childcare system is the strong regional variation in childcare offer rates. This is due to the different perspectives on family policy adopted in the two German countries prior to German reunification. In the GDR, it lied within the sphere of public responsibility to provide childcare for children at all ages. Universally accessible childcare should facilitate both female labor force participation as well as guarantee national education. Given a high supply of childcare (56% of children age 0-2 had a slot in public care) and the allowance for mothers to take one year off after childbirth, there was basically full coverage for children age 1-2 years. In contrast, the former FRG has until recently embraced the view that child care is the responsibility of each family and that mothers should best care for their children until they enter Kindergarten. In support of this view, Germany rapidly expanded parental leave from 3 months in 1979 to 36 months of job protected, and 24 months of paid leave in 1992. Yet the supply of formal childcare for 0-2 year olds remained very limited (1%).

German reunification in 1990 implied adoption of West German family policy in all dimensions (parental leave, tax system) except for childcare. Despite the agreement in the reunification contract to maintain the supply of childcare, financial shortages and a dramatically decreasing fertility rate lead to a decline of the coverage rate for children aged 0-2 years in East Germany (41.3% in 1994, 36.4% in 1998 and 37.1% in 2002). In West Germany, however, due to a general concern about the relevance of universal childcare, the amount of childcare centers started slowly to increase (2.2% in 1994, 2.8% in 1998 and in 3.6% in 2002).

Currently, each county (439 counties in total) is in charge of organizing its own child care system and hence growth rates of available slots vary also on a regional level. Despite a slow convergence process, the German childcare system is still characterized by enormous regional differences. Figure 1 displays a map shading counties (Kreise) according to the number of full

³All facts about the institutional background are taken from OECD (2004), Dittrich, Peucker, and Schneider (2002) and Riedel, Gadow, van Santen, Fuchs, Schilling, and Leu (2005)

Figure 1: Slots in center-based care per 100 children aged 0-3

time childcare slots available per 100 children aged 0-3 years on Dec 31, 1998. Clearly, there is striking regional variation in childcare offer rates between regions located in former East Germany and regions located in the West. Generally, offer rates are on the order of 40 % in the former East, whereas they are below 10 % in the West. Yet, note that there is also substantial within region variation. While in Bayern, the state with the lowest supply of childcare in West Germany, on average only 1.4 out of 100 children can be placed in formal childcare, there are counties within Bayern that offer as few as 0.1 slots per 100 children and other counties that offer as many as 7.1 slots per 100 children. In Brandenburg, the state with the highest supply in East Germany, on average 51.9 out of 100 children aged 0 to 3 years old will be able to find a place in a formal childcare center in Brandenburg. However, the coverage rate varies again from a minimum of 42.7 % to a maximum of 61.2%. Overall, supply varies from 0.1 to 23.4 % in West Germany, and from 11.7 to 61.2% in East Germany.

Given that the supply of childcare differs strongly across regions, it is crucial to understand how children and slots are matched. Centers typically operate with waiting lists. In the West, many parents who are on a waiting list do not get an offer for a slot until long after registering on the waiting list. Centers also give preference to children with working parents, single mothers and to children whose sibling is already enrolled in the childcare center. Rationing is likely to favor children from advantaged backgrounds. Fees vary across regions and depend on family income in a progressive manner. The available evidence, however, does not indicate that fees vary strongly between East and West. Parents have the option to purchase informal childcare (nanny, child-minder, etc.) on the market, but the costs of doing so far exceed childcare fees such that these modes are only used for rare occasions (only 5.5% of the families rely on careminders on a frequent basis).

Besides providing care, centers have a clear educational mission in two dimensions. Educational goals concern developing skills related to pattern recognition, motor skill development, and language skill development. Center staff develop these skills using educational activities and playful activities in support of these skills. Moreover, center-based care is also expected to contribute to the development of social skills such as interacting with others, calling other people by their name, etc.

Does the quality of childcare vary across regions? Center-based care for 0-3 year olds is tightly regulated but oversight is decentralized at the state level. Regulations concern dimensions such as staff child ratios, space, but also special training and qualifications for the staff has before

Table 1: Key characteristics of the childcare system by region

being allowed to work in the sector.⁴ Table 1 shows key characteristics of the childcare system by region.

Regions in the West and regions in the East of Germany are on average quite similar with respect to formal criteria such as the tightness of their regulations concerning maximal size of the group of children, staff-child ratios, size of the childcare center, etc. In both regions about 6 out of 10 possible regulations are put in practice. Children who live in the West benefit from somewhat better staff to child ratios than children who live in the East. There are about 5 children per employee in the West whereas there are almost 7 children per employee in the East. In contrast, staff in East Germany appears to be somewhat better trained than in West Germany. Whereas more than 90 percent of the staff in the East has a specialized degree in childcare, the corresponding figure is 84 percent in the West. Moreover, childcare staff work typically full-time work in the West but part-time in the East. Overall, Table 1 shows that there are differences in childcare quality between East and West. These differences are, however, relatively small and there is no consistent pattern indicating that one region dominates the other region in terms of quality of childcare.

3 Data and Descriptive Evidence

The next subsection 3.1 describes the available data sources and the subsection 3.2 provides a descriptive analysis of the relationship between center based care and child development and discusses potential channels through which early formal care might exert its effect on children's development.

3.1 Data sources

The empirical analysis draws upon two different datasets, providing information for different cohorts. The first dataset is the German Child Panel (GCP), which contains information on 948 children born 1996 and 1997. The parents of these children are interviewed up to 3 times when their children are between 5 to 10 years old. The second dataset contains supplementary data recently collected by the German Socioeconomic Panel (GSOEP) on 803 children born to women who are part of the original GSOEP between 2002 and 2005. For these children we have information when on age 24 to 47 months. In other words, the GSOEP allows us to assess

⁴In an effort to integrate staff members from centers of the former GDR, recognition of degrees was done but limited to the specific age groups. However, training for further integration and qualification was offered and very frequented.

the short-run impact of center-based childcare on children's skill acquisition, while the GCP allows us to evaluate its medium-run impact. Both surveys cover a broad range of indicators of child development concerning different characteristics and non-cognitive skills. The questions are obviously adjusted to the age of the child. The following key groups can be identified:

- Independence: The GSOEP asks questions if the child eats with a spoon without making a mess, blows nose without assistance, uses toilet to do number 2, puts on pants and underpants frontwards, brushes teeth without assistance. The GCP asks a battery of questions how the child manages unexpected or problematic situations.
- Social skills: Questions contained in the GSOEP are if the child calls familiar people by name, plays games with other children, participates in role-playing games, shows particular liking for certain playmates or friends, calls his/her own feelings by name. The questions contained in the GCP are about the relations the child has to children of his age group, if (s)he likes company, likes to meet kids, shows empathy, starts to fight, argue, bug or provoke other children, etc.
- Behavior: The GSOEP asks the mother to judge about the child's behavior ranking it on a scale between characteristics such as focused/distracted, obstinate/obedient, quick in learning/need time to understand. The GCP provides similar information on a child's degree of prudence, concentration, assertiveness, fidgetiness, quickness, etc.
- Personality: Both datasets include judgments about a child's personality such as how happy, irritable, difficult to console, curious, active, communicative, empathic, shy, etc. the child is.

With respect to the cognitive development the following skill categories are asked:

- Language skills: The GSOEP provides information on a child's communication skills such as if the child understands brief instructions, forms sentences with at least 2 words, listens attentively to a story for at least 5 minutes or relates simple messages.
- School grades: The GCP informs about a child's performance in a range of subjects in primary school: math, reading, writing, science, sports, arts and music.

The GSOEP contains additionally information on children's motoric skills at age 2 to 3 (e.g. if a child walks forwards down the stairs, uses door handle to open doors, climbs jungle gyms, uses scissors to cut paper, paints / draws recognizable forms on paper).

Assessment is done choosing from a range of up to 4 discrete categories: possible answers are that the characteristic is completely true (1), more or less true (3), less true (2) and last not at all true (4). Employing factor analysis separately on both datasets we create an index across all different non-cognitive skill dimensions (including all variables mentioned above among the categories independence, social skills, behavior and personality) as well as separate indices for each of the different categories of the non-cognitive (independence, social skills, behavior, personality and motoric skills) and cognitive (language and school grades) development. All indices are scaled to have mean zero and standard deviation of one.

Interpretation of the indices is straightforward for the domains that reflect skills or capacities. Higher values signify more developed or better developed skills. Interpretation of the indices measuring personality or behavior is not as clear cut. We assign positive scores to personality traits or behaviors which have positive connotation but recognize that this coding is not uncontroversial. We therefore provide not only effects on the aggregate child development index but also on its components.

It is important to mention that all indicators are based on mother's assessment of the child's development. Self reports could be affected by a range of biases. First, mothers could overestimate their child's abilities. This is a bias that plausibly affects all mothers. Second, self-reports could also be affected by childcare mode. For instance, mothers who use some formal care may evaluate their child relative to their children's playgroup at the childcare center whereas mothers who do not use childcare evaluate their child compared to their own expectations. Yet note that this bias is unlikely to be important. Survey items target the capacities of the child under consideration and are not formulated in a relative fashion. Moreover, if this bias is important, it will affect "subjective" measures (personality) more strongly than "objective" (independence, motoric skills, behavior) measures. A pattern of results that finds effects for "subjective" skills only would be suspect. Third, mothers who use formal care may evaluate their children better in order to justify their absence. This bias is important for the cohort aged 2-3 years but less important for the cohort aged 5-10 years since attendance to early childcare occurred back in time and hence any type of reporting bias should have disappeared.

Like all other skill dimensions, grades are reported by mothers and refer to the final grade her child attained in the most recent grade transcript. Naturally, school grades are available for children who are enrolled in primary school and are already receiving scaled grades (aged 9 years or older – before children only receive a verbal recommendation). Note that school grades refer to non-standardized tests. Grading may therefore not be comparable across different school classes. Moreover, grading styles may differ across German states. We assess this by correlating

grades with childcare offer rates for children who are not in formal care; however, we do not see any significant correlation.

We study a full range of skills characterizing children’s development at different ages (2-10 years old). They can be grouped into cognitive (language skills and school grades) as well as non-cognitive skills (independence, social skills, behavior, personality, as well as motor skills). This allows discussing whether only non-cognitive, cognitive, or both types of skills are affected by a shift from maternal care to formal care in the short- and/or medium-run.

