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## Conference Paper

# How does Early Child Care affect Child Development? Learning from the Children of German Unification

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# How Does Early Child Care affect Child Development?

## Learning from the Children of German Unification

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### Abstract

This paper studies the role of early center-based child care (age 0-3) for the development of a wide range of skills. The identification strategy uses historical variation in regional child care offer rates in Germany to address selection into center based care. While differences in parenting style across Germany may be confounding the effect of center based care, our analysis indicates that such differences are largely absent among the generation raising children today. Center-based care improves language skills, every day skills, social skills, behavior but neither motor skills nor personality among 2 to 3 year old children. For 5-10 year old children, we find that children with some exposure to early formal care improve in terms of non-cognitive skills and school grades.

JEL Classification: J13, I21, I38

Keywords: Child care, child development, non-cognitive skills

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# 1 Introduction

The aim of this paper is to measure the causal effect of substituting child care time from the mother to center based care. Understanding this effect is important for at least two reasons. First, policies aiming to encourage female labor force participation via expanding the supply of center based 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.

What do we mean with the causal effect of child care? We focus on identifying the overall effect of shifting hours of care provided by the mother to hours of care provided by the child care center. This shifting hours of maternal care to center based care changes two potentially important margins: a child spends less time with her or his mother – a quantity effect – and the mother focuses on providing different types of care – a quality effect. Facilitating access to center based care will probably affect both margins of adjustment, i.e. mothers will both spend fewer hours with their child and fill these hours with different activities. Our analysis pays particular attention to the quantity and quality effects.

The empirical analysis uses data recently collected by the German Socioeconomic Panel (GSOEP) on about 850 children aged 2 to 3 years living in Germany. This data has three important advantages. First, the data contain a rich set of indicators on skills and characteristics such as language skills, every day skills, social skills, motoric skills, personality, and behavior. This allows discussing a comprehensive range of measures of child development. Second, the survey also contains a rich module on the hours of non-maternal child care, i.e. provided by the partner, the extended family, informal child care and formal child care such as day care centers. This allows providing a very broad assessment of facilitating access to formal child care on the *quantity* aspect of actual child care arrangements. Third, the survey also provides information on a broad range of activities between mothers and children. This information is central to discussing the *quality* aspect of child care. The analysis relies furthermore on a second dataset, the German Child Panel, which provides us with similar information on children aged 5 to 10 years old. Hence, we can use this dataset to assess the medium run impact of early center based child care on children’s cognitive and noncognitive development.

We report two sets of results. The first set compares children who spend some time in formal child care to children who do not conditional on a rich set of individual and regional characteristics. This identification strategy targets estimating the average effect of child care on children who get exposed to child care – the effect of treatment on the treated. The problem

with this identification strategy is that households decide to send their children into child care or not. This first approach therefore relies on comparing self-selected samples.

The second identification strategy deals with self-selection by using plausibly exogenous regional variation in child care offer rates in 1994. Germany is characterized by tremendous variation due to historical reasons. A core element of the family policy of the German Democratic Republic (GDR) consisted in facilitating female labor force participation by setting up a comprehensive system of child care providing care from early on. In contrast, the Federal Republic of Germany (FRG) did not introduce any formal child care for children aged 0-3. This historical pattern of child care persists even today thus creating strong variation in child care offer rates between East and West Germany but also within regions. This unique historical situation allows measuring the effect of large scale substitution between child care provided by the mother as opposed to formal child care centers.

There are three potential threats to this identification strategy. First, mothers of the children we analyze were socialized in different political and economic systems. This means that differences in parenting styles confound the causal effect of child care. We address this problem by taking mother's pre-unification region of residence into account. Doing so does not affect our main results. Second, there is a strong gap in economic performance across German regions. This gap changes incentives for labor force participation and therefore also the demand for child care. We address this potentially important problem by controlling for a vast set of regional economic, demographic and health-related indicators. Again, considering these regional differences does not affect any of our main results. Indeed, results indicate that the regional economic, demographic, or medical structure turns out to be irrelevant for child development. Third, once the child is taken care off in center based care, mothers can work and hence contribute to the income of the family. This additional income in turn can be used to buy goods that promote children's development. We shed some light on this potential channel of center-based child care on child development by additionally investigating its impact on maternal employment and hence, household income. We find that that child care hours and market work hours do not increase one-for-one so the potential for this channel to explain the main results is limited.

Our empirical analysis identifies three important results. First, using a simple least squares identification strategy, we find that children aged 2-3 years who spend some time in center-based care have better language skills, every day skills and social skills. Second, using regional child care offer rates to instrument the usage of center-based care identifies even slightly larger effects of center-based care on these dimensions of child development. The IV strategy reveals moreover, that children who attend formal care also score differently in terms of behavior. Third, early

center-based care also appears to matter in the medium-run. Children aged 5-10 years perform better both in terms of a comparable range of non-cognitive skill measures, such as every day skills, social skills and behavior and school grades.

The remainder of this paper is structured as follows. Section 2 discusses the existing literature along with our contribution to this literature. Section 3 discusses the institutional background. Section 4 provides information on the data sources and a set of key descriptive statistics. Section 5 discusses our two main identification strategies. Section 6 presents the main results, and section 7 provides a summary and implications of our findings.

## 2 Previous Literature

This paper is related to three main strands of the literature. The first strand discusses the relevance of child care on child development for very young children, aged 0-4 years. In the child development field, much of the research is based on a national panel study by the National Institute of Child Health and Development – Early Childcare Research Network. This non-experimental body of research suggests positive effects of child care on the development of cognitive skills while also some negative effects on non-cognitive skills are reported. For instance, Belsky *et al.* (2007) find that the amount of time spent in child care throughout a child’s first 4.5 years predicts higher vocabulary scores whereas Belsky (2001) finds that child care is associated with development risks. Baker *et al.* (2008) discuss the introduction of universal child care in the Canadian province of Quebec. Findings indicate that lowering the out-of-pocket cost of childcare increases the use of childcare by 14.6 percentage points, lowers child well-being (increases anxiety, decreases health) and leads to more hostile parenting styles. Moreover, Ramey *et al.* (2000) discuss the effects of the Abecedarian project, a randomized pre-K intervention. Positive and systematic cognitive and academic achievement differences were found for children in the treatment condition. Besides, availability of pre-K programs improved mother’s educational and employment outcomes, particularly so for teenage mothers.

The second strand discusses the role of pre or kindergarten programs on children’s cognitive and non-cognitive outcomes. This literature focuses on child development in the age bracket 3-7 years. Cascio (2009) studies the staggered introduction of kindergarten across U.S. states and finds that white children aged five after the typical state reform were less likely to be high school dropouts and had lower institutionalization rates as adults. She rules out similar effects for blacks arguing that the federally funded kindergarten program crowded out early education among the poor five year olds. Berlinski *et al.* (2009) discuss the effect of a large expansion of universal pre-primary education on subsequent primary school performance in Argentina. They

estimate that one year of pre-primary school increases average third grade test scores by 23% of the standard deviation of the distribution of test scores. Fitzpatrick (2008) studies availability of universal pre kindergarten programs in the U.S. and finds that these programs increase both reading and mathematics test scores at fourth grade as well as the probability of students being on-grade for their age for children residing in small towns and rural areas. Adopting a regression discontinuity design, Gormley Jr. *et al.* (2008) find that Ohio's pre-K program increases cognitive skills more strongly than federally funded Head Start programs. Magnuson *et al.* (2004) qualify these findings showing that while pre-K programs increases reading and mathematics skills at school entry, they also increases behavioral problems and reduces self-control. Furthermore, the effects of prekindergarten on skills largely dissipate by the spring of first grade, although the behavioral effects do not. Besides this fairly large body of literature for the US, there is some evidence for several European countries. Horstschraer and Muehler (2009), for instance, focus on the German state of *Brandenburg* and use regional variation of available slots in Kindergarten to identify the effect of child care on school readiness. Least squares findings suggest positive effects on school readiness while IV estimates using regional differences in child care offer rates are negative. Dat (2007) study shifts between low quality (informal) care)and high quality (center-based) care in Denmark and find a negative impact of informal care on non-cognitive outcomes for boys whose mothers has a low education. Last, Hav (2009) discuss the long-run effects of introducing universal high quality care in Norway and show that offering universal child care improves adult educational and earnings outcomes.

A third strand of the literature uses time use data to understand the effects of maternal employment on child outcomes. Cawley and Liu (2007) study the role of maternal employment for child obesity in the American Time Use Survey finding that employed women spend significantly less time cooking, eating with their children, and playing with their children, and are more likely to purchase prepared foods. This reduction is partly offset by partners. Another paper by the same authors (Cawley and Liu 2007b) assess the impact of maternal employment on mother child interactions in detail. The findings are in line with the ones of the previously cited paper and say that that employed women spend significantly less time reading to their children, helping with homework, and in educational activities in general. Moreover, they don't find any evidence that these decreases in time are offset by increases in time by husbands and partners.

