Essays in Empirical Family Economics: Investments in Children and Work-Life Balance of Parents

Dissertation

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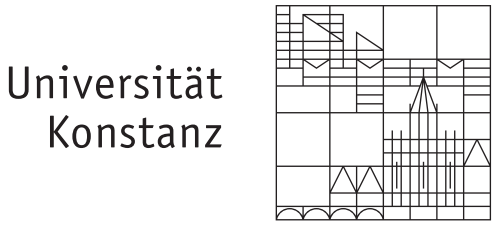

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Summary

This dissertation consists of three independent research papers that were written in the years 2010 to 2014 during my doctoral studies at the University of Konstanz as a participant of the "Doctoral Programme in Quantitative Economics and Finance". Though these chapters are self-contained, they have a common focus on challenges faced by families. Based on unique data sources and advanced microeconometric methods, this thesis empirically investigates mechanisms and policies that affect the opportunities of children and their parents to form and use their human capital. The first two papers deal with investments in the development of children conducted by parents and educational institutions. The third paper places the emphasis on the parents and how policies can support their efforts to reconcile parenthood and career. Before summarizing the three chapters in detail, I will briefly discuss the economic relevance and the role of the family for the society. The last part of the summary contains a short outlook to future research.

Children and their parents are highly valuable resources for economies. Whether and how these individuals are able to reach their full potential are key questions for societies facing demographic change. The younger generation's human capital and earnings are needed to keep up with technological progress and to reduce the pressure on intergenerational transfer systems (Smeeding, 2014). Forming new human capital and efficiently using existing human capital is essential to sustain economic growth.

However, there is reason to believe that the extent to which children and parents have the opportunities to unlock their potential is restricted and crucially depends on factors these individuals are not free to choose. Important policy issues that may impair their prospects are insufficient educational and health investments in children, socioeconomic inequalities, as well as gender or family inequality in the workplace (Smeeding, 2014).

Family investments have a strong impact on the children's opportunity to realize their full potential (see Heckman et al., 2006a; Cunha and Heckman, 2008; Currie, 2009). Particularly early childhood investments yield high returns and determine a person's ability for human capital formation later in life (Cunha and Heckman, 2007, 2008). However, children are unable to choose their parents and parents cannot borrow against their children's future. Parents with low socioeconomic status may neither have the financial re-

sources nor the skill to provide a sufficiently high quantity and quality of investments to their children. Therefore, economic inequalities lead to unequal prospects for children, if not compensated by public investments. One generation's low level of human capital presents a barrier to the next generation's achievement of its potential, resulting in a strong positive correlation between human capital of parents and their children (see Ermisch et al., 2012).

Parents face the conflict of either devoting their time to their children, which has in general been assumed to be beneficial for child development (Leibowitz, 1974b; Del Boca et al., 2014), or to follow their career aspirations and raise financial resources available to the family. Independent of their socioeconomic status, parents are constrained in optimally choosing their allocation of time. On the one hand, there exists a limited availability of high-quality substitutes for parental caring time. On the other hand, workplace inflexibilities complicate the reconciliation of work and family (OECD, 2007). Hence, in a society where women are increasingly pursuing and achieving higher education, a large part of productive potential remains unused. This work-life conflict reduces parental well-being (e.g. Bertrand, 2013) and has also been accounted for the low or diminishing fertility in many European countries and the United States (Smeeding, 2014; OECD, 2015).

Family policies implemented in the past in Western societies often set disincentives for mothers to participate in the labor market (Datta Gupta et al., 2008). These career breaks have a detrimental effect on the mothers' labor market prospects (see DiPrete and Buchmann, 2006; Bertrand et al., 2010). Not until the 21st century, policy makers in Germany as well as in other OECD countries started to focus on family policies that aim to enable parents to realize their careers without forgoing care of adequate quality for their children (OECD, 2007). Next to the increase of subsidized daycare provision, family-friendly workplaces are a crucial element of the new strategy. Such firm policies have the potential for being more effective in facilitating the reconciliation of work and family than public policies, given that they are more compatible with the workplace requirements.

This thesis sheds light on three essential questions for policy makers aiming to solve the work-family conflict faced by parents and to increase children's prospects to realize their full potential: Firstly, how do the investments of parents with high socioeconomic status differ from those with low socioeconomic status? Secondly, does non-parental care, particularly center-based care, provide an appropriate substitute for parental care? Thirdly, are family-friendly workplaces able to reduce the burden to parents and set incentives for parents to devote more time to their job?

The first chapter of the thesis provides novel insights on educational differences in parental time investments in children. The importance of time investments has long been recognized by economists (Becker, 1965; Hill and Stafford, 1974) and there exists evi-

dence that the caring behavior of highly educated parents differs from those with lower education (e.g. Leibowitz, 1974a; Guryan et al., 2008a). The underlying mechanisms are not yet fully explored. The analysis in Chapter 1 contributes to achieving this objective.

The second chapter picks up on question two and analyses the impact of universal daycare on child weight and fitness. The study also adds to the scarce evidence on the effect of daycare for children under the age of three years. Most existing studies explore the effect of daycare on cognitive and behavioral development and mainly reveal positive effects, also in the long-run (e.g. Blau and Currie, 2006; Havnes and Mogstad, 2011; Apps et al., 2013). Despite the importance of health, and particularly obesity, for child human capital development and economic cost (see Cawley, 2004; Cawley and Spieß, 2008; Currie, 2009), the focus in daycare research turned to physical health outcomes only recently (e.g. Herbst and Tekin, 2011; Frisvold and Lumeng, 2011; Campbell et al., 2014). Chapter 2 expands the available evidence in this area.