Our data does not permit discussing the effects of child care for later labor market success. Yet note that existing literature suggests that this relationship is strong (Gregg and Machin, 1998). Moreover, we provide evidence on an intermediate outcome – school grades – that is quite strongly associated with later labor market success. Also, the child development measures correlate strongly with child background characteristics that have been shown to predict future labor market success (birth weight, parental education, etc.). This suggests that improvement on the child development measures are predictive of improvements of future labor market success.

3.2 Descriptive evidence

In this section, we provide descriptive evidence on the differences in cognitive and non-cognitive skills between children enrolled in center-based (or formal) care and children who are solely taken care of by their mothers. We also shed light on the underlying channels through which center based child care might exert its effects. In particular, we discuss if mothers, whose children are not enrolled in formal care, rely on other sources of childcare, interact in a significantly different way with their children and last, have a different perception about motherhood and child raising.

How do children differ depending on their child care use? We allocate children into two groups: Children with formal care (or treated children) are those whose mother responds sending/having sent them to the day care center for at least one minute per week. We contrast children in this group with children without formal care (or control children), i.e. these children never attend/have attended a day care center. Table 2 indicates that children who attend some formal child care do better in terms of cognitive skills, such as language skills, as well as noncognitive skills, such as independence, social skills, and motor skills. There are no differences in terms of personality and behavior as well not in grades obtained in school. Overall, there is a 0.09 standard deviation difference in terms of the average skills and abilities for children attending a day care center compared to children who never attend the day care center.

What explains the differences in terms of child development between children with some for-

Table 2: Child development and Child Care

Table 3: Non-maternal Child care and Maternal Market Work

mal care compared to children with no formal care? There are at least three different underlying explanations. The first explanation focuses on the quantity of care effect which refers to a pure substitution of hours of maternal care with hours of formal care. The second explanation focuses on the fact that if mothers spend less time with their children this may also affect the activities that mothers undertake with their children – a quality of maternal care effect. Third, mothers who place their child in formal care can earn additional income that can be spent invest in the human capital of their children.

Besides these causal explanations, there could also be differences in terms of family background as well as in terms of economic development and labor market opportunities between treated and control children. These differences may also explain differences in child development. Before assessing the causal impact of early center based child care on children’s development, we assess the validity of these explanations in turn.

Table 3 contains information on the quantity channel due to child care, in particular on weekly hours of non-maternal care along with the weekly hours of maternal market work, by exposure to formal care. Overall, partners care for their child during about 12.45 hours per week. The second most important source of care is formal care provided by a child care center during 9.65 hours per week. Next in line is the extended family. Grandparents provide about 4.95 hours of care per week, siblings and relatives together provide 1.46 hours per week. Finally, childminders and nannies provide also 1.39 hours of care per week. Overall, children are exposed to about 31 hours of care provided not exclusively by the mother. This does not mean that the mother is not present at that time, in particular during times when the father or any other family member provides care. It is clear from this table that the main mode of non-parental care is formal care and other privately organized, paid modes, such as a careminder or a nanny, are rather exceptions.

How do child care arrangements differ by formal care attendance? Children with some formal care spend on average 22.29 hours in the childcare center, and receive 1.30 hours less child care provided by a childminder. There are no other important differences between children exposed to different modes of child care. The average child in child care experiences a pure substitution from maternal care to care provided by the child care center. Interestingly, the mothers who place their child in childcare work almost 14.5 hours per week whereas mothers whose child does not attend formal care work about 11.5 hours per week. Thus, the labor supply effect of child

Table 4: Activities undertaken by mothers and children

care is quite small for mothers who have a child in care.⁵

What about the quality of care? Child care is due to three different types of sources: the child care center, other non-maternal sources of child-care and the mother. The quality of care provided by the child care center varies little across regions of Germany (see Section 2). Moreover, since children spend so little time in informal care, differences in the quality of informal care can be neglected. The quality of maternal care might, however, change as a function of child care mode. We use information on a range of activities mothers have undertaken with their child during the last two weeks prior to the survey to assess the quality of maternal care. These activities can be grouped with respect to whether they stimulate cognitive abilities (singing to the child, reading to the child, looking at picture-books with the child, watching TV with the child), stimulate motor skills (painting/handicraft, walking with the child), stimulate social skills (going to the playground) and passive childcare (visiting other families, going shopping with the child).

One would expect the frequency of all activities to decrease if time of maternal care decreases. This is exactly what happens in terms of home production or passive childcare – mothers with some formal care go shopping with their child less frequently and visit less often other families. However, mothers who use some formal care sing and read to their children more frequently than mothers who do not use formal care at all. Thus use of formal care appears to be associated with higher quality of maternal care. There are no other differences between the children in formal care and children who are not in formal care at all. Results suggest that substituting maternal hours of child care with formal child care also changes the content of hours of maternal care. Formal child care appears to substitute for hours of low quality care (going shopping with the child) and child care involving social activities (visiting other families with the child). In contrast, reducing hours of maternal care leads to more activities stimulating cognitive skills (singing and reading).

Child development may differ between children in formal care and informal care because of differences in pre-existing characteristics. Table 5 contrasts children by formal care. Overall, Table 5 indicates that 18% of all children are born in East Germany; this share is 27 % for

⁵There are at least two explanations for this finding. First, mothers may purchase child care to free up time for non-market work or leisure. Second, mothers who purchase child care may have access to more family care that is less available at times when they are working than mothers who do not purchase child care. But note that also parental leave policy has been shown to generate small substitution effects. Schoenberg and Ludsteck (2008) study Germany and Lalive, Schlosser, Steinhauer, and Zweimueller (2010) who study Austria find less than one-for-one effects of expansions of parental leave on maternal labor supply. This is mainly for two reasons. First, an important share of women do not work even long after giving birth to their first child. Second mothers tend to shift between unemployment insurance and parental leave when parental leave is expanded.

Table 5: Individual and regional background characteristics

children with formal care exposure. About 55 % of all children are boys , 10% are underweight at birth (less than 2500 grams at birth) with low birth weight being less prominent for children with exposure to formal care. Moreover, children with formal care exposure are younger and born into smaller families than children with no exposure to formal care. Mothers of children in formal care do not differ in terms of age (about 30.5 years old) and cohabitation status. But mothers who place their child in formal care are better educated (26 % have a university degree vs 16 % for mothers who do not use formal care). Moreover, household income is significantly higher for children with some formal care compared to children with no formal care (14 % income exceeding 4000 Euro vs 10 % with income exceeding 4000 Euro). These results indicate that there is clear selection into formal care based on mother education, household income, family size and child birth weight. The empirical analysis will need to correct for these differences.

Table 5 also provides a detailed set of features of the county (Kreis). The key regional characteristic is the child care offer rate. In 2002, this rate stood at 10.13 percent with a huge standard deviation of 15 percentage points. Note that this rate is much lower than the percentage with some formal care in the sample. This is probably due to few children using formal child care below the age of 1 and children sharing full-time slots. The change in child care offer rates 1994 to 2002 is negative. Notice, however, this development masks an expansion in the West and a contraction in the East. Regional characteristics also indicate that children with exposure to formal care live in regions with higher unemployment, lower fertility, and slightly older age structure. Estimates also need to take these regional differences into account.

4 Conceptual Framework and Estimation

This section clarifies the what we mean by the causal effect of formal care on child development, introduce the empirical framework, and discuss three main empirical strategies: ordinary least squares (OLS), linear IV (IV), and intention-to-treat (ITT) analysis.

What do we mean by the causal effect of formal care on child development? The effect of formal care on a particular child is just the difference in child development with some exposure to center based care and child development in the absence of child care. This individual causal effect may arise for at least two reasons. The first way in which child care can affect child development is direct. Since children aged 0 to 3 years need to be cared for throughout the week, any child care time generates a shift in the structure of early child care. We show above that children are cared for by four basic types of care providers: the mother, the center, the extended family, and

providers of informal care. Placing a child in formal care necessarily entails a shift from the three remaining providers of care to center based care. This shift in type of child care will produce a positive effect on child i if the quality of center based care dominates other sources of care. The second way in which child care can affect child development is indirect. Placing a child in child care frees up (predominantly female) time for market work thus potentially raising household income. Moreover, mothers who place their children in child care may also undertake different activities with their children. Even though these channels are indirect, they are nevertheless a straightforward consequence of placing child i in center based care and they are therefore part of the causal effect.

Let $D_{ia} = 1$ if child i of age cohort a ever spent some time in center-based childcare during ages 0 to 3 years, and $D_{ia} = 0$ otherwise.⁶ Let y_{ia} measure skill or ability development of child i of age cohort a measured in year t , currently living in region c , where c indexes the counties in Germany (*Kreise*). Our main objective is to identify the parameter δ in the following linear model of child development:

$$y_{iat} = \alpha + X'_{ia}\beta + X'_{ca}\gamma + \delta D_{ia} + \epsilon_i \quad (1)$$

Our first empirical strategy is ordinary least squares (OLS) taking into account individual level background characteristics (vector X_{it}), and regional characteristics (vector X_{ct}). Note that both sets of characteristics are measured at child-birth. The reason for this is the following. Current individual characteristics are endogenous, i.e. families may strongly change working arrangements after child-birth. Current individual characteristics are "bad controls" in the language of Angrist and Pischke (2009). Moreover, current regional controls may be a result rather than a predictor of the birth cohorts which child i is a part of. Regional characteristics are particularly important since German regions differ strongly not only in terms of offer rates of formal care, but as well in terms of their socio-economic development and demographic structure.

OLS compares children who are or have been exposed to center-based care early in their childhood to children who have never been in formal care. OLS is a weighted average of the underlying heterogeneous treatment effects. The weights are related to the inverse of the conditional variance of being in treatment (Angrist, 1998). This effect is similar to the average effect of treatment on the treated with the exception of the weights. One uses the probability of

⁶Note that by coding formal care in a binary fashion we will not be able to speak about the importance of the amount of exposure to formal care. This is not because we do not think it is interesting to measure how the child skill production function depends on time in formal care. We abstract from the quantity of formal care for at least two important reasons. First, child skills arguably depend on hours of formal care in a non-linear fashion. Yet the IV strategy cannot distinguish a linear effect of hours of care from non-linear hours of care effects. Second, we have information on current exposure of center based care for young children (in the GSOEP) but not for the older age groups (in the GCP).

treatment rather than its variance in calculating the average effect of treatment on the treated.