This paper contributes to the existing literature in at least two respects. First, the paper documents the effects of a very strong shift in child care use. While, for instance, Baker *et al.* (2008) study an increase by 14.6 percentage points following a financial subsidy to public child-

care usage, we study the effects of regional child care offer differences between German that are on the order of at least 29 percentage points. Moreover, differences in regional child care offer rates represent a shift from care provided by the mother to high quality care. This allows discussing the relative quality of mother's time input compared to high quality care. In contrast, Baker *et al.* (2008) and Dat (2007) discuss shifts from informal care to formal center based care. Second, our key focus is a comprehensive set of cognitive (language skills, school grades) and non-cognitive outcomes (motor skills, behavior, personality, health etc.). While the existing literature documents positive effects on most cognitive outcomes, the existing evidence only find mixed effects for non-cognitive and behavioral outcomes. Hence, our study sheds allows us to assess a broad range of cognitive and noncognitive skills at the same time.

### 3 Institutional Background

This section discusses the current child care system in Germany, provides key evidence on regional differences in the supply of child care across German regions, and discusses the reasons for these differences.

Centers organize early child care depending on a child's age. Babies up to 12 months of age are cared for in separate groups than children aged 13 to 36 months. The key difference between the baby group and the young children's group is in terms of staff child ratios. Children typically spend anywhere between one half day up to 5 days at the center.

Child care centers accept babies as soon as their mother has exhausted maternity leave (8 weeks after birth). Fees vary across regions and depend on family income in a progressive manner. The available evidence does not indicate that fees vary strongly between East and West (615 €per month versus 770 €per month corresponding to about 30 % of the average monthly income in each region).

The central aspect of the German child care system is the strong regional variation in child care offer rates. When Germany was divided after World War II, the German Democratic Republic started to implement strong institutions favoring female labor force participation. The presence of a well functioning and universal child care system was seen to be central to enhance labor force participation. Correspondingly, early child care offer rates in the former GDR typically reached levels close to 100 %. In contrast, the former Federal Republic of Germany has until recently embraced the view 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. The supply of formal child care for 0-3 year olds was therefore limited.

Figure 1: Child slots per child aged 0-3 years old

German re-unification in 1990 implied adoption of West German family policy in all dimensions (parental leave, tax system) except for child care. Child care is organized at the level of each community (i.e. village or city). Re-unification did not directly affect the size of the child care system. The former East is therefore still characterized by a substantially higher offer rate than the former West. Only in 2004, when a female Christian Democrat became head of the ministry of family affairs, Germany has adopted an official policy of extending the number of child care slots to 500.000 in 2013 which corresponds to a nationwide coverage of 25 slots per 100 children aged 0-3 years.

What is the regional distribution of child care slots across Germany? Figure 1 display a map shading counties (*Kreise*) according to the number of full time child care slots available per 100 children aged 0-3 years on Dec 31, 2002.<sup>1</sup> Clearly, there is striking regional variation in child care offer rates between regions located in former East Germany and regions located in the West. For instance, in the *Bundesländer* Bayern or Baden-Wrttemberg, on average only 2 out of 100 children can be placed in formal child care. In contrast, 56 out of 100 children aged 0 to 3 years old will be able to find a place in a formal child care center in Sachsen-Anhalt. 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. For instance, while *Thüringen* has an average offer rate of 22 slots per 100 children, there are counties that offer as few as 12 slots per 100 children and other counties that offer as many as 43 slots per children.<sup>2</sup>

Given that the supply of child care 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. Parents have an option to purchase informal child care (nanny, child-minder, etc.) on the market but the costs of doing so far exceed child care fees and is used only for rare occasions. Centers give preference to single women with children and to children whose sibling is already enrolled in the child care center.

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

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<sup>1</sup>Note that the offer rate measures full-time slots but typical child care use is part time (section 4.2). This means, for instance, that an offer rate of 50 % can be sufficient to provide part-time care for two children.

<sup>2</sup>In 2002, the child care offer rate ranges overall from 0.2 % in *Oberallgäu* to 65 % in *Bernburg* for children aged 0-3 years old.



Table 1: Key characteristics of child care in East and West

to contribute to the development of social skills such as interacting with others, calling other people by their name, etc.

Does the quality of child care vary across regions? Center based care for 0-3 year olds that is tightly regulated but oversight is decentralized at the *Bundesland* level. Regulations concern dimensions such as staff child ratios, space, but also qualifications for child care staff. Staff have to undergo special training before being allowed to work in the sector. Table 1 shows key characteristics of the child care system by region.<sup>3</sup> 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, availability, further education, size of the child care center, etc. 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 child care, the corresponding figure is 84 percent in the West. Moreover, child care staff work typically full-time work in the West but part-time in the East. Overall, Table 1 shows that there are differences in child care 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 child care.

Children aged 3 to 6 years attend a different type of child care centers. But child care offer rates for these children nowhere near vary across regions to the same extend as the early child care slots. This is because policy has recognized the importance of offering care after parental leave expires. The main East West difference concerns the availability of full-time care (much more frequent in former East and West).

## 4 Data and descriptive evidence

The focus of this paper is to understand how use of formal center based care affects children's cognitive and non-cognitive skill development. The next subsection describes the available data sources and the subsection 4.2 provides a descriptive analysis of the relationship between center based care and child development and discusses potential channels through which early formal child care might exert its effect on children's development.

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<sup>3</sup>Note that Berlin is excluded from these statistics because Berlin represents a mix of both systems.

## 4.1 Data sources

Our main analysis uses data on a module recently added to the German Socio Economic Panel (GSOEP) – the supplementary child survey. This supplement provides information on all children born between 2002 and 2005 to mothers that are part of the GSOEP sample. These children are aged 24 to 47 months at the time of the survey, with 75 % being younger than 36 months.

The survey covers a broad range of indicators of child development concerning skills, behavior, personality, and health. We group them into the following seven key groups

- Language skills: child understands brief instructions, forms sentences with at least 2 words, listens attentively to a story for at least 5 minutes, relates simple messages
- Every day skills: child eats with 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
- Social skills: 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
- Behavior: child is shy/outgoing, focused/distracted, obstinate/obedient, quick in learning
- Personality: child usually happy, content, irritable, cries frequently, difficult to console, curious, active, communicative, shows empathy when others are sad
- Motoric skills: 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
- Health Disorders: Asthma, Bronchitis, Middle-ear inflammation, Neurodermitis, Vision impairment, Hearing impairment, etc.

For each group we create an index by adding up the number of components that the child is able or capable of doing. This index ranges from 0 to 1 and reflects child development in the different dimensions. We also create an overall indicator measuring aggregate child development across all cognitive and noncognitive groups (except health disorders).

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 over-estimate their child's abilities. This is a bias that plausibly affects all mothers. Second, self-reports could also be affected by child care mode. For instance, mothers who use some formal care may evaluate their child relative to their children's playgroup at the child care center whereas mothers who do not use

child care evaluate their child compared to their own expectations. The bias due to child care mode dependent self-reports will work against finding effects of child care. 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 2-4 years but less important for the cohort aged 5-9 years since child care coverage is uniformly high for the 5-9 year age group. Moreover, self-reporting biases will be less important for objective indicators such as everyday skills, motor skills, or health.

To assess the medium run effects of early center based care, we study a second group of children born between 1996 and 1997. These children are aged 5-10 years at the time of the survey. Survey responses include important information on child development as well as school grades. We group them as follows

- Every day skills: having new ideas, try new things, problem solving in different situations, following others
- Social skills: likes company, likes to meet kids, empathic, fights, provokes, bugs, start to argue, gets angry easily, loses control
- Behavior : concentrated, understands quickly, accomplishes, acts w/o thinking, insecure, timid, fears strange kids
- Concentrated: fidgety, cannot sit quietly
- Self confidence: proud of achievements, ok with himself
- School grades: Grades are available for a range of subjects: math, reading, writing, science, sports, arts and music.

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 regions. We assess this by correlating grades with child care offer rates for children who are not in formal care. We do not see any significant correlation.

Taken together, we study a full range of skills characterizing children's development. They can be grouped into cognitive (language skills and school grades) as well as non-cognitive skills (everyday skills, 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 child care.

Table 2: Child development and Child Care

## 4.2 Descriptive evidence

In this section, we want to provide some descriptive evidence for the immediate effects of center based care on child development using information on children aged 24-47 months, but also to shed some light on the underlying channels through which center based child care might exert its effects.

Table 2 provides descriptive statistics along with controlled contrasts of child development indicators by formal care status and by geographic location, signifying areas with high and low availability of center based child care slots. Column 1 indicates that children aged 24-47 months master 90 percent of the language skills, 63 percent of the everyday skills, 80 percent of the motor skills, 88 percent of the social skills, 89 percent of the personality skills, and 65 percent of the behavioral skills. Disorders are not very frequent with only 6 percent of all children having one or more disorders. On average, children attain a score of 80 percent in terms of the abilities and personality characteristics that are covered by the child survey.