For whom does the effect apply then? Suppose children of parents with more education and hence more career ambitions get enrolled first – i.e. there is selection into child care based on parents’ intellectual background. This selection mechanism is plausible given that centers use waiting lists placing children earlier whose parents have expressed a strong interest in a slot earlier. Children of mothers with high educational skills would benefit more from spending time with their mothers rather than in child care. The gains from formal childcare are smallest for children of skilled mothers. Self-selection on parents’ intellectual backgrounds and limited supply of formal care therefore leads to an OLS estimate which probably underestimates the effect on children who are not yet enrolled into formal care. Considering the variation of childcare offer rates in Germany, high supply and enrollment in the East and low supply and low usage in the West, the OLS is expected to be particularly large in East Germany compared to West Germany.⁷

Note, however, that OLS may also be affected by selection bias. Families may base their decisions to purchase formal child care for their children on unobserved child ability, they may also differ in terms of other aspect that are correlated with child skill. Note, however, that our analyzes control for a wide range of observed characteristics at both the individual and the regional level. We therefore expect the bias due to unobserved characteristics not to be quantitatively important. Yet since a bias is possible and since children who are currently in care are positively selected, OLS will tend to provide an upper bound on the effect of child care on the average child.

The second empirical strategy uses instrumental variables. Let Z_{ct} indicate the offer rate of slots in child care in the county c and year t when child is born. Importantly, we measure the number of slots potentially available per 100 children rather than actual slots filled. This is a pure measure of the supply of child care slots. This supply measure will be predictive of whether a child attends formal care or not if there is excess demand. A situation of excess demand is plausible for West Germany but less so for East Germany. Note again that we use the local supply of formal care at the time of childbirth, hence prior to parent’s actual decision to send their child to formal care. This means that supply of slots is pre-determined.

In a situation of excess demand for child care slots, we expect that the offer rate is correlated with the use of formal care, i.e.

$$D_i = \pi_0 + X'_{it}\pi_1 + X'_{ct}\pi_2 + \pi_3 Z_{ct} + \nu_i \quad (2)$$

⁷Indeed, this is what we find. Results are available upon request.

The key issue when judging the validity of using regional child care supply at childbirth as an instrument for usage of formal child care is whether the regional offer rate be excluded from the model explaining child development. Exclusion may fail because regions differ strongly in terms of a range of structural features which both shape labor supply incentives and supply of child care. These include observable aspects such as the local labor market, fertility decisions, the health system but also potentially less well observable aspects such as mother’s attitude towards raising their children or education systems.⁸

Recall, however, that our baseline specification (1) accounts for a wide range of observed regional differences in socio-economic development and demographic structure. Specifically, our baseline estimates control for the unemployment rate and regional GDP. Moreover, we condition on fertility, migration and the age structure to take the rapidly changing age structure between East and West into account. Thus, while unconditional exclusion surely fails, conditional exclusion may be justified. To address these concerns, we provide supplementary analyzes that discuss the sensitivity of our baseline results to unobserved region effects. We do this in two ways. We first add dummy that identifies former Eastern German states. This strategy identifies from within region variation in offer rates. This is useful since West and East Germany is the most important regional divide in Germany. We also add state fixed effects for all Western states in addition to the East dummy. This is to account for the strong regional variation within West Germany in terms of education systems and conservatism. Taken together, these two strategies allow assessing whether our baseline strategy confounds child care effects with culture or formal education systems.⁹ We are confident that we can discuss whether the child car offer rate can be excluded in terms of omitted region level variables.

We use a standard two stage least squares approach and report the resulting IV estimate for formal care. This approach has also been termed "linear IV" by Heckman and Vytlacil (2000). How can this effect be interpreted? Heckman and Vytlacil (2000) show that the linear IV estimate is a weighted average of the marginal treatment effect (MTE) parameter. The MTE parameter is the causal effect of center based care for people conditional on observed characteristics and propensity to be placed in center based care.¹⁰ With a continuous instrument Z_{ct} , as in our context, linear IV measures a weighted average of the underlying heterogeneous MTEs for children with different propensities to attend center based care. The weights are,

⁸Alesina and Fuchs-Schndeln (2007) find that current day political preferences have been shaped by the strong differences in political ideology between the FRG and GDR. The paper also shows that there is slow convergence in political preferences.

⁹Note that adding state fixed effects also addresses the strong East West migration after re-unification to some extent. We also find that families’ migration decision in the years around childbirth can not be predicted by differences in the supply of slots in child care centers. This finding suggests that families do not move to regions with better supply of child care.

¹⁰The MTE can also be estimated directly using a local version of our IV strategy.

Table 6: Baseline Results

again, related to the conditional variance of being in the treatment. If children are placed in child care based on parents' intellectual background, the IV parameter puts more weight on children with mothers who have low educational background. IV can exceed the OLS in this situation if these children benefit particularly strongly from formal care.

We also provide estimates that relate child development to child care offer rates directly as follows

$$y_{ia} = \alpha + X'_{it}\beta + X'_{ct}\gamma + \nu Z_{ct} + \mu_i \quad (3)$$

The parameter ν captures the so-called intention-to-treat effect (ITT), i.e. the effect of increasing the child care offer rate by one unit. The ITT provides an overall estimate of the consequences of raising the child care offer rate by one unit. The parameter ν is the relevant policy parameter and could, for instance, be used for cost benefit analysis of the extension of early child care.

5 Results

This section discusses first the effect of exposure to formal care using ordinary least squares (OLS) measuring the effect on the average child placed in childcare. The section then discusses the effect of an increase in the supply of care facilities using ordinary least squares (ITT) and third, the results of the instrumental variable estimation (IV), measuring the effect on the extra child placed in child care because access is less restricted. Besides the main skill factor summarizing the non-cognitive skills for the pooled sample, we distinguish between the different dimensions of cognitive and non-cognitive skills. Moreover, we present the short-run and the medium-run effects. Last, we discuss possible channels through which formal care attendance may influence children's development.

Table 6 shows the main results regarding the aggregate non-cognitive skill factor for the sample pooling children at all ages (2-10 years old). This indicator reflects the mean over all the skills and abilities discussed in section 3.2, in particular independence, social skills, behavior and personality.

Column 1 of table 6 shows the effect of formal care attendance on the average child placed in formal care. As we can see clearly, children with some exposure to formal care do on average better in terms of non-cognitive skills. The difference in child development is on the order of 0.11

standard deviations. Table 6 as well as table A1, in the Appendix, also indicate that the regional background characteristics matter neither individually nor jointly, the exception being the share of women older than 65 years. In contrast, individual characteristics such as birth weight and gender predict child development in a statistically significant and important fashion. Children who are underweight at birth (birth weight being lower than 2500 grams) score 0.275 standard deviations worse than children with normal birth weight. This disadvantaged skill development for low birth weight children corresponds to the difference in scores between boys and girls (boys score 0.275 standard deviations lower than girls). The socio-economic background of the family matters also significantly; mother's education influences a child's development positively, with children of mothers with a primary school degree scoring 0.20 standard deviations higher than children of mothers without a school degree, children whose mother has a secondary school degree scoring 0.22 standard deviations higher and children whose mother graduated from university scoring even 0.25 standard deviations higher. Additionally children belonging to lower income groups fare worse in terms of the child development measures we study. The remaining child or mother characteristics are not statistically significant.

Column 2 of Table 6 shows the effect of an increase in the available slots per 100 children in the county where a child is born; an increase in 1 slot per 100 children increases the overall non-cognitive skills by 0.01 standard deviations. This effect is non-negligible; in case a county would change from no childcare facilities at all to full coverage (meaning a change from 0 to 100 slots per 100 children), overall skills would increase by 1.15 standard deviations, an effect which is immense in comparison to the effect of individual exposure to childcare.

Before turning to the estimates of the instrumental variable approach that estimates the effect of exposure to child-care given that the child gets enrolled due to an increase in child-care supply, we want to discuss the strength of the instrument. Column 3 in Table 6 provides the first stage result, yielded by a linear probability model. The regression relates use of formal care to the local child care offer rate at childbirth. Results indicate that increasing the child care offer rate by one percent increases the probability that a child is enrolled in child care by 0.9 percentage points. It is important to report that the F-statistic is 78.51, hence far-above the recommended critical F-statistic of 10. We do not face a problem of a weak instrument.

We also discuss the other determinants of a child's attendance to formal care. Education is very important. In comparison to a mother with no educational degree, a mother with secondary school degree is 20.1% more likely to send her child to childcare and a mother with university degree even 28.9% more likely. This finding strengthens the claim that rationing favors children from advantaged backgrounds. Highly educated mothers may place their children early enough

on the waiting list in order to place their children in formal care despite excess demand. Hence, children with the lowest gains from formal care are placed first. Moreover, we can observe a general positive trend in childcare attendance: children from more recent cohorts are more frequently registered in a formal care facility. The remaining individual characteristics are not statistically significant.

Turning to the IV estimates, Table 6 Column 4 provides the estimates of the effect of formal care exposure using local care supply as an instrument. Results indicate that enrollment into formal care following an increase in the local supply improves child development by 1.19 standard deviation – a huge effect. The estimate is statistically significant at any conventional level. Comparing results in column 1 and column 4 indicates that simply contrasting the development of children who are enrolled in formal care with those who are not enrolled underestimates the effect of formal care for those children who are not (yet) enrolled when access is limited. As the result of the IV estimation reveals, the children who are enrolled in formal care once access is less restricted have by far larger gains from exposure to high-quality care than the children enrolled regardless the shortage of supply. As already discussed in Section 4, rationing may be based on advantaged backgrounds or put it differently on gains from exposure to high-quality non-parental care, with the children with the lowest gains being the ones enrolled first. Due to the absence of rationing in East Germany, the effect for the average child placed in childcare in East Germany should be higher than for the average child placed in childcare in West Germany. The estimates using separate OLS regressions of the overall skill indicator on formal care usage for children from East and West Germany confirm this hypothesis; while there seems to be basically no difference between the non-cognitive skills (neither the overall skill indicator nor the single categories) of West German children enrolled in formal care and West German children taken care of solely by their mother, among East German women there are substantial improvements for children who are attending high-quality child care (by 0.19 standard deviations in the overall index).

One threat to our main identification strategy is that, despite major integration efforts, there may still remain regional differences in the parenting style as well as the pedagogical methods used in East and West Germany. Despite the fact that the regional characteristics were not significant in any of the baseline estimations presented in Table 6, we want to address this potential problem by controlling additionally for the residence of the family at childbirth. Results including additionally a dummy for residence in East Germany, fixed effects for all states in West and an East Germany indicator are shown in table 7. We also show results that include separate linear time trends for all West German states and East Germany (in addition to separate

Table 7: Sensitivity analysis controlling for regional fixed effects

intercepts).

Panel B table 7 shows the results for the different estimations – OLS, ITT, First Stage and IV – controlling for the set of individual and regional characteristics as well as for a dummy for residence in East Germany. As we can see results do not change significantly. Interestingly, the point estimate for the IV estimation is even higher: the effect on the extra child placed in childcare once access is less restricted is now 1.5 standard deviations. Once we control additionally for the states in West Germany (Panel C in table 7), the point estimate of the IV estimation decreases slightly, but is still significantly different from 0. Note that the variables indicating a family’s residence are jointly significant in the OLS regressions – the F-statistics being 13.09 and 3.85, respectively – they do not remain significant in the IV estimations – the F-statistics being 0.21 and 2.41, respectively. This suggests that there is no direct effect beyond the effects driven by differences in child care offer rates that affect child development differently across regions in Germany. Panel D in table 7 presents results that allow for separate linear time trends in all West German states plus East Germany. Results are, again, robust to the inclusion of separate time trends. These results suggest that endogeneity of child care offer rates with respect to time invariant or slowly moving state characteristics is not a concern.

Table 8 provides results by region of residence (West vs East) and mother education. Results for children who live in West Germany indicate that the effect of child care on the average child in childcare (OLS) is not significantly different from zero. Yet, expanding the child care offer rate significantly and quantitatively importantly improves child development (ITT). Moreover, increasing the offer rate by one slot leads to almost one additional child per 100 children experiencing formal care (First Stage). Overall, the effect of child care on the marginal child is significantly different from zero and on the order of almost two standard deviations. In contrast, results for children who live in the East indicate that the average child benefits significantly and quantitatively importantly from being cared for in the day care center (OLS Panel B). Interestingly, expanding the offer of child care does not lead to incremental take up of child care in East Germany (First stage Panel B). This suggests that East Germany is characterized by excess supply of child care slots. The child care offer rate is not a valid instrument for child care attendance. Moreover, child development is not correlated with the child care offer rate. This suggests that the correlation between child development and child care offer rates is a causal effect of spending time in the day care center. Note that OLS results by region are consistent with a view that the first children to get into child care are those who stand least to gain from

Table 8: Results by Region and Mother Education

child care. The effect of child care on the average child in child care is not significantly different from zero in the West (where few children are in child care) and it is significant and positive for children who live in the East (where many children are in child care).

A second way to assess rationing by potential gains from child care is to assess results by mother education. Panel C in table 8 provides results for children whose mother has completed primary or secondary education (OLS). The effect of formal care is positive and significant for the average child in formal care. Expanding the child care system improves child development significantly and quantitatively importantly (ITT). This is because more children attend formal care as the number of slots in formal care is increased (First Stage). Overall, the marginal child of a mother with low to intermediate educational background benefit strongly from attending childcare (IV). The effect of attending child care is on the order of 1 standard deviation. In contrast, children of highly educated mothers do not benefit from being placed in formal care (OLS Panel D). Moreover, increasing the number of day care slots does not lead to higher take up of child care among children of mothers with completed university education. Again, the child care offer rate is not correlated with child development (ITT) suggesting that the causal link between expansion of child care offer rates and child development is due to actual formal care attendance. The OLS results suggest that child development gains from child care differ by educational background of the mother. Moreover, the first stage results demonstrate that the marginal child entering child care because supply is expanded is from a low educational background with corresponding large gains from being placed into child care.

Taken together, the results in Table 8 explain why the OLS results are so much lower than the IV results in Table 6. The OLS results measure the effect of child care on the average child which is from a high educational background and correspondingly weak gains from child care. The IV results measure the effect of child care on the children exposed to child care because slots are less rationed – children with large gains from attending child care.

How does formal care affect the different dimensions of child development? Table 9 provides detailed results regarding skill dimensions. The results in column one indicate that the main benefits for children with some exposure to formal care are in dimensions such as independence and social skills. There are no differences in terms of personality and behavioral development. Turning to column 2, the ITT estimates, we can see that the ceteris paribus effect of offering 1 slot in formal care per 100 children more favors children in all dimensions: in case a county would change from no childcare facilities at all to full coverage (meaning a change from 0 to 100 slots per

Table 9: Detailed Results

Table 10: Short-Run Impact

100 children), the observed effects are immense in all skill dimensions, ranging from 0.49 standard deviations improvement for behavior to 0.9 standard deviations in children's independence. Similarly, the effect of child care on the additional children entering care because child care offer rates are expanded (column 3) are positive in all dimensions contained in the overall non-cognitive skill indicator: we observe significant improvements in children's independence (1.03 standard deviations), social skills (0.84 standard deviations), personality (0.81 standard deviations) and last, even if not significant, but still remarkable improvements in their behavior (0.43 standard deviations).

Results indicate that children in formal care when aged 0-3 years old attain different levels of development than children who are not in formal care. Is this a persistent effect? One may argue that everyone will learn to perform some skills listed in section 3. On the other hand, initial advantages may turn into medium-run advantages because someone who is able to master basic activities earlier will have more time to invest and learn more difficult activities. Additionally early advantages in basic skills, such as for instance in children's independence or social interactions, may constitute certain advantages in the acquisition of cognitive skills. We therefore distinguish our analysis and contrast non-cognitive and cognitive outcomes for children aged 2-4 as well as children aged 5-10 years by use of early formal care. Table 10 and Table 11 display the effects of exposure to formal care during early childhood (age 0-3) on children's cognitive and non-cognitive skills at age 2-4 and age 5-10, respectively. The first set of results, the short-run effects, is based on the GSOEP data, while the second set of results, the medium-run effects is based on the GCP. The latter contrast reflects differences in early care exposure but also, to a weaker extent, differences in Kindergarten exposure (aged 3-6). Even though Kindergarten offer rates are much more similar across German regions than early care offer rates, there are important differences in terms of how easily parents can combine work and family between East and West. East German Kindergarten is typically all day with a meal provided by the Kindergarten. In contrast, West German Kindergarten only offer half-day slots (parents choose morning or afternoon slots).

Table 10 shows that children enrolled in formal care have a clear advantage in all dimensions. Children in formal care have better language skills (by 0.26 standard deviations), better motoric skills (by 0.24 standard deviations), better social skills (by 0.36 standard deviations) and are more independent (by 0.30 standard deviations) than children who are not in formal care. Similar

Table 11: Medium-Run Impact

to the pooled results, the effect is again higher for the children who start to attend formal care as soon as supply increases: at age 2-3 these children are more proficient in German (by 0.87 standard deviations), master daily tasks better (by 0.72 standard deviations), interact more openly with their companions (by 0.83 standard deviations) and have also better manners (by 0.79 standard deviations).

In the medium-run the differences between children who attended formal care and the ones who never attended it, seem to dissipate on average. As we can see in Table 11, the coefficients of basically all non-cognitive skills are insignificant. With respect to the cognitive skills, we even observe worse results: children who were taken care of in a center-based care obtain on average 0.20 worse grades than children who were taken care of solely by their moms. Given our comparison of pre-existing differences, see Table 5, mainly higher educated mothers are sending their children to center-based care. Hence, the medium-run OLS estimates indicate that their children would perform better in school if their mothers would have taken care of them instead of sending them to formal care. Children who enter child care once access is less restricted seem, however, to benefit substantially from exposure to high-quality care at early childhood, even several years later (see Column 3, Table 11): we do not only observe gains in dimensions of the non-cognitive skills, such as tackling of unexpected and difficult situation (by 1.26 standard deviations) and a more outgoing and happy personality (by 0.94 standard deviations), but also improved results at school (by 1.49 standard deviations, but only significant at a 15% significance level). This suggests that these children benefit not only in terms of non-cognitive skills but also in terms of skills evaluated by teachers in school. These results are unlikely to be driven by regional differences in grading. First, school grades do not correlate with the regional offer rates among children who have not experienced formal care aged 0-3 year old. Second, students who live in East German regions perform better in standardized tests (e.g. PISA) than students from West German regions.

Taken together, these results are consistent with rationing of children taking place based on parental background. Children with a good child development potential are selected into child care in a situation with few slots available. As child care is expanded children with higher potential gains from center based care enter child care. This generates a situation with a weak average effect of child care on child development and a strongly positive effect on the marginal child. These findings indicate that high-quality care might contribute to decrease inequalities arising due to different socio-economic backgrounds and to weaken intergenerational

Table 12: Quality channel

transmissions of socio-economic status. Childcare at early childhood can help to "level the playing field" (as in Havnes and Mogstad (2009a)).

What explains the formal care advantage? The section on descriptive statistics (Section 3.2) discusses three important channels. Use of formal care implies a substitution from maternal care to formal child care – the *quantity* channel. Formal care may also affect the overall educational exposure of the child not only via educational activities in the child care center but also via activities with the mother – the *quality* channel. Last, usage of formal care may lead to an increase in mothers' labor force participation and hence to increased family income – an income effect.

Table 12 discusses the quantity channel. Column 1 provides an overview of the differences in usage of different care modes, as well as in maternal labor market outcomes. Results indicate that there are only minor differences in the usage of other paid forms of child care (-2.31 hours/week) between children enrolled and not enrolled in formal care. Even more interestingly, there are no differences in the remaining modes of care, which are basically members of the extended family. The picture changes only slightly when analyzing the correlation of the local childcare offer rates and the usage of alternative care modes, regardless of children's formal care status. Results indicate that a 10 percentage point increase in the child care offer rate increases care provided by the extended family by 1.4 hours. Moreover, the usage of other informal care does not correlate with the availability of formal care. This is an important finding. It means that neither the structure of family networks nor the availability of alternative sources of care could contribute to the main finding that child development is more favorable in German regions with high child care offer rates. Last, we only observe an increase in the help provided by family members for children who are enrolled in childcare once supply is less restricted: once they are enrolled in formal care other family members also take over more of the remaining time (12.60 hours/week). Increased family care is unlikely to contribute to the strong positive effect on child development since the care provided by other family members is, arguably, of similar quality as the care provided by the mother. Other paid sources of care are, however, not significantly associated with the child care offer rate.

Table 12 also discusses the income channel, i.e. the impact of formal care usage and availability on mothers' labor market participation and income. Overall, mothers' labor market engagement seems to benefit from having public child care available. Mothers' whose children are enrolled in formal care work on average 4.58 hours per week more and earn 190.4 Euro more

Table 13: Quality channel

per month. Interestingly enough, in case a woman can send her child only once access is less restricted, she seems to take even more advantage of not having to take care of her child all day; she increases her working hours on average by 26.85 hours per week and earns 689.3 Euro per month more Overall, an increase in local supply of childcare by 10 slots leads to an increase in female labor force participation by 2.93 hours per week as well as to 72.75 Euro per month more in overall gross income. Taken together, availability and usage of child care facilities seem to stimulate mothers' labor force participation. Part of the increased income may be invested in a child's human capital development, for instance by buying books, paying tutoring classes, etc. Hence, increased income may be one channel through which children may benefit when not being taken care of solely by their mothers.