How do children differ depending on their child care use? We allocate children into two groups: Children with formal care are those whose mother responds sending them to the day care center for at least one minute per week. We contrast children in this group with children without formal care, i.e. these children never attend the day care center. Column 2 in 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 everyday skills, motor skills, and social skills. There are no differences in terms of personality and behavior. Overall, there is a 3.3 percentage point 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. In contrast, children in formal care also are affected more strongly by health problems. The difference in terms of health disorders is substantial. The effect is 0.0126 – about 20 percent of the mean incidence of health disorders.

The key problem in this contrast is, however, that mothers who use some formal care are self-selected. Column 3 in Table 2 therefore contrasts women living in the East and the West. The key advantage of this contrast is that it compares all women living in the regions with high and low supply of center-base child care, so self-selection is not an issue. On the other hand, this contrast could be problematic because of migration and cultural differences with respect to child care. We address these issues in the empirical analysis. Children born to these two groups of mothers are expected to differ in terms of the child care arrangements since child care offer rates

are substantially lower in the West compared to the East. This means that contrasting children living in the East and in the West is potentially informative on the role of early child care for child development. Results indicate that children living in the East have mastered about 11.6 percent more of the skills of everyday life than children living in the West. Moreover, mothers living in the East also indicate that their children call their playmates by their names more, they play with other children more, i.e. they master more social skills. Children in the East also differ strongly from children living in the West in terms of their behavior. Children in the East are more focused, obedient, and quick in learning than children in the West. In contrast, there are no differences in terms of language skills and personality between the children from the East and children from the West. Interestingly, these two groups of children also do not differ in terms of motor skills and health.

What explains the differences in terms of child development between children in the East and in the West? There are at least three different underlying explanations, which we are going to discuss in the following. The first explanation focuses on the *quantity* of care effect which refers to a pure substitution of hours of maternal care towards hours of child 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 were raised in the FRG may have very different attitudes towards family and work life than mothers who worked in the former GDR. These attitudes may lead to different perceptions of motherhood which in turn could cause differences in outcomes.

Besides these causal explanations, there could also be tremendous differences in terms of economic development and labor market opportunities between East Germany and West Germany. These differences may also explain differences in child development.<sup>4</sup> Before assessing the causal impact of early center based child care on children’s development, we therefore proceed to assess the validity of these explanations in turn.

We first discuss the *quantity* channel due to child care. Table 3 contains information on weekly hours of non-maternal care along with the weekly hours of maternal market work, by residence in West and East Germany and by attendance to formal care and no attendance. Overall, parents care for their child during about 12.5 hours per week. The second most important source of care is formal care provided by a child care center during 9.6 hours per week. Next in line is the extended family. Grandparents provide about 5 hours of care per week, siblings and relatives together provide about 1.4 hours per week. Finally, child minders and nannies provide also about 1.4 hours of care per week. Overall, children are exposed to about 31

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<sup>4</sup>Note, however, that differences in economic development are likely to bias the East West contrast against finding more favorable child development in the East.

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

hours of non-maternal care. This does not mean that the mother is not present in the household. For instance, non-maternal care provided by the partner may be provided during times when the mother is also present in the household. Nevertheless, hours of non-maternal care reflect hours of care where the principal child care provider is someone else than the mother.

How do total hours of non-maternal care compare to maternal hours of work? Average hours of work (including overtime) is a bit larger than 15 hours per week, i.e. weekly hours of market work by mothers is lower than the weekly total of non-maternal care. There are two explanations for this. First, some hours of care provided by the partner, grandparents, or other relatives may be joint with the mother. For instance, in case the mother spends all the time joint with the partner, children are taken care off 18 hours which is only slightly more than the net working time of mothers (15 hours). Second, non-maternal care may also be used for commuting time, home production, etc. Thus, the difference between non-maternal care and hours of market work does not necessarily reflect hours of leisure.

How does child care differ by formal care? Children with some formal care spend on average 22 hours more hours in the child care center than children with no exposure to formal child care. Moreover, children with some formal child care receive 1.3 hours less child care provided by a child minder. Overall, mothers who use some child care work 3.3 hours more during a week. There are no other important differences between children exposed to different modes of child care.

How does child care differ by residence in areas with high and low availability of center based child care (columns 2 and 3 in Table 3)? The key difference between East and West arise with respect to formal child care. Children who live in the East spend 22.7 hours per week in the day care center whereas children who live in the West only spend 5.6 hours per week in the day care center – or 17.1 hours less per week (the difference is significant at the 1 percent level). Children who live in East Germany also receive about 2.9 more hours of care by their fathers. A child growing up in the West will see her father during 11.8 hours, the corresponding time is 14.7 hours for a child growing up in the East. Strikingly, there are no differences between former East and West with respect to other sources of care, neither with respect to the extended family nor with respect to other sources of child care.

Total hours of non maternal care amount to 26 hours per week in the West but almost 46 hours per week in the East. Accounting for the fact that during some of these hours of non-maternal care the mother might be present in the household does not change the conclusion that exposure to maternal care is substantially lower in East Germany than West Germany –

(presumably non-shared) formal care is 17.1 hours longer in the East compared to the West. How does non-maternal care compare to work hours? The last row in Table 3 shows that women in the West work during about 14 hours per week – or slightly more than one half of their hours of non-maternal care. In contrast, women in the East work during about 18.5 hours – 4.2 hours more than their Western counterparts. Interestingly, the additional hours of non-maternal care do not translate one for one into additional hours of market work. Because the market work effect is small contrasting children from the East with children from the West identifies a *quantity* of maternal care effect rather than effects arising due to changes in household income. Moreover, even though household income is expected to increase due to the labor supply effect, one has to bear in mind that an important part of the increased income (roughly 45 percent) will be used to finance child care fees.

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 3). Moreover, since the quantity of other informal sources of non-maternal care varies little across German regions, we suppose that the average quality also does not vary much across regions. What, however, about the quality of maternal care? The GSOEP child module contains very detailed information on the number of times that mothers have undertaken a range of activities with their child during the last two weeks prior to the survey. Table 4 contrasts children with respect to their exposure to formal care (some vs none; column 1) and with respect to residence (East vs West; column 2). Arguably, these activities can be grouped with respect to stimulating cognitive abilities (singing to the child, reading to the child, looking at picture-books with the child, watching TV with the child), stimulating motor skills (painting/handicraft, walking with the child), stimulating social skills (going to the playground, visiting other families) and joint child care and home production (going shopping with the child). At first thought, 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 – mothers with some formal care go shopping with their child less frequently. 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. Table 4 also contrasts children in terms of their residence. Mothers who live in the East sing to their children more, they look at picture books more, and (even though not statistically significant) are more likely to walk with their child and paint with their children), and they also watch TV with their

Table 4: Activities undertaken with child

Table 5: Perceptions of Motherhood

children more than women who live in the West. In contrast, East German mothers visit other families less and go shopping with their child less often than West German mothers.

Taken together, both contrasts 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).

As suggested, one further underlying explanation for the effect of center-based care on child development might be that mothers who use some formal care may also differ substantially in terms of perceptions of motherhood. The GSOEP provides a detailed set of questions that allow investigating this issue. Table 5 provides information on positive aspects of motherhood (child provides happiness, motherhood is satisfying, new contacts via the child, providing tenderness) and negative aspects of motherhood (life conditions changed, often at end of strength, overchallenged and limited by motherhood). Contrasting mothers who use some formal care with mothers who use none indicates that mothers who use formal care find that motherhood is satisfying, and they are less limited by motherhood. Also, mothers who use formal care are less likely to state that life conditions have changed greatly than mothers who use no formal care. Table 5 cautions against using the formal vs no formal care contrast to identify the effects of child care. It clearly shows that mothers using some formal care are less likely to be stressed, and limited by motherhood. This means that perceptions of motherhood differ strongly between these groups of women.

What about mothers living in the East and the West? Table 5 column 2 shows that there are no differences in terms of perceptions of motherhood between East and West. This is a striking result. Even though family policy and social norms have differed substantially between FRG and GDR, mothers raising their children in recent times are perceiving motherhood in a very similar fashion. The key advantage of the regional contrast is that it allows focusing on the entire population of women who live in the East and in the West rather than on self-selected subgroups within those regions.