Table 13 discusses the quality channel. Overall the descriptive result that usage of child care is associated with differences in terms of the activities undertaken with the child can be confirmed. As we can see both mothers who take advantage of child care as well as mothers who live in a region with higher offer rates are in general more likely to perform activities with their children that stimulate their development, such as reading books, singings songs, walking outside, or painting together. Even more striking ist the decrease in activities which do not foment children's development directly: mother of children who attend childare are for instance less likely to visit other families with the child and go shopping with the child. This suggests that formal care substitutes for passive activities, such as non-formal social activities (visiting other families) and household production (going shopping). Overall, this pattern of results is consistent with better child development outcomes for children with formal care. Hence, the improved child outcomes may be not only due to education inside the childcare center, but also due to improved quality of the interactions undertaken by the mother with her child.

Taken together, we find exclusively positive effects of center-based child care, being it the effect of usage, the overall effect of an increase in the supply of formal care or the effect of childcare usage following an increase in the local supply. The underlying channel seems to be a mixture of exposure to high-quality formal care, but also improved quality of the interaction between the mother and the child as well as additional income.

What explains the positive effects of formal child care in Germany in relation to the literature? Our results stand in stark contrast, for instance, with respect to the results in Baker, Gruber, and Milligan (2008). The expansion of universal child care in Quebec is that this expansion led to emotional disorders, reduced standardized motor development score, and reduced

child health (due to contagious diseases). Note, however, that these effects were identified in a period of rapid expansion of child care offers. Even though Quebec imposed quite strict regulations on the quality of care, it is not clear whether average quality of care was successfully maintained, in particular given that part of the rapid increase in child care facilities occurred in home-based care. Moreover, the Quebec reform entails both an expansion of offers and a strong increase in child care subsidies, particularly for high income earners. This may have induced families with high earnings to send their children to formal care, i.e. the children who are most likely worse off in center based care than at home. In the case of Germany, formal care is highly regulated and hence offers only high-quality care. Moreover, the children who are enrolled first are children from families with a high socio-economic status and hence, possibly with lower gains from exposure to formal care. Children who get enrolled only after an increase in the supply of formal care seem to be the children with higher gains from exposure to high-quality care.

6 Conclusions

This paper studies the causal effect of high-quality formal care during early childhood (age 0-3) on children's short- and medium-run development in a wide range of cognitive and non-cognitive skills. We are particularly interested in understanding the heterogeneity of this effect across differential family backgrounds. For this reason, we analyze three different effects: first, the effect of exposure to formal childcare on children who are already enrolled in formal care, second, the effect of exposure to childcare on children who are only enrolled once access is less restricted, and third, the overall effect of an increase in the supply of formal care.

The key identification strategy relies on both immense regional variation in childcare offer rates (0-65%), mainly stemming from the different political regimes prior to German reunification, as well as on time variation due to differential growth in available childcare slots after German reunification (-2% - 18% per year).

The main findings of this paper is that early child care seems to improve child development. Studying a range of indicators of child development, we find that children in formal child care tend to do slightly better and certainly not worse than children who are exclusively cared for by their mothers. Moreover, the key findings indicate that the early child care advantage persists for the period after early child care exposure. Additionally, we find heterogeneity in the effect of exposure to high-quality childcare with respect to parental background. Children who are enrolled regardless of the shortage in supply – who are children from an advantaged family background – benefit the least from exposure to high-quality care. Children who are however only enrolled once access is less restricted – who are presumably children from a less advantaged

family background – are the ones with the highest gains from exposure to formal care.

These findings add to the current debate on how to set in place institutional arrangements that allow combining market work and family life. Our empirical evidence indicates that there are no costs in terms of early child development of setting up a tightly regulated and high quality system of formal child care. Quite the opposite, in line with previous research, our findings indicate that universally accessible formal care, conditional on being high-quality care, even contributes to decreasing inequalities across children from different socio-economic backgrounds. In other words universal childcare helps to level the playing field. Further research should therefore focus on additional aspects of the agenda of facilitating work and family life such as mother's labor market success or fiscal consequences of setting up universal child care.

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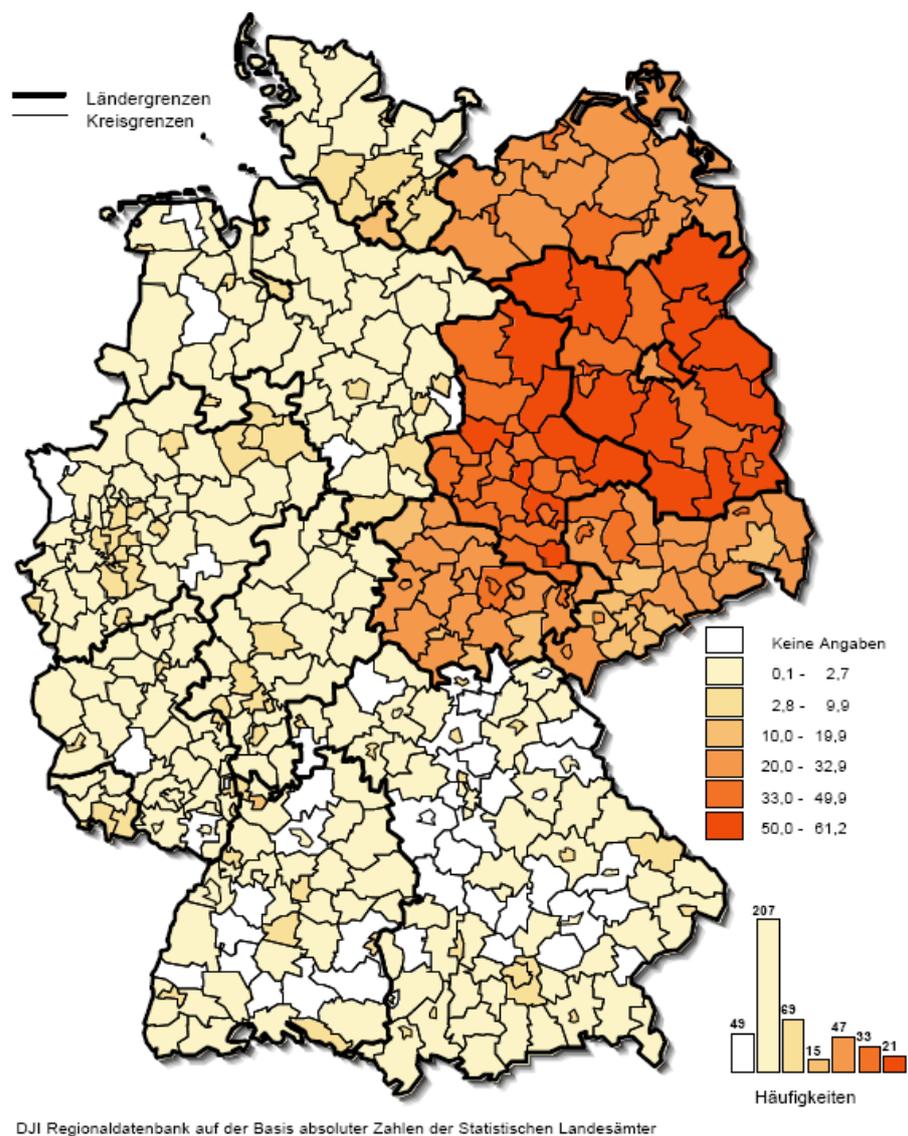


Figure 1: Child care offer rate (Child care slots per 100 children age 0-3 years old)

Note: This figure shows the number of slots in center based care for children aged 0 to 3 years available in each region (*Kreis*) in 1998. Dark lines indicate state (*Bundesland*) borders.

Source:

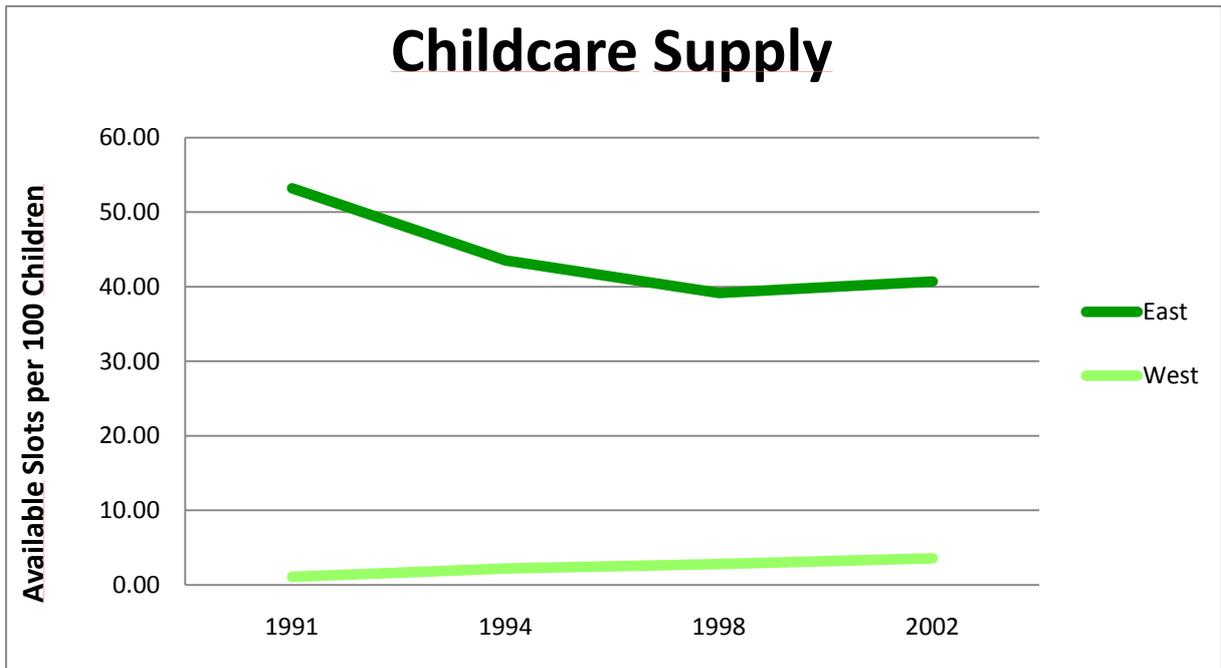


Figure 2: Changes in Slots per 100 children age 0-3 years old

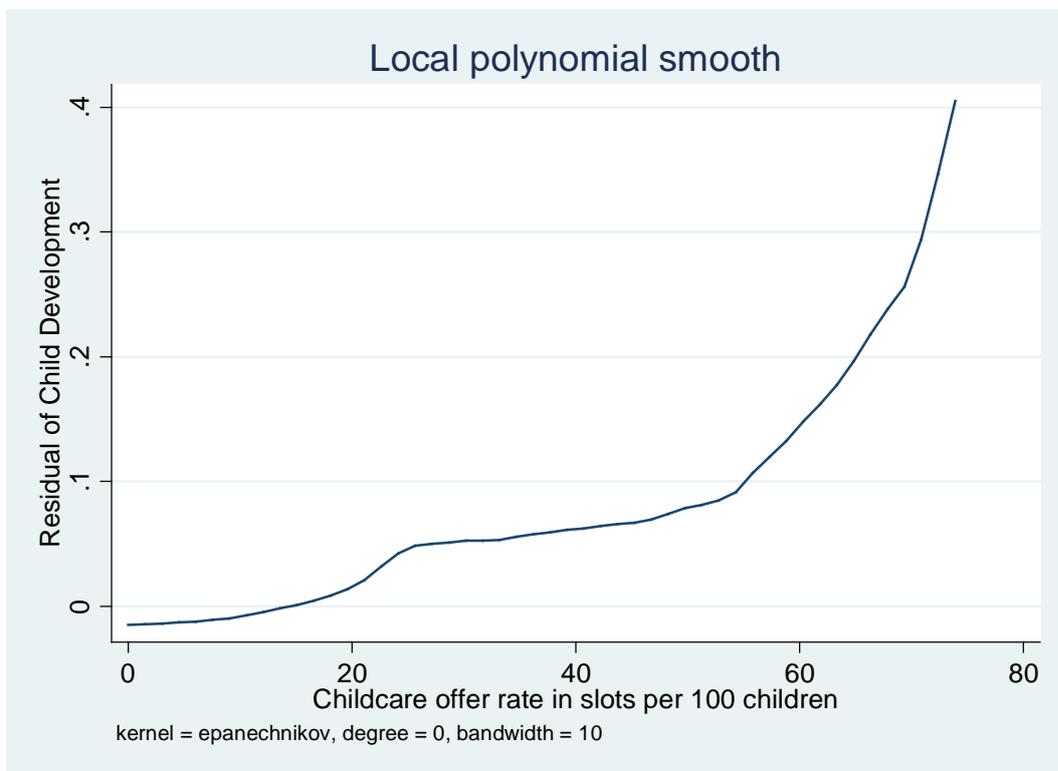


Figure 3: Heterogenous gains from center-based care attendance

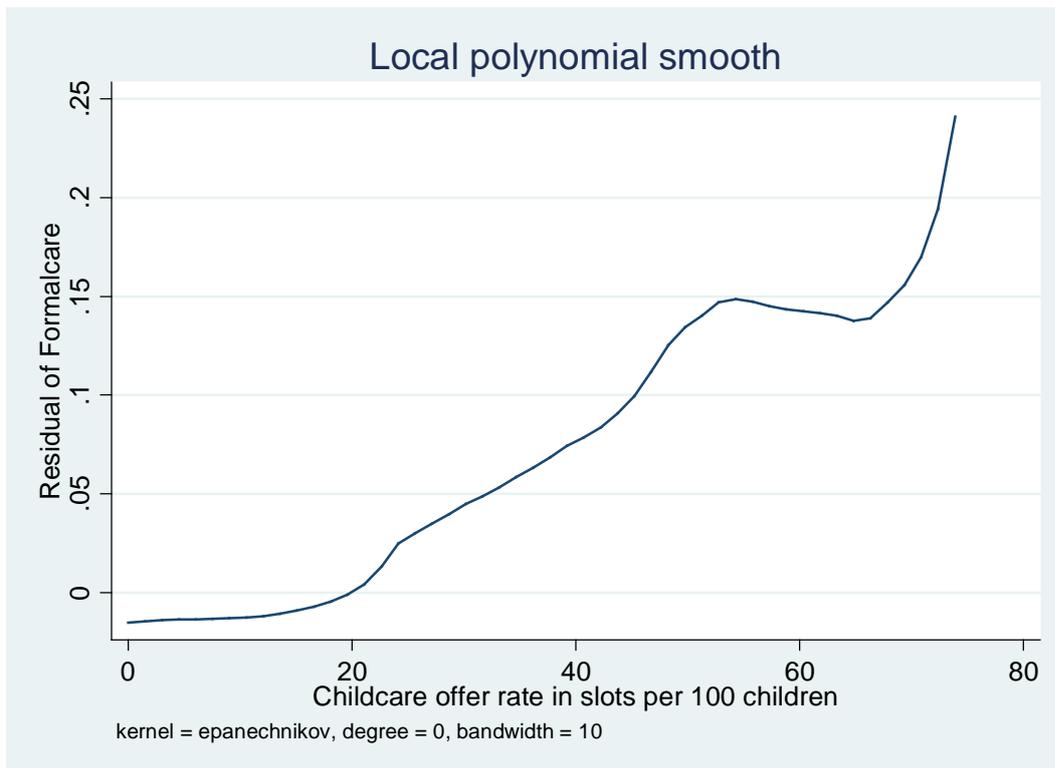


Figure 4: Heterogeneous usage of center-based care attendance

	West	East
Regulations 2007	59%	58%
Children/ Staff Ratio	5.13	6.76
E ducation 2008		
General degree	3.6	2.7
Degree in child care	83.7	90.1
Other	12.7	6.3
Full-time employees 2002	51.9	19.9
E xpenditures 2003 (% of total)	3.2	4.9

Table 1: Key characteristics of the childcare system by region

Notes: Regulations 2007 refers to the share of all regulations concerning space, training of child care staff, etc. operating in centers based in West Germany and in East Germany. Expenditures 2003 refers to the share of total public expenditures devoted to child care .

Source:

	Pooled	Not in Formal Care	Formal Care	Difference Formalcare vs. Not in Formalcare	Std. err.
A. Non cognitive skills	0.0000	-0.0395	0.0528	0.0923**	(0.0491)
Independence	0.0000	-0.0409	0.0543	0.0952**	(0.0481)
Social skills	0.0000	-0.0523	0.0754	0.128***	(0.0483)
Behavior	0.0000	-0.0004	-0.0072	-0.00679	(0.0481)
Personality	0.0000	0.0018	-0.0087	-0.0106	(0.0479)
Motoric skills	0.0000	-0.0962	0.1257	0.222***	(0.0832)
B. Cognitive skills					
Language skills	0.0000	-0.0990	0.1304	0.229***	(0.0834)
Grades	0.0000	0.0327	-0.1023	-0.135	(0.117)
Core Grades	0.0000	0.0434	-0.0907	-0.134	(0.117)
Liberal Grades	0.0000	-0.0002	-0.0631	-0.0628	(0.117)

Note: All variables are standardized to mean zero and standard deviation one. They stem from both datasets, the GSOEP and the CP and are constructed using factor analysis on the set of questions regarding children's skills. The sample contains overall 803 children which are at the time of the survey between 2-3 years old and 946 children which are between 5-9 years old. Notice the older children are surveyed up to three times, at age 5-6, 7-8 and 8-9. Standard error corrected for clustering at individual level in parentheses.

Table 2: Child development with respect to type of care

	Pooled	Not in Formalcare	Formalcare	Formalcare vs. Not in formalcare	
A. Formal Care					
Center	9.65	0	22.29	22.290***	(0.609)
B. Family Care					
Partner	12.45	11.96	13.08	1.112	(1.152)
Father (sep.)	0.59	0.58	0.59	0.006	(0.313)
Grandparents	4.95	5.07	4.84	-0.229	(0.557)
Siblings	0.95	0.8	1.16	0.366	(0.399)
Relatives	0.51	0.63	0.44	-0.186	(0.152)
Total	19.2	18.63	19.95	1.324	(1.412)
C. Informal Care					
Minder	0.91	1.47	0.17	-1.304***	(0.323)
Nanny	0.48	0.58	0.34	-0.234	(0.247)
Total	1.39	2.05	0.51	-1.535***	(0.405)
D. Work					
Mom's hrs of work	12.83	11.53	14.53	2.997***	(1.206)

Note: The GSOEP asks the mothers about the different types of care their children receive. Each type of care is reported in hours per week. Thus, the sample on which above statistics are based contains mothers of 803 children age 2-3 years old. The last two columns are the results of a means test (the difference as well as the standard error) for the group of children in center-based care and not in center-based care.

Table 3: Non-maternal child care and maternal market work

	Pooled	Not in Formalcare	Formalcare	Formalcare vs. Not in formalcare	
A. Stimulating cognitive skills					
Singing to the child	2.15	2.06	2.27	0.211***	(0.069)
Painting/Handicraft	1.90	1.90	1.90	-0.000	(0.061)
Reading to the child	2.46	2.38	2.56	0.175***	(0.057)
Looking at books with child	2.63	2.61	2.66	0.047	(0.045)
Watching tv with the child	1.76	1.78	1.74	-0.047	(0.076)
Total stimulating cognitive skills	10.84	10.66	11.08	0.418**	(0.186)
B. Stimulating motor skills					
Walking with the child	2.58	2.59	2.56	-0.032	(0.044)
Going to the playground	1.51	1.55	1.46	-0.087	(0.067)
Total stim. Motoric skills	4.07	4.12	4.00	-0.118	(0.092)
C. Passive time					
Visiting friends with the child	1.23	1.26	1.19	-0.070	(0.050)
Going shopping with the child	1.62	1.76	1.43	-0.330***	(0.051)
Total passive time	2.83	3.01	2.60	-0.404***	(0.079)

Note: The GSOEP asks the mothers how often they perform the above mentioned activities with their children and can choose from the following answers: 0 = never, 1 = once per week, 2= more than once per week, 3 = daily. Thus, the sample on which above statistics are based contains mothers of 803 children age 2-3 years old. The last two columns are the results of a means test (the difference as well as the standard error) for the group of children in center-based care and not in center-based care.