The final reason why child development may differ between former East and West is differences in pre existing characteristics. Table 6 contrasts children by formal care and residence. Overall, Table 6 indicates that 43 % of the children in the sample are exposed to some formal



Table 6: Individual and regional background characteristics

care. About 23 % of all children live in the East of Germany, 30 % have a mother who lived in the East before re-unification. Note that pre-unification region of residence is only available for the reduced subset of mothers who have been living in Germany before re-unification (92 %) and responded to the survey item (83 %). About 49 % of all children are boys, weighting 3350 grams at birth, with mean birth order 1.8 and 6 percent having an APGAR – a test applied to newborn babies considering activity, pulse, grimace response, appearance, and respiration – score indicating bad health (below 5). Mothers are 31 years old, about 15 % are immigrants, 92 % cohabit, and 53 % possess of primary education, 17 % secondary education, and 23 % university education. Total net household income is 2626 Euro per month. Table 6 also provides a detailed set of regional characteristics measures at the *Landkreis* level. The key regional characteristic is the child care offer rate. In 2002, this rate stood at 11 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, children sharing full-time slots, children in our sample already aged 37-47 months and hence with the right to attend Kindergarten, etc. The change in child care offer rates 1994 to 2002 is negative masking an expansion in the West and a contraction in the East. Interestingly, the situation in 2002 mirrors the situation in 1994. The child care offer rate stands at about 12.6 %, with a standard deviation of 17.5 %. GDP per capita is 27,102 Euros, the unemployment rate is 13.5 percent, the fertility rate is 1.36 children per women, the age structure indicates that 2.5 percent are children below the age of 3, 37 percent of all women are aged 19-49, and 22 percent are aged 65 plus. The number of pediatricians per 10,000 children is 54.

Column 4 in Table 6 provides differences between children in formal care and informal care. Children with formal care are more likely to live in the east, are older (and are of lower birth order), are less likely to be non-native, and have mothers with higher education. There are also clear regional differences between children with formal care and those with no formal care. Comparing children living in East Germany to children living in West Germany (column 5) shows that more East German children have access to formal care, East German mothers are younger at birth, there are fewer immigrant women, fewer women cohabit with their partner, and total net household income is 521 Euros lower in the East compared to the West – a substantial difference. In contrast, there are no education differences between East and West. Turning to differences in regional characteristics indicates that GDP per capita is 9,629 Euros lower in East German regions, and unemployment rates are 9 percentage points higher. Total fertility is .098

children lower in the East compared to the West and the age distribution is skewed towards the right, i.e. there are more women in the age group 65 or older in the East than in the West. Moreover, the health system seems to be in favor of children with the pediatrician density being substantially higher in the East than in the West. The most striking difference can be observed with respect to the child care offer rates, which are 29 percentage points higher in East Germany than in West German regions. Yet East German regions have seen a 8.7 percentage point weaker growth in child care offer rates than West German regions.

## 5 Identification

The purpose of this paper is to identify the causal effect of formal care on a range of child development indicators. We focus on understanding the effects of some formal child care vs no formal child care at all.

Let  $D_i = 1$  if child  $i$  spends some time in formal child care, and  $D_i = 0$  otherwise. Note that we abstract from the number of hours of care by coding formal care in a binary fashion. Ideally, we would be interested also in the question whether child development varies with hours of formal care in a non-linear fashion but the IV strategy that we propose can not distinguish a linear effect of hours of care from non-linear hours of care effects. Let  $y_i$  measure skill or ability development of child  $i$  living in region  $r$ , where  $r$  indexes the regions in Germany (*Landkreise*). The main objective is to identify the parameter  $\delta$  in the following linear model of child development:

$$y_i = \alpha + X_i' \beta + X_r' \gamma + \delta D_i + \epsilon_i \quad (1)$$

Our first identification strategy is ordinary least squares. OLS can account for individual level background characteristics (vector  $X_i$ ), and regional level background characteristics (vector  $X_r$ ). As pointed out in Section 4, region level 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 economic development, demographic structure and medical services.

Yet ordinary least squares can not account for self-selection into formal care. What are the consequences of self-selection? Suppose children are exposed to formal care based on expected improvements in child development – i.e. there is selection into child care based on gains in child development. 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. Selection on gains will place children with large gains into formal care leaving children who would have small or negative gains in child development entirely in the care of their mothers. Self-selection

on gains therefore leads to a large effect of treatment on the treated. Considering the variation of child care offer rates in Germany, the treatment effect on the treated is particularly large in West Germany compared to East Germany. Using OLS to measure the treatment effect on the treated will, however, provide a lower bound on the treatment effect on the treated since children who are not in formal care have better outcomes without formal care than children who are in formal care Angrist (2004). (See appendix discussing this in detail.)

We propose to address self-selection as follows. Let  $Z_r$  indicate the regional offer rate of slots in child care in 1994 (the earliest reliable time information about availability of child care offer rates is available). Importantly, we measure the number of slots potentially available per 100 children rather than actual slots filled, i.e. this is a pure measure of supply side restrictions in getting formal child care. This offer rate captures historical regional differences in supply of child care slots. We expect that the offer rate is correlated with the use of formal care, i.e.

$$D_i = \pi_0 + X_i'\pi_1 + X_r'\pi_2 + \pi_3 Z_r + \nu_i \quad (2)$$

The key issue when judging about the validity of using regional child care supply 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 for three important reasons. First, regions differ strongly in terms of a range of structural features which both shape labor supply incentives and supply of child care (Table 6). We argue, however, that conditional exclusion can be justified. We account for all regional differences in economic development, age structure, and the health system. Specifically, our estimates control for the unemployment rate and regional GDP. Moreover, we condition on fertility and the age structure to take the rapidly changing age structure between East and West into account. We also capture regional differences in pediatricians per 10,000 children.

Second, after re-unification a strong East West migration has characterized the recent German history. Migration implies that the current region of residence might be endogenous. Specifically, suppose that young women planning to start a family also consider availability of formal child care and their children's welfare in migration decisions. Women who are particularly concerned with their children's welfare relocate to regions that offer a sufficient number of child care slots. We address such endogenous re-location decisions by using the child care offer rate in 1994 as an instrument rather than 2002 child care offer rates. Selective migration of women is arguably based on actual supply side restrictions rather than historical restrictions. Furthermore, current supply side restrictions are the result of changes in fertility in the regions that we study. In contrast, historical child care offer rates reflect the ideological differences between

former East and West Germany. We also condition on the change in the supply of child care between 1994 and 2002. This change in supply is driven by migration and changes in fertility and therefore ideally captures the recent extension in child care supply of the regions.

The third threat to exclusion refers to cultural differences in child care. Mothers who grew up in the GDR may be inclined to demand more from their children and train them harder than mothers who grew up in the FRG.<sup>5</sup> We address these issues by conditioning on the original region of residence of mothers before German re-unification. Pre-unification region of residence directly captures cultural differences in child development.

We are therefore confident that the historical child care offer rate is a valid instrument. We use it to identify the effect of formal child care on child development in a standard two stage least squares approach. It is however important to be aware that the IV estimates and the OLS estimates do not identify the same parameters. OLS is designed to capture the effect of formal care on children with formal care. In contrast, the IV strategy identifies the effects of formal care for mothers using formal care due to an increase in the child care offer rate. The IV strategy therefore focuses on the sub-population that will start using formal care once supply side restrictions have been lifted – given that waiting lists are long this is a substantial group in West Germany. If children are placed in child care based on expected gains from child care, the IV parameter can exceed the effect of treatment on the treated. IV identifies the marginal effect of child care as new children are placed in child care starting from a very low baseline. The marginal effect will exceed the average if selection into child care is from the top of the distribution of individual child care gains. This appears plausible given that the more parents want their children to be in childcare the earlier they put them on a waiting list.

A more pragmatic approach that does not rely on exclusion is to relate child development directly to child care offer rates as follows

$$y_i = \alpha + X_i'\beta + X_r'\gamma + \nu Z_r + \mu_i \quad (3)$$

The parameter  $\nu$  captures the so-called intention-to-treat effect, i.e. the effect of increasing the child care offer rate by one unit. The intention to treat effect does not assume that the effect of child care on child development only arises because of an increase in the child care offer rate. The parameter  $\nu$  is also the relevant policy parameter and hence, is an interesting parameter to report.

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<sup>5</sup>Alesina 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.

Table 7: Main Result on Overall Skill Indicator – OLS

## 6 Results

Table 7 shows the main result regarding the aggregate skill and ability indicator. This indicator reflects the mean over all the skills and abilities discussed in section 4.2. Column 1 presents ordinary least squares results controlling for regional background characteristics and individual characteristics. Column 1 indicates that children with some formal care on average do better in terms of the aggregate skill indicator. The difference in child development is on the order of 0.03 points on a scale between 0 and 1. This difference is 30 % of the standard deviation in the child development scale, i.e. this difference is important. Results also indicate that none of the regional background characteristics matter neither individually nor jointly.

In contrast, individual characteristics such as birth weight and health at birth predict child development in a statistically significant and important fashion. A one standard deviation increase in birth weight (590 grams) improves child development on the standardized scale by 0.01 points or by about one tenth of a standard deviation. Bad health refers to a score of below 5 in the APGAR scale (which ranges from 0 to 10). Increasing that score by one unit is associated with .0385 points lower child development on the overall scale standardized scale. Interestingly, the formal care effect is of the same order of magnitude as bad health. Boys score .037 points lower on the aggregate child development scale than girls. The remaining child or mother characteristics are not statistically significant.

Column 2 in Table 7 provides the intention to treat estimates. Column 2 focuses on the sample of 730 out of the original 803 children with information on the offer rate in 1994. They explain child development with regional offer rates, individual characteristics, and regional characteristics. Results indicate that a one standard deviation increase in the offer rate of 17 percentage points is associated with an .016 increase in terms of average child development. This effect is quantitatively important – it represents 16 % of the standard deviation in child development indicators.

Column 3 in Table 7 provides OLS results on the effect of formal care on child development for the sample of children where we have information on child care offer rates in 1994. Results are very much in line with the results based on the entire sample suggesting that missing information on the regional offer rate in 1994 is not biasing results.

Turning to IV estimates, Table 8 Column 1 presents the OLS estimate of the effects of formal care controlling for the regional child care offer rate. This is a "test" of exclusion in the sense that it allows discriminating whether child care offer rates affect child development via formal

Table 8: Main Result on Overall Skill Indicator – IV

care or other channels. Results indicate that formal care is significant, regional child care offer rates are not significantly related to child development, and mother’s residence in GDR before re-unification is not either. This pattern of results is consistent with exclusion not being rejected.

Column 2 in Table 8 provides the first stage result (2). The regression relates use of formal care to the child care offer rate in 1994. Results indicate that increasing the child care offer rate by one percent increases the probability that a child is enrolled in child care by 2.8 percentage points. This estimate is surprisingly large. But note that the child care offer rates calculates full time slots in relation to children aged 0-3. This means that there can be a more than one to one relation between the regional offer rate and the probability that a child is in child care due to sharing of child care slots and due to delayed entry into child care.

Column 3 in Table 8 provides IV estimates of the effect of formal care. Results indicate that formal care improves child development by 0.12 points. This is slightly more than one standard deviation – a huge effect. The estimate is statistically significant at any conventional level. Comparing results in column 1 and column 3 indicates that simply contrasting mothers using formal care with those who do not use formal care underestimates the effect of formal care. This is surprising in view of the quality of care. Mothers using formal care are less stressed (table 5) and provide more high quality care (table 4). It can be rationalized, however, by considering the fact that OLS and IV measure different parameters. The gains to extending child care by increasing offer rates are larger than the average child care effect for children in a high offer rate environment as in East Germany.

Column 4 in Table 8 assesses the key concern with identification regarding differences in cultural attitudes. The IV results condition on the mother’s pre-unification region of residence. Results indicate that there is a slight but insignificant advantage to children whose mother grew up in the GDR. Accounting for the GDR advantage also decreases the point estimate on formal care somewhat, from 0.118 to 0.100. Yet the key result remains unchanged. Formal care appears to improve child development by about one standard deviation. Yet accounting for pre-unification region of residence does decrease the precision of the IV estimates strongly, not at last due to a substantial reduction in the sample size. This is why we provide results that do not account for this information throughout the rest of the paper.

How does formal care affect the different dimensions of child development? Table 9 provides detailed results regarding skill dimensions. Column 1 provides OLS results. These results indicate that children with some formal care are more developed with respect to language skills, everyday skills, motor skills, and social skills. Interestingly, the descriptive level formal care

Table 9: Formal Care and Child Development: Detailed Results

disadvantage in terms of health (Table 2) is no longer present in least squares results. This suggests, again, that the prima facie evidence on the effects of formal care on health is biased. There are no differences in terms of personality and behavioral development.

Turning to IV estimates in column 2 indicates that formal child care improves language skills, everyday skills, social skills, and behavior. The effect of formal care on motor skills is not statistically significant but on the same order of magnitude as the least squares results. Consistent with OLS, there is neither an effect on personality nor on health disorders. The overall pattern of the results in table 9 is one of very strong coherence between OLS and IV results with IV consistently identifying stronger effects than OLS.

How do we interpret the differences between the OLS and IV results? With self-selection into formal care based on gains from formal care, OLS is downward biased so OLS represent a lower bound on the effects of formal care on children in formal care – the effect of treatment on the treated. Moreover, the effect of treatment on the treated is likely to be small. Most children in formal care live in East Germany. If there is selection based on gains in child development, the average effect of child care is likely to be small. In contrast, the IV strategy is capturing the effects of formal care on families that manage to place their children in formal care because of lifted supply side restrictions. Lifting such restrictions will tend to benefit children whose parents would like to place them but can not due to constraints. The sample identifying the IV effect is therefore likely to consist of children gaining a lot in terms of child care.

What explains the formal care advantage? The section on descriptive statistics (section 4.2) 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. Alternatively, use of formal care may also affect the level of stress or be associated with different perceptions of motherhood.

Table 10 discusses the quantity channel. It shows that increasing the child care offer rate indeed increases the number of hours children spend at the child care center. Column 1 provides results on all children, regardless of their formal care status. Results indicate that a 10 percentage point increase in the child care offer rate increases care in the child care center by 4 hours. The corresponding increase in mother’s hours of work is between 0.9 (for total work hours) and 1.0 (for work hours excluding overtime). The third effect that is significant is hours of child care provided by the partner (living in the same household). These increase by 0.7 hours if the child

Table 10: Regional Differences in Non-maternal Hours of Child Care

Table 11: Regional Differences in Activities

care offer rate increases by 10 percentage points. On the other hand, none of the remaining sources of care are associated with the child care offer rate. This is an important finding. It means that neither the structure of family networks nor the price or 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.

Column 3 in Table 10 provides results for children with some formal care. This allows assessing the intensive margin of formal care along changes in terms of other modes of care for children with exposure to formal care. Results indicate that there is an important change in terms of the hours of formal care for children with some formal care. A change in the offer rate by 10 percentage points is associated with a change in the hours of formal care on the order of 2.9 hours. Results also indicate that mothers with some formal care work longer in regions with more child care slots (1.3 hours more for a change by 10 percentage points), and care provided by the father is 0.25 hours longer in areas with 10 percentage points higher offer rates. Interestingly, there is no significant association between offer rates and care provided by the partner for children with some care. This suggests that partners provide a fixed number of hours of care that depends on whether there is formal care or not possibly indicating that partners are involved in bringing the child to the child care center. Apart from the other sources of care, there is no significant association between the supply of child care and hours of care provided by the partner, other relatives, nannies or child minders.

Table 11 discusses the quality channel. Column 1 confirms the earlier result that regional differences in the availability of child care is associated with differences in terms of the activities. Mothers who live in a region with higher offer rates 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 non-formal social activities (visiting other families) and for household production (going shopping). Overall, this pattern of results is consistent with better child development outcomes for children with formal care.

Column 2 in Table 11 focuses on children with some formal care. Results indicate that the frequency of walking with the child, playing with the child is higher in regions with higher child care offer rates. Moreover, the frequency of trips to the supermarket or visits to other families with children is lower in regions with high child care offer rates. Recall that increases in the regional offer rate are associated with more time in formal care and more time at the workplace.



Table 12: Regional Differences in Perceptions of Motherhood

Table 13: Long-run results, children aged 5-9 years

This suggests that the quality of care changes as a function of the time children spend in formal child care or time mothers spend at the workplace.

Table 12 discusses the perception of motherhood channel, i.e. mothers who live in regions with more formal care may also be perceiving motherhood differently, or be stressed out less, etc. Regressions of perceptions of motherhood on the regional offer rates indicate that there is absolutely no regional difference in perceptions of motherhood nor in terms of stress due to motherhood across German regions. This allows narrowing down the mechanism explaining more favorable outcomes for children in formal care.

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 the everyday skills listed in section 4. 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. We therefore contrast non-cognitive outcomes for children aged 5-9 years by use of early formal care. These contrasts reflect 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 care givers 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 13 discusses OLS results and IV results that use the regional offer rate of formal care in 1994 (around the time these children were born) as an instrument for early formal care.

OLS results (column 1) indicate that there is no difference in terms of everyday skills, social skills, behavior, concentration and self-confidence between children who used early formal care and children who did not. In contrast, IV estimates indicate that there is a positive and significant differential for children with early formal care (column 2). This is interesting because the relative pattern of OLS and IV remains the same. OLS tends to provide lower bounds on the treatment effects identified with IV.

Table 13 also provides results on school grades for children age 9-10 years. OLS results indicate that children in early formal care do worse in terms of cognitive skills than children

who were not in formal care. Interestingly, using the IV strategy identifies positive and significant effects in terms of school grades. This suggests that 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 from the East perform better in standardized tests than students from the West (see e.g. PISA study).