Table 4: Activities undertaken by mothers and children

	Pooled	Not in Formal- care	Formal- care	Formalcare vs. Not in formalcare	
A. Regional Conditions					
Residence in East Germany	0.182	0.129	0.275	0.146***	(0.014)
Supply of center-based care	10.244	7.743	14.398	6.655***	(0.558)
Growth rate in childcare	-0.208	-0.168	-0.279	-0.111	(0.203)
Gdp per capita	24.871	24.753	25.079	0.323	(0.385)
Unemployment ratio	12.213	11.675	13.163	1.475***	(0.176)
Female employment rate	43.730	42.873	45.248	2.354***	(0.479)
Fertility rate	1.357	1.364	1.343	-0.021***	(0.005)
Living space (km2)	38.995	39.161	38.702	-0.455***	(0.115)
Net migration	1.120	1.256	0.880	-0.372	(0.315)
Population 0-2 years (%)	0.029	0.030	0.028	-0.002***	(0.000)
Female population 19-49 yrs (%)	0.394	0.393	0.396	0.003	(0.002)
Female population >65 years (%)	0.199	0.198	0.201	0.003***	(0.001)
B. Individual Characteristics					
Boys	0.550	0.545	0.558	0.012	(0.018)
Low birth weight	0.098	0.111	0.078	-0.026***	(0.010)
Birth cohort	5.868	5.958	5.709	-0.247***	(0.084)
Age of mom at birth	30.448	30.472	30.406	-0.061	(0.172)
Mom cohabits at birth	0.932	0.935	0.927	-0.008	(0.009)
Number of children	2.074	2.116	2.000	-0.092***	(0.031)
Mom education: primary	0.600	0.633	0.543	-0.087***	(0.018)
Mom education: secondary	0.181	0.178	0.186	0.008	(0.014)
Mom education: university	0.198	0.161	0.262	0.099***	(0.015)
Total net income < 325€	0.006	0.007	0.003	-0.003	(0.003)
Total net income 325-500 €	0.016	0.018	0.013	-0.004	(0.004)
Total net income 500-1250 €	0.073	0.077	0.066	-0.01	(0.009)
Total net income 1250 - 1750 €	0.119	0.128	0.104	-0.021*	(0.011)
Total net income 1750-2250 €	0.190	0.194	0.184	-0.009	(0.013)
Total net income 2250 - 2750 €	0.191	0.196	0.182	-0.012	(0.013)
Total net income 2750 -3250 €	0.152	0.149	0.157	0.006	(0.012)
Total net income 3250-4000 €	0.128	0.122	0.139	0.015	(0.011)
Total net income >4000 €	0.113	0.097	0.142	0.038***	(0.011)

Note: The above descriptive statistics are based on the whole sample, using the GSOEP and the CP. The sample contains overall 803 children which are at the time of the survey between 2-3 years old and 946 children which are between 5-9 years old. Notice the older children are surveyed up to three times, at age 5-6, 7-8 and 8-9

Table 5: Individual and Regional Background Characteristics

	OLS	ITT	FIRST STAGE	IV
Childcare usage	0.106**	-	-	1.256***
	(0.0451)	-	-	(0.298)
Local childcare supply	-	0.0111***	0.00929***	-
	-	(0.00247)	(0.00128)	-
Observations	2170	2018	2108	1965
R-squared	0.060	0.074	0.117	-
F- stat. reg. variables	1.13	2.21	1.99	1.35
F- stat. ind. variables	4.33	5.33	5.39	3.23

Note: Results from Column 1 and 2 stem from separate regressions using OLS. The dependent variable is an indicator for overall child development, summarizing independence, social skills, behavior and personality, while the coefficients shown above belongs to the independent variable formalcare and local offer rate, respectively. Column 3 is estimated using a linear probability model, where the dependent variable is formal care usage. Column 4 is estimated using instrumental variable technique where the instrument is the local childcare supply. In all four regression, we cluster on the individual level and additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, female employment rate, fertility rate, demographic structure, area/inhabitant in km2 and net migration).

Table 6: Baseline results

	OLS	ITT	First Stage	IV
Panel A: Baseline result	0.106**	0.011***	0.009***	1.256**
	(0.045)	(0.002)	(0.001)	(0.298)
Observations	2170	2018	2108	1965
R-squared	0.060	0.074	0.117	-
Panel B: Add East Dummy	0.0829*	0.00883***	0.00652***	1.522**
	(0.0453)	(0.00327)	(0.00173)	(0.650)
Observations	2170	2018	2108	1965
R-squared	0.064	0.074	0.120	-
F- statistics East dummy	10.78	1.13	5.10	0.26
Panel C: Add East & State FE for West	0.0886*	0.00653*	0.00884***	0.884**
	(0.0455)	(0.00352)	(0.00181)	(0.443)
Observations	2170	2018	2108	1965
R-squared	0.072	0.081	0.127	-
F- stat: East dummy & state FE	3.53	1.85	2.81	2.35
Panel D: Add Regional time trend	0.0846*	0.00736**	0.00794***	1.072**
	(0.0462)	(0.00349)	(0.00179)	(0.493)
Observations	2170	2018	2108	1965
R-squared	0.075	0.086	0.152	-
F- stat: East dummy & state FE	3.24	2.53	5.4	3.05
F- stat: Regional time trends	0.92	1.24	6.99	1.12

Note: Results from Column 1 and 2 stem from separate regressions using OLS. The dependent variable is an indicator for general child development, summarizing independence, social skills, behavior and personality. Column 3 is estimated using a linear probability model, where the dependent variable is formal care usage. Column 4 is estimated using instrumental variable technique where the instrument is the local childcare supply. In all four regression, we cluster on the individual level and additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, fertility rate, demographic structure, area/inhabitant in km², net migration). Panel A repeats the baseline result (Table 7), Panel B adds a dummy for Eastern states, Panel C adds state fixed effects in Western regions, and Panel D adds separate time trends for each region.

Table 7: Sensitivity Analysis controlling for regional fixed effects and regional time trends

	OLS	ITT	First Stage	IV
Panel A: West	0.0565	0.0146***	0.00860***	1.913**
Regional Controls measured at birth	(0.0515)	(0.00464)	(0.00269)	(0.826)
Observations	1745	1592	1658	1540
R-squared	0.064	0.079	0.081	
Panel B: East	0.207**	0.00611	5.18e-05	-
Regional Controls measured 3 years prior to birth	(0.103)	(0.00692)	(0.00317)	-
Observations	425	426	450	-
R-squared	0.161	0.155	0.306	-
Panel C: Primary or secondary education	0.132**	0.0133***	0.0118***	1.247***
Regional Controls measured at birth	(0.0518)	(0.00304)	(0.00147)	(0.300)
Observations	1740	1606	1686	1569
R-squared	0.061	0.071	0.120	
Panel D: University education	0.00404	0.00629	0.00236	-
Regional Controls measured 3 years prior to birth	(0.0981)	(0.00431)	(0.00245)	-
Observations	430	412	422	-
R-squared	0.138	0.169	0.170	-

Note: Above results are based on the GSEOP, and thus on 803 children age 2-3 at the time of the survey. Results from Column 1 and 2 stem from separate regressions using OLS. The dependent variable is a general child development measure, summarizing independence, social skills, behavior and personality. Column 3 is estimated using a linear probability model, where the dependent variable is formal care usage. Column 4 is estimated using instrumental variable technique where the instrument is the local childcare supply. In all four regression, we cluster on the individual level and additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, female employment rate, fertility rate, demographic structure, area/inhabitant in km², net migration). Panel A focuses on children living in West German regions, Panel B on children living in the East German regions, Panel C shows results for children whose mother has completed primary or secondary education, and Panel D shows results for children whose mother has completed university education. IV analyses in Panel B and D are not feasible since child offer rates are not valid instruments for exposure to formal care.

Table 8: Results by Region and Mother Education

	OLS	ITT	IV
Independence	0.114** (0.0447)	0.0101*** (0.00252)	1.199*** (0.304)
Social Skills	0.136*** (0.0430)	0.00819*** (0.00232)	0.887*** (0.266)
Personality	0.0153 (0.0442)	0.00689*** (0.00244)	0.813*** (0.284)
Behavior	-0.0376 (0.0433)	0.00494** (0.00251)	0.500* (0.277)

Note: Above estimations are based on the complete sample, children from the GSOEP and the GCP. Each of the above displayed coefficient stems from a separate regression where the dependent variable is the respective skill listed on the left side. Column 1 and 2 are estimated using OLS clustered on the individual level, while column 3 is estimated using IV, also clustered on the individual level, employing the local childcare offer rate at childbirth as the instrumental variable. In each regression we additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, female employment rate, fertility rate, demographic structure, area/inhabitant in km2, net migration).

Table 9: Formal Care and Child Development: Detailed Results

	OLS	ITT	IV
Std. noncog. Skills	0.194** (0.0778)	0.00884** (0.00354)	0.848** (0.356)
Independence	0.162** (0.0713)	0.00894*** (0.00324)	0.872*** (0.337)
Social skills	0.306*** (0.0768)	0.00921*** (0.00354)	0.902** (0.359)
Behavior	-0.0884 (0.0804)	0.00777** (0.00369)	0.755** (0.384)
Personality	-0.00111 (0.0804)	0.00282 (0.00368)	0.268 (0.353)
Language skills	0.175** (0.0774)	0.00997*** (0.00360)	0.923*** (0.354)
Motoric skills	0.167** (0.0777)	0.00518 (0.00358)	0.507 (0.355)

Note: Above results are obtained using data from the GSOEP only, the sample has 803 observations. Results from Column 1 and 2 stem from separate regressions using OLS. The dependent variable is the respective skill dimension shown on the right side, while coefficient shown above belongs to the independent variable formalcare and local offer rate, respectively. Column 3 is estimated using instrumental variable technique where the instrument is the local childcare supply. In all four regression, we additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, female employment rate, fertility rate, demographic structure, area/inhabitant in km2, net migration).

Table 10: Short run impact

	OLS	ITT	IV
Std. noncog. Skills	-0.00220 (0.0490)	0.0115*** (0.00383)	1.526*** (0.547)
Independence	-0.0399 (0.0493)	0.00989*** (0.00362)	1.390*** (0.536)
Social skills	0.00794 (0.0455)	0.00375 (0.00337)	0.392 (0.389)
Behavior	-0.0429 (0.0455)	0.00314 (0.00364)	0.310 (0.409)
Personality	0.0311 (0.0471)	0.00679* (0.00347)	0.959** (0.439)
Std. grades	-0.199** (0.0867)	0.0184*** (0.00663)	2.047 (1.281)
Std. grades (core course)	-0.184** (0.0879)	0.0151** (0.00754)	1.786 (1.312)
Std. grades (liberal course)	-0.120 (0.0939)	0.0119* (0.00649)	1.188 (0.856)

Note: Above results are obtained using data from the GCP only, the sample contains 948 children and 1894 observations. Results from Column 1 and 2 stem from separate regressions using OLS clustered on the individual level. The dependent variable is the respective skill dimension shown on the right side, while coefficient shown above belongs to the independent variable formalcare and local offer rate, respectively. Column 3 is estimated using instrumental variable technique where the instrument is the local childcare supply at childbirth. In all four regression, we control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, female employment rate, fertility rate, demographic structure, area/inhabitant in km², net migration).