What explains the positive effects of formal child care in relation to the literature? Our results stand in stark contrast with respect to the results in Baker *et al.* (2008). The key finding of 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. 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 thus foregoing the high level of care available through their mothers. Our results are also in stark contrast with Horstschraeer and Muehler (2009) who find negative effects of Kindergarten (available for ages 4-6) on school entrance examinations. Their main identification strategy uses regional variation in Kindergarten offer rates. Yet Kindergarten offer rates typically exceed 90 %. This means that IV results identify effects of loosening offer restrictions from a very high baseline. If parents send their children based on the achievement gains from Kindergarten, the last few children entering Kindergarten will have the lowest gains. This paper identifies the effects of loosening offer restrictions of early child care (age 0-3) from a very low baseline of less than 10 %. This means that we capture the positive domain of child development gains.

## 7 Conclusions

This paper studies the causal effect of formal child care on children's early development as well as longer run outcomes. The key identification challenge is to address self-selection into formal care. This paper proposes to rely on the unique regional variation in child care offer rates in Germany to identify the causal effects of formal care due to weakening supply side restrictions.

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.

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. 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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## Appendix

This appendix clarifies the relationship between the effect of treatment on the treated and the local average treatment effect. We suppose that selection is based on gains and children with the largest gains get chosen for formal care first.

Let  $Y_0 = \epsilon_0$  be child development without formal care, and  $Y_1 = \mu + \epsilon_1$  denote child development with formal care, where  $\epsilon_0$  and  $\epsilon_1$  are uncorrelated bivariate normal with variances  $1/2$ . We simplify the analysis assuming that there are only two doses of formal child care. Suppose selection into child care is based on child development gains, i.e.  $Y_1 - Y_0 = \mu + \epsilon_1 - \epsilon_0 = \mu + \epsilon$  where  $\epsilon \equiv \epsilon_1 - \epsilon_0$ .

There are two regions, one with limited supply (West Germany), denoted with  $Z = 0$  and one with less limited supply (East Germany),  $Z = 1$ . Supply side restrictions imply that the fraction with child care is lower in  $Z = 0$  than in  $Z = 1$ . The fraction in formal care can be characterized by supposing that assignment to formal care depends on gains and that those with large enough gains select into child care, i.e.  $D = 1$  if  $Y_1 - Y_0 > z_Z$  where  $z_Z$  is a region specific threshold. In this case, the fraction in child care in region 1 is  $p_1 = Prob(D = 1|Z = 1) = Prob(\mu + \epsilon > z_1) = \Phi(\mu - z_1)$  and the fraction in child care in region 0 is  $p_0 = Prob(D = 1|Z = 0) = \Phi(\mu - z_0)$  where  $\Phi()$  is the c.d.f. of the standard normal,  $z_1$  and  $z_0$  are region specific lower bounds on the gain due to formal care.

Consider the average effect of treatment on the treated in region 1 and region 0. The average effect of treatment on the treated in region 1 is  $E(Y_1 - Y_0|D = 1, Z = 1) = E(\mu + \epsilon|\mu - z_1 > \epsilon) = \mu + IMM(\mu - z_1)$  where  $IMM$  is the inverse mills ratio, and the corresponding effect in region 0 is  $E(Y_1 - Y_0|D = 1, Z = 0) = \mu + IMM(\mu - z_0)$ . Since  $IMM$  is a monotonically decreasing function, the average effect of treatment on the treated is larger in the supply side constrained region 0 than in the less constrained region 1. The population average effect of treatment on the treated across these two regions is a weighted average of the effects of treatment on the treated within those regions, i.e.  $E(Y_1 - Y_0|D = 1) = \mu + IMM_0 P(Z = 0|D = 1) + IMM_1 P(Z = 1|D = 1)$ .

Consider now estimating the treatment effect on the treated using observed data on child development  $Y$  and formal care use  $D$ . The prima facie contrast is downward biased because children are selected based on gains. This implies that child development without formal care,  $Y_0$ , on average is lower for children in formal care than for children who are not in formal care.

What is the effect estimated by using region to instrument for formal care? In the presence of heterogeneous treatment effects, two stage least squares estimates the local average of treatment on the treated. This is the effect on children who would not be exposed to formal care in region 0 but will be exposed to formal care in region 1 due to the lifting of supply constraints. Formally,

this is

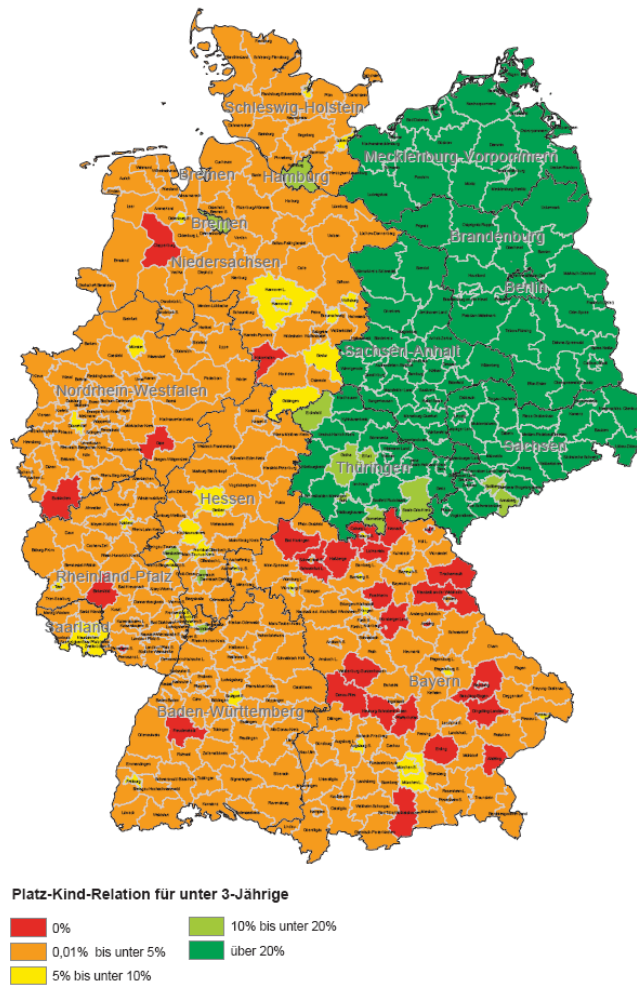
$$E(Y_1 - Y_0 | D_1 = 1, D_0 = 0) = \mu + E(\epsilon | z_0 > \mu + \epsilon > z_1)$$

This local average treatment effect is bounded by the average effect of treatment on the treated in region 1 and the average effect of treatment on the treated in region 1. Under realistic assumptions the LATE can exceed the average effect of treatment on the treated, especially taking the downward bias due to self-selection into account.

## Figures and Tables

### Figure 1: Child Care Offer Rates for Children age 0-3 years old

Abbildung 1: Versorgungsgrad mit Plätzen für unter 3-Jährige nach Kreisen und kreisangehörigen Städten am 31.12.2002 (verfügbare Plätze je 100 Kinder unter 3 Jahren)





**Table 1: Quality/ Price/ Provider structure of Child Care in East and West**

	West	East
Fees per month	770€	615€
Regulations 2007	59%	58%
Children/ Staff Ratio	5.13	6.76
Education 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
Expenditures 2003 (% of total)		
Fees	770€	615€

**Table 2: Child Development, by Formalcare and Residence**

	Overall (1)	Std. Dev	Formal Care Contrast (2)	Std. Dev. of (2)	East West Contrast (3)	Std. Dev. of (3)
Means of no-cogn. skills	0.7960	0.1036	0.0330***	(0.0073)	0.0296***	(0.0085)
Language skills	0.9022	0.1461	0.0349***	(0.0104)	0.0024	(0.0121)
Everyday skills	0.6313	0.2390	0.0865***	(0.0168)	0.116***	(0.0194)
Motoric skills	0.8085	0.1782	0.0429***	(0.0126)	0.0101	(0.0148)
Social skills	0.8882	0.1494	0.0524***	(0.0105)	0.0279**	(0.0124)
Personality	0.8905	0.0831	-0.0055	(0.0059)	-0.0008	(0.0069)
Behavior	0.6549	0.1401	-0.0117	(0.0010)	0.0230**	(0.0116)
Disorders	0.0584	0.0785	0.0126**	(0.0056)	0.0075	(0.0065)
Chronic disorders	0.1403	0.2201	0.0089**	(0.0044)	0.0051	(0.0057)
Contagious disorder	0.0311	0.0618	0.0236	(0.0157)	0.0182	(0.0128)

**Table 3: Differences in non-maternal care and maternal labor supply - unconditional**

Care measured in hours/week	Mean of Pooled Sample	Difference Formal vs. Non Formal Care	Std. Dev.	Difference East vs. West	Std. Dev.
Care by partner	12.4498	1.112	(1.152)	2.931**	(1.339)
Care by father (separated)	0.5865	0.006	(0.313)	0.344	(0.363)
Care by grandparents	4.9698	-0.229	(0.557)	-0.703	(0.648)
Care by sibling	0.9539	0.366	(0.399)	0.205	(0.464)
Care by relative	0.5493	-0.186	(0.152)	-0.254	(0.176)
Care by minder	0.9103	-1.304***	(0.323)	-0.0472	(0.380)
Care by nanny	0.4757	-0.234	(0.247)	0.0354	(0.288)
Care in creche	9.6459	22.29***	(0.609)	17.11***	(0.990)
Other care	0.4913	0.015	(0.209)	-0.246	(0.243)
Mom's work hours	12.8298	2.998**	(1.206)	4.239***	(1.400)
Mom's work hours+overtime	15.2612	3.276**	(1.341)	4.188***	(1.558)

**Table 4: Activities undertaken with child**

	Contrast formal care vs. not in care		Contrast East vs. West Germany	
<b>A. Stimulating cognitive skills</b>				
Singing to the child	0.211***	(0.0692)	0.184**	(0.0807)
Painting/Handicraft with the child	-0.0003	(0.0605)	0.0810	(0.0704)
Reading to the child	0.175***	(0.0574)	0.0078	(0.0671)
Looking at picture- books with child	0.0468	(0.0454)	0.113**	(0.0527)
Watching tv with the child	-0.0465	(0.0762)	0.243***	(0.0882)
<b>B. Stimulating motor &amp; social skills</b>				
Walking with the child	-0.0321	(0.0443)	0.0806	(0.0515)
Going to the playground the child	-0.0872	(0.0673)	-0.0225	(0.0783)
Visiting other families with the child	-0.0697	(0.0501)	-0.291***	(0.0573)
<b>C. Low quality time</b>				
Going shopping with the child	-0.330***	(0.0510)	-0.316***	(0.0599)

**Table 5: Perceptions of Motherhood**

	Contrast formalcare vs. not in care		Contrast East vs. West Germany	
<b>A. Positive aspects</b>				
New contacts via child	-0.0464	(0.0615)	0.0945	(0.0715)
Child provides happiness	0.0275	(0.0273)	-0.0005	(0.0319)
Motherhood is satisfying	0.101**	(0.0449)	-0.0358	(0.0524)
Providing tenderness to child	0.0069	(0.0215)	-0.0082	(0.0251)
<b>B. Negative aspects</b>				
Life conditions changed greatly	-0.148**	(0.0664)	-0.0566	(0.0775)
Overchallenged by new tasks	0.0120	(0.0502)	0.0057	(0.0584)
Often at end of strength	-0.0342	(0.0602)	0.0620	(0.0700)
Limited by motherhood	-0.180***	(0.0575)	-0.0803	(0.0674)

**Table 6: Individual and regional background characteristics: Overall (mean and std.) by formalcare and by east and west (t.b.d.)**

	<b>Obs.</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>Formal care contrast</b>	<b>East West contrast</b>
<b>Formal care</b>	803	0.4321	0.4957	-	0.4360***
<b>Living in the East</b>	803	0.2379	0.4260	0.3221***	-
<b>Mom's from the east</b>	671	0.3010	0.4591	0.290***	0.856***
<b>Birth year</b>	803	2003	1.1264	0.245***	0.143
<b>Male</b>	803	0.4894	0.5002	0.0060	0.0105
<b>Birth weight</b>	801	3349	590.21	4.201	-66.75
<b>Birth order</b>	803	1.8313	1.0790	-0.279***	0.0243
<b>Bad health at birth</b>	803	0.0573	0.2325	0.0057	-0.0133
<b>Age of mom at birth</b>	802	30.6097	5.3886	0.403	-0.821*
<b>Foreigner</b>	789	0.1546	0.3618	-0.145***	-0.141***
<b>Mom cohabits</b>	752	0.9215	0.2691	-0.0222	-0.0657***
<b>Moms' education: primary</b>	726	0.5344	0.4992	-0.0623*	-0.0025
<b>Moms' education: secondary</b>	726	0.1708	0.3766	0.129***	0.0562
<b>Moms' education: university</b>	726	0.2287	0.4203	0.139***	0.0543
<b>Total household net income/month</b>	741	2625.9	1376.1	103.6	-521.0***
<b>Childcarequote 2002</b>	803	10.9064	15.3084	11.78***	28.52***
<b>Childcarequote 1994</b>	730	12.6366	17.5874	13.40***	35.56***
<b>Creche growth 1994-2002</b>	803	-0.6521	8.9485	-1.48**	-7.48 ***
<b>Gdp/capita (in 1000€)</b>	803	27.1020	12.5436	-1.985**	-9.629***
<b>Unemployment quota</b>	803	13.5069	5.4139	3.222***	9.050***
<b>Fertility rate</b>	803	1.3564	0.1154	-0.0630***	-0.0981***
<b>Population age 3 in %</b>	792	0.0256	0.0053	-0.0014***	-0.0036***
<b>Female Population age 19-49 in %</b>	793	0.3711	0.0202	-0.0027*	-0.0134***
<b>Female Population age 65+ in %</b>	793	0.2251	0.0240	0.0095***	0.0302***
<b>Nr. of pediatricians for 10K children</b>	803	54.0274	23.2883	12.45***	27.99***

**Table 7: Main Result on Overall Skill Indicator**

	OLS Child development	ITT Child development	OLS Child development (restricted sample)
Formal care	0.0309*** (0.00791)	- -	0.0324*** (0.00823)
Child care offer rate 1994	- -	0.00111*** (0.000405)	- -
GDP/CAPITA	-0.000632 (0.000412)	-0.000452 (0.000438)	-0.000683 (0.000420)
Unemployment quota	-0.00140 (0.00115)	-0.00245* (0.00128)	-0.00164 (0.00119)
Fertility	0.0257 (0.0464)	0.0467 (0.0483)	0.0472 (0.0478)
Absolute creche growth 94-'02	-0.000649 (0.000424)	3.24e-05 (0.000501)	-0.000652 (0.000425)
% 0-3 year olds	0.985 (0.741)	1.009 (0.751)	0.934 (0.745)
% of females age 19-49	0.677 (0.512)	0.723 (0.538)	1.016* (0.526)
% of females age 65+	0.486 (0.445)	0.560 (0.470)	0.783* (0.462)
Pediatricians for 10K children	0.000141 (0.000219)	4.33e-05 (0.000230)	0.000105 (0.000223)
Birth weight	1.83e-05*** (6.28e-06)	1.98e-05*** (6.80e-06)	1.93e-05*** (6.77e-06)
Bad health at birth	-0.0390** (0.0156)	-0.0315* (0.0163)	-0.0332** (0.0162)
Child is male	-0.0388*** (0.00725)	-0.0370*** (0.00765)	-0.0377*** (0.00761)
Born in 2003	-0.00925 (0.00876)	-0.0129 (0.00923)	-0.00916 (0.00920)
Born in 2004	-0.0126 (0.00896)	-0.0170* (0.00956)	-0.0142 (0.00949)

Birth order	0.00457 (0.00389)	0.00140 (0.00408)	0.00309 (0.00407)
Age of mom at birth	-1.12e-05 (0.000798)	0.000734 (0.000841)	0.000583 (0.000837)
Mom's foreigner	-0.00349 (0.0124)	-0.00853 (0.0134)	-0.00595 (0.0134)
Mom's cohabiting	0.0193 (0.0143)	0.0223 (0.0146)	0.0210 (0.0145)
Mom's education: primary	0.00832 (0.0166)	0.00714 (0.0181)	0.00648 (0.0180)
Mom's education: secondary	0.0181 (0.0175)	0.0121 (0.0189)	0.0120 (0.0188)
Total household net income	-2.31e-06 (3.15e-06)	-1.27e-06 (3.39e-06)	-2.52e-06 (3.36e-06)
F-stat excluding regional	1.01	1.08	1.17
F-stat excluding individual	4.21	3.82	3.70
Observations	803	730	730
Adjusted R2	0.100	0.100	0.108

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**Table 8: Main Result on Overall Skill Indicator - IV with child care offer rates in 1994 as IV**

	Validity of IV Noncognitive Skills	IV: First stage	IV Noncognitive skills	IV Noncognitive skills
Formal care	0.0296*** (0.00893)	- -	0.118*** (0.0406)	0.1000* (0.0547)
Child care offer rate 1994	0.000682 (0.000525)	0.0284*** (0.00739)	- -	- -
Mom was living in GDR	0.00844 (0.0153)	0.216 (0.210)	- -	0.00285 (0.0184)
GDP/CAPITA	-0.000908* (0.000502)	0.00180 (0.00680)	1.34e-05 (0.000407)	-0.000934* (0.000511)
Unemployment quota	-0.00218 (0.00136)	0.00489 (0.0186)	-0.00174 (0.00125)	-0.00228 (0.00142)
Fertility	0.0836 (0.0526)	-1.420** (0.722)	0.0452 (0.0489)	0.116* (0.0639)
% 0-3 year olds	-0.000117 (0.000522)	0.0189** (0.00750)	-0.000588 (0.000450)	-0.000531 (0.000462)
% of females age 19-49	0.827 (0.855)	-0.171 (11.44)	1.217 (0.782)	0.821 (0.876)
% of females age 65+	1.059* (0.580)	-8.733 (8.089)	-0.0275 (0.124)	1.229** (0.587)
Pediatricians for 10K children	0.567 (0.504)	-7.682 (7.029)	-0.122 (0.150)	0.720 (0.519)
Birth weight	7.55e-05 (0.000241)	0.000153 (0.00346)	-7.74e-05 (0.000254)	7.16e-05 (0.000248)
Bad health at birth	2.39e-05*** (7.17e-06)	0.000112 (9.79e-05)	1.76e-05** (7.09e-06)	2.12e-05*** (7.67e-06)
Child is male	-0.0254 (0.0163)	0.0532 (0.220)	-0.0308* (0.0171)	-0.0270 (0.0167)
Born in 2003	-0.0403*** (0.00822)	0.111 (0.113)	-0.0391*** (0.00806)	-0.0425*** (0.00863)
Born in 2004	-0.00428 (0.00995)	-0.232* (0.137)	-0.00503 (0.0101)	0.00145 (0.0108)