Table 11: Medium run impact

	OLS	ITT	IV
A. Child care arrangements			
Formal care	20.03*** (0.654)	0.377*** (0.0436)	33.24*** (3.330)
Family care	1.441 (1.603)	0.203*** (0.0727)	18.12*** (7.007)
Informal care	-2.342*** (0.453)	-0.0262 (0.0222)	-2.337 (1.948)
B. Work and Income			
Maternal Work hours	1.353 (1.131)	0.115** (0.0525)	10.28** (4.885)
Maternal labor income	198.3** (83.86)	8.670** (3.915)	799.3** (375.0)

Note: Results from Column 1 and 2 stem from separate regressions using OLS. The dependent variable is indicated on the right side, while coefficient shown above belongs to the independent variable formalcare and local offer rate, respectively. Column 3 is estimated using instrumental variable technique where the instrument is the local childcare supply. In all four regression, we additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, female employment rate, fertility rate, demographic structure, area/inhabitant in km², net migration).

Table 12: Quantity Channel

	OLS	ITT	IV
Cognitive stim.	0.213 (0.208)	0.0152 (0.00968)	1.358 (0.881)
Motoric stim. Activities	-0.0606 (0.104)	0.00241 (0.00489)	0.215 (0.437)
Passive activities	-0.198** (0.0893)	-0.0170*** (0.00420)	-1.518*** (0.428)

Note: Results from Column 1 and 2 stem from separate regressions using OLS. The dependent variable is indicated on the right side, while coefficient shown above belongs to the independent variable formalcare and local offer rate, respectively. Column 3 is estimated using instrumental variable technique where the instrument is the local childcare supply. In all four regression, we additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, fertility rate, demographic structure, area/inhabitant in km², net migration).

Table 13: Quality Channel

APPENDIX

	OLS	ITT	First Stage	IV
Formal care attendance	0.106** (0.0451)	- -	- -	1.256*** (0.298)
Local care offer rate	- -	0.0111*** (0.00247)	0.00929*** (0.00128)	- -
Gdp per capita	-0.00553 (0.00357)	-0.00238 (0.00375)	0.00142 (0.00185)	-0.00333 (0.00421)
Unemployment rate	-0.00527 (0.00760)	-0.0152* (0.00830)	0.00532 (0.00393)	-0.0239** (0.0100)
Female employment rate	0.00392 (0.00271)	0.00178 (0.00283)	-0.000496 (0.00137)	0.00163 (0.00320)
Fertility rate	-0.0361 (0.167)	0.0768 (0.168)	0.0197 (0.0702)	0.0854 (0.200)
Creche growth	-0.00412 (0.00320)	- (0.00350)	-0.00443** (0.00189)	-0.00319 (0.00362)
Living space/person	-0.00185 (0.00941)	0.0109 (0.00976)	0.0119*** (0.00438)	-0.00590 (0.0110)
Net migration	0.00271 (0.00282)	-0.00167 (0.00289)	-0.00172 (0.00153)	0.000530 (0.00315)
Population age 0-3 (%)	1.944 (4.080)	11.66*** (4.083)	5.244 (3.226)	5.938 (4.614)
Female population age 19-49 (%)	1.679 (1.737)	2.448 (1.737)	1.694* (0.872)	0.549 (2.305)
Female population age 65+ (%)	3.562** (1.696)	3.997** (1.717)	0.706 (0.856)	3.365 (2.059)
Low birth weight	-0.273*** (0.0903)	-0.296*** (0.0928)	-0.0551 (0.0362)	-0.233** (0.102)
Male	-0.275*** (0.0439)	-0.305*** (0.0447)	0.0344* (0.0207)	-0.325*** (0.0534)
Born 1997	-0.0270 (0.0611)	-0.128** (0.0614)	-0.00823 (0.0303)	-0.0766 (0.0763)
Born 2002	-0.0380 (0.105)	-0.0919 (0.104)	0.0423 (0.0506)	-0.0998 (0.126)
Born 2003	-0.0423 (0.109)	-0.138 (0.111)	0.0913* (0.0533)	-0.192 (0.133)
Born 2004	0.122 (0.107)	0.0527 (0.107)	0.153*** (0.0551)	-0.0918 (0.132)
Born 2005	0.109 (0.104)	0.0800 (0.104)	0.148*** (0.0535)	0 (0)
Mom's age at childbirth	0.00555 (0.00425)	0.00707 (0.00447)	-0.00410** (0.00208)	0.0125** (0.00529)
Mom's cohabiting	0.0487 (0.0969)	0.110 (0.0974)	-0.0883* (0.0456)	0.191 (0.119)
Mom's education: primary	0.192 (0.141)	0.194 (0.143)	0.168*** (0.0581)	0.0102 (0.178)
Mom's education: secondary	0.251* (0.147)	0.223 (0.149)	0.200*** (0.0620)	-0.0214 (0.187)

Mom's education: university	0.208 (0.147)	0.204 (0.149)	0.290*** (0.0626)	-0.156 (0.201)
Number of siblings	0.0412 (0.0257)	0.0235 (0.0264)	-0.0183 (0.0121)	0.0575* (0.0301)
Total net income < 325Euros	0.344 (0.462)	0.347 (0.447)	-0.0455 (0.139)	0.183 (0.479)
Total net income 325-500 Euros	0.675 (0.430)	0.703* (0.413)	-0.00437 (0.125)	0.472 (0.440)
Total net income 500-1250 Euros	0.874** (0.428)	0.872** (0.410)	0.0323 (0.123)	0.615 (0.436)
Total net income 1250 - 1750 Euros	0.758* (0.431)	0.716* (0.414)	0.0870 (0.123)	0.418 (0.437)
Total net income 1750-2250 Euros	0.703 (0.429)	0.727* (0.412)	0.126 (0.124)	0.347 (0.440)
Total net income 2250 - 2750 Euros	0.658 (0.428)	0.710* (0.410)	0.159 (0.124)	0.327 (0.437)
Total net income 2750 -3250 Euros	0.762* (0.430)	0.754* (0.413)	0.160 (0.126)	0.348 (0.442)
Total net income 3250-4000 Euros	0.842* (0.435)	0.868** (0.417)	0.200 (0.127)	0.394 (0.447)
Constant	-2.387** (1.169)	-3.614*** (1.176)	-1.348** (0.573)	-1.893 (1.491)
Observations	2170	2018	2108	1965
R-squared	0.060	0.074	0.117	-
F- statistics regional characteristics	1.13	2.21	1.99	1.35
F- statistics individual characteristics	4.33	5.33	5.39	3.23

Note: Above results are based on the overall sample, 803 children from the GSOEP and 948 children (1894 observations) from the GCP, Results from Column 1 and 2 stem from separate regressions using OLS clustered on the individual level. The dependent variable is an indicator of general child development, summarizing independence, social skills, behavior and personality. Column 3 is estimated using a linear probability model, where the dependent variable is formal care usage. Column IV is estimated using instrumental variable technique, clustered on the individual level, where the instrument is the local childcare supply.

Table A1: Baseline results

	OLS	ITT	First Stage	IV
Panel A: Baseline:	0.194**	0.009**	0.010***	0.848**
Regional Controls measured at birth	(0.078)	(0.004)	(0.002)	(0.356)
Observations	780	760	779	760
R-squared	0.148	0.152	0.265	0.072
F- statistics reg. characteristics	1.71	2.23	3.26	1.81
F- statistics ind. characteristics	5.34	5.55	4.96	4.73
Panel B:	0.139	0.008*	0.008***	0.961*
Regional Controls measured 3 years prior to birth	(0.085)	(0.004)	(0.002)	(0.562)
Observations	690	674	690	674
R-squared	0.135	0.142	0.278	0.025
F- statistics reg. characteristics	1.19	1.09	2.9	0.68
F- statistics ind. characteristics	4.22	4.52	4.46	3.73

Note: Above results are based on the GSEOP, and thus on 803 children age 2-3 at the time of the survey. Results from Column 1 and 2 stem from separate regressions using OLS. The dependent variable is a general child development measure, summarizing independence, social skills, behavior and personality. Column 3 is estimated using a linear probability model, where the dependent variable is formal care usage. Column 4 is estimated using instrumental variable technique where the instrument is the local childcare supply. In all four regression, we cluster on the individual level and additionally control for a child's innate characteristics (low birthweight, gender and cohort dummies), a child's family background (mother's marital status, mother's education - measured in dummies - mothers' nationality, number of siblings and total household net income, measured in dummies) as well as macroeconomic local conditions (gdp per capita, unemployment rate, female employment rate, fertility rate, demographic structure, area/inhabitant in km², net migration).

Table A2: Sensitivity Analysis controlling regional characteristics 3 years prior to childbirth

VARIABLES	Move	Move	Move	Move
Child care supply	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
GDP per capita	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Unemployment rate	-0.009*** (0.003)	-0.009*** (0.003)	-0.009*** (0.003)	-0.009*** (0.003)
Female employment	0.000** (0.000)	0.000** (0.000)	0.000** (0.000)	0.000** (0.000)
Living space	0.000 (0.003)	0.000 (0.003)	0.000 (0.003)	0.000 (0.003)
Net migration	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
% population < 3 years old	-2.713** (1.206)	-2.657** (1.208)	-2.581** (1.209)	-2.611** (1.207)
% population female, 19-49 years old	-3.714*** (0.763)	-3.651*** (0.766)	-3.699*** (0.768)	-3.627*** (0.768)
% population female & 65+ years old	-2.567*** (0.654)	-2.535*** (0.655)	-2.592*** (0.658)	-2.522*** (0.662)
Total net income		0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Child birth			0.002 (0.003)	0.002 (0.003)
Wedding			0.007 (0.004)	0.007 (0.004)
Divorce			0.020 (0.014)	0.021 (0.014)
Separation			0.001 (0.009)	0.001 (0.009)
Satisfaction with life quality				-0.001 (0.003)
Satisfaction with childcare				-0.002* (0.001)
Satisfaction with leisure				0.000 (0.002)
Satisfaction with home				0.009*** (0.002)
Satisfaction with work				-0.000 (0.001)
Constant	2.122*** (0.415)	2.096*** (0.416)	2.181*** (0.418)	2.091*** (0.421)
Number of individuals	803	803	803	803
Observations	4015	4015	4015	4015
R-squared	0.023	0.023	0.025	0.032

Table A2: Migration around childbirth (2 years before until 3 years after childbirth)