Birth order	-0.0127 (0.0103)	-0.135 (0.140)	-0.0128 (0.0101)	-0.00889 (0.0106)
Age of mom at birth	0.00319 (0.00464)	-0.125** (0.0638)	0.00747 (0.00462)	0.00629 (0.00513)
Mom's foreigner	0.000954 (0.000961)	0.0194 (0.0131)	6.69e-05 (0.000902)	0.000447 (0.00108)
Mom's cohabiting	-0.0195 (0.0186)	-0.400 (0.274)	0.00658 (0.0155)	-0.0112 (0.0201)
Mom's education: primary	0.0214 (0.0153)	0.201 (0.210)	0.0174 (0.0155)	0.0167 (0.0161)
Mom's education: secondary	0.0137 (0.0281)	-0.158 (0.390)	0.00457 (0.0191)	0.0181 (0.0291)
Total household net income	0.0226 (0.0285)	-0.0225 (0.395)	0.00619 (0.0201)	0.0237 (0.0292)
F-stat excluding regional	1.53	12.27	11.82	12.76
F-stat excluding individual	3.88	19.94	40.94	41.40
Observations	612	612	730	612
Adjusted R2	0.137	-	-	-

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**Table 9: Formal Care and Child Development: Detailed Results**

	<b>OLS</b>	<b>IV</b>
<b>Language skills</b>	0.0325*** (0.0112)	0.0990* (0.0523)
<b>Every day skills</b>	0.0771*** (0.0178)	0.158* (0.0822)
<b>Motoric skills</b>	0.0496*** (0.0137)	0.0774 (0.0632)
<b>Social skills</b>	0.0504*** (0.0114)	0.146*** (0.0551)
<b>Personality</b>	-0.00709 (0.00647)	0.00856 (0.0295)
<b>Behavior</b>	-0.0153 (0.0109)	0.127** (0.0543)
<b>Disorder</b>	0.00600 (0.00597)	-0.0339 (0.0282)

Note: Above estimation results stem from single regression where further control variables are child characteristics (such as gender, age, birth weight, health at birth), mom's characteristics (cohabiting, educational dummies, foreigner, total net household income) as well as regional macroeconomic conditions (GDP/capita, unemployment rate, fertility, % of population being age 0-3, female age 19-49 and female age 65 plus, number of pediatricians per 10000 and absolute regional crèche growth).



**Table 10: Correlation between regional child care offer rates and child care modes**

	Child care quote 1994	p-value	Child care quote 1994 conditional on attending formal care	p-value
Care by partner	0.0689**	(0.0344)	0.0543	(0.0420)
Care by father (separated)	0.0135	(0.00832)	0.0258*	(0.0141)
Care by grandparents	-0.0208	(0.0165)	-0.00265	(0.0205)
Care by sibling	0.00179	(0.0123)	-0.00638	(0.0220)
Care by relative	-0.00494	(0.00445)	-0.000110	(0.00459)
Care by minder	-0.000768	(0.00998)	-0.00372	(0.00393)
Care by nanny	0.00176	(0.00765)	-0.00481	(0.00800)
Care in creche	0.402***	(0.0261)	0.289***	(0.0336)
Other care	-0.00813	(0.00645)	-0.0185**	(0.00859)
Only taken care off by mom	-0.000290	(0.000360)	0	(0)
Mom's work hous	0.105***	(0.0360)	0.134***	(0.0501)
Mom's work hours + overtime	0.0888**	(0.0400)	0.107*	(0.0547)

**Table 11: Regional Differences in Activities**

	<b>Local Childcare quote</b>	<b>Local Childcare quote conditional on attending some childcare</b>
<b>Singing to the child</b>	0.00325 (0.00378)	0.00605 (0.00578)
<b>Walking with the child</b>	0.00386 (0.00250)	0.00833** (0.00395)
<b>Painting/Handicraft with the child</b>	0.00601* (0.00338)	0.00880* (0.00515)
<b>Reading to the child</b>	0.000957 (0.00308)	-0.00352 (0.00438)
<b>Looking at picture books with the child</b>	0.00327 (0.00250)	0.00463 (0.00373)
<b>Going to the playground the child</b>	0.00348 (0.00372)	0.00231 (0.00561)
<b>Visiting other families with the child</b>	-0.00542** (0.00274)	-0.0103** (0.00422)
<b>Going shopping with the child</b>	-0.00801*** (0.00289)	-0.00893** (0.00417)
<b>Watching TV with the child</b>	0.00226 (0.00411)	0.00692 (0.00613)

Note: Above estimation results stem from single regression where further control variables are child characteristics (such as gender, age, birth weight, health at birth), mom's characteristics (cohabiting, educational dummies, foreigner, total net household income) as well as regional macroeconomic conditions (GDP/capita, unemployment rate, fertility, % of population being age 0-3, female age 19-49 and female age 65 plus, number of pediatricians per 10000 children and last the absolute change in crèches during 1994 and 2002).

**Table 12: Regional Differences in Perceptions of Motherhood**

	<b>Local child care quote</b>
<b>Life conditions changed greatly</b>	-0.00273 (0.00348)
<b>Child provides happiness</b>	0.00128 (0.00156)
<b>Often at end of strength</b>	-0.00354 (0.00336)
<b>Mother-hood is satisfying</b>	-0.00130 (0.00254)
<b>Over-challenged by new tasks</b>	0.00138 (0.00286)
<b>New contacts via child</b>	-0.000381 (0.00338)
<b>Limited by motherhood</b>	-0.00153 (0.00324)
<b>Tenderness is important</b>	-0.00149 (0.00127)

Note: Above estimation results stem from single regression where further control variables are child characteristics (such as gender, age, birth weight, health at birth), mom's characteristics (cohabiting, educational dummies, foreigner, total net household income) as well as regional macroeconomic conditions (GDP/capita, unemployment rate, fertility, % of population being age 0-3, female age 19-49 and female age 65 plus, number of pediatricians per 10000 children and absolute regional crèche growth).

**Table 13: Long run outcomes - 5-9 year olds**

	OLS with regional controls	IV with regional controls	Correlation with regional offer rate (children with no formal care)
<b>Every day skills</b>	-0.00170 (0.00472)	0.0849** (0.0341)	0.000291 (0.000425)
<b>Social skills</b>	0.000589 (0.00475)	0.0826** (0.0341)	-0.000451 (0.000423)
<b>Behavior</b>	0.00657 (0.00502)	0.115*** (0.0373)	0.000120 (0.000453)
<b>Concentrated</b>	-0.00342 (0.0107)	0.0820 (0.0731)	0.000703 (0.000945)
<b>Self confidence</b>	0.00366 (0.00504)	0.0272 (0.0339)	-0.000309 (0.000451)
<b>Grades (all)</b>	-0.0170** (0.00824)	0.131** (0.0585)	-0.000768 (0.000919)
<b>Grades (majors)</b>	-0.0196* (0.0109)	0.164** (0.0757)	-0.000415 (0.00123)
<b>Grades (minors)</b>	-0.0134 (0.0104)	0.0980 (0.0649)	-0.00125 (0.00112)

Note: Additional controls in the above regressions are child characteristics (age, gender, birthweight), mom's characteristics (marital status, education, number of children) and total income. All variables above are discrete variables from 0 to 1 (0= very low, 1=very high). Regional controls include gdp per capita, unemployment quota, fertility, percentage of population age 0-3, female and age 19-49 and female age 65+, pediatricians per 1000 children all measured in the year of the survey (2002, 2004 and 2005), and last absolute regional crèche growth 1994-2002. The Cragg-Donald Wald F statistic of the first stage is 30.48 and rejects the null hypothesis of the local child care offer rate being a weak instrument at the 1% significance level. Once we include the location of residence (distinguishing between East and West) the F-statistics drops down to 14.79 and we can reject the null hypothesis of the local child care offer rate being a weak instrument only reject at the 10% significance level.