The third chapter explores the effect of family-friendly firm policies, more precisely childcare support and flexible working schedules, on parent's satisfaction in work and family related areas as well as on their working time. Extensive research exists on public family policies, such as parental leave (see Datta Gupta et al., 2008; Spieß, 2011), but there exists little research on how firms can contribute to reducing the conflicts faced by their employees with children by providing family-friendly policies. Chapter 3 investigates this question.

I will now summarize the three chapters and discuss the main results.

Parental Education and How Parents Invest Time in Children

The first chapter of this thesis is single-authored and links two empirical facts: First, child human capital is highly positively related to parental human capital. Second, parental investments are crucial in shaping child human capital. The study investigates whether and how time investments might explain observed disparities in child development. Three potential channels through which highly educated parents could make the difference are explored and contrasted. It is dealt firstly with the amount of time parents spend with their children, secondly with the amount of time in which caring for children is actually the primary activity and thirdly with the proportion of the time spent with children devoted to specific care activities. The main analysis is based on the German Time Use Survey (GTUS, 2001/02). In addition, because there is a lack of comparative evidence, comparable estimates are derived for the United States, based on the American Time Use Survey (ATUS, 2003/04).

Time-use data provides much more reliable information on how time is spent and is less affected by recalling issues and problems with over-and underestimation compared

to stylized survey questions about average time use. There are two empirical issues to deal with in this setting. As common in diary data there is a non-negligible frequency of zero time use for many activities. The study accounts for this by using two-part models, which allow for separate processes determining the decision to conduct an activity and the decision about the time devoted to the activity. In time-use data it is shown that two-part models outperform the tobit model, which is commonly used for censored data (Stewart, 2013). In addition, the issue that the share of time with children devoted to specific care activities is a fractional variable is handled by combining the two-part model with a fractional logit model.

The analysis examines the contributions of both parents and how they adapt to the child's age. The estimations for Germany reveal that university educated mothers spend less time with their children than lower educated mothers. The effect of maternal education on childcare time only becomes positive when children reach preschool age. Their partners compensate by providing more childcare time when children are young. Overall, there is no clear evidence for children of highly education parents receiving a higher quantity of parental time. A more distinct explanation for developmental disparities can be found in the allocation of time to specific care activities. Highly educated mothers focus on activities that can be assumed to foster child human capital development and highly educated fathers devote relatively more time to ensuring physical well-being.

Comparable estimations for the United States reveal a very different relationship of parental education and total time use. In the United States, maternal childcare time is positively related to paternal education, but only in families with toddlers. However, it is striking that the educational pattern in the choice of caring activities is very similar to Germany. In addition, it turns out that in both countries parents with a high education background adjust their caring behavior more strongly to the children's age-dependent needs.

The Effect of Early Universal Daycare on Child Weight Problems

The second chapter is conducted in cooperation with the Robert-Koch Institute (RKI), represented by Thomas Lampert. The study is based on the National Health Interview and Examination for Children and Adolescents. This is a large representative study on child health in Germany and is called KiGGS. The KiGGS provides objective measures of child health and thus prevents estimates from being biased due to subjective parental reporting. For the analysis in Chapter 2, this dataset had to be linked to administrative data on the availability of publicly subsidized daycare, which was possible cooperating with the RKI.

The rise in daycare usage for young children in the 2000s stirred up a discussion about its effect on child well-being. Simultaneously we observe an alarming increase in child-

hood obesity. The study investigates whether using universal daycare of regulated quality, as in Germany, before the age of three may be able to reduce obesity and accompanying fitness deficiencies. Prospects are good as interventions early in life are shown to yield particularly high returns for child development, including health development. The study explores the impact of early daycare usage in the group of children aged five to nine years. Weight problems are measured using the Body-Mass-Index and supplemented by the percentage body fat. An indicator of gross motor skills is included as well to provide a comprehensive picture of the children's physical fitness.

Whether daycare is used early is influenced by parental and child characteristics. It is not plausible to assume that all relevant factors are observed in the KiGGS. Therefore, for the main analysis, regional differences in the availability of publicly subsidized daycare for children under the age of three are exploited as the source of exogenous variation in early daycare usage in a non-linear instrumental variable strategy. Similar to previous studies (e.g. Mogstad and Wiswall, 2012), this non-linear instrumental variable strategy turns out to be more efficient and leads to more precisely estimated effects compared to the standard linear two-stage least squares approach.

Conditional ordinary least squares estimates show only very weak differences pointing to small gains on average. The local average treatment effects derived by the instrumental variable approach reveals that early daycare leads to a significantly better physical development for children 'at the margin', i.e. whose childcare decision is impacted by the availability of daycare for children before the age of three. Further analysis suggests that the caring decision in families with low and medium income and with an overweight father is most strongly influenced by differences in daycare supply. Hence it can be concluded that the estimated effects are driven by less privileged children.

The Effects of Family-Friendly Firm Policies on Parental Well-Being and Working Time

The third chapter is joint work with Johanna Storck from the German Institute for Economic Research (DIW) and much of the paper was developed during my visit at DIW in 2013 and 2014. This paper provides novel evidence on the effect of family-friendly firm policies on well-being and working time of parents. In autumn 2006 German politicians set up several programs to support firms in becoming more family-friendly. However, research on the effects of the promoted family-friendly firm policies is rare. This study contributes to filling this research gap.

The focus of the analysis is on two specific firm policies: Childcare support and flexible working schedules. The analysis exploits the fact that, supported by the public programs, since the mid-2000s an increasing share of employers reacts to their employees' needs by offering a family-friendly work environment. These changes over time allow us to identify causal effects of the two family-friendly policies on parental well-being,

measured by satisfaction related to life, job, family, childcare and time pressure, and on the time devoted to the job.

The estimation is based on difference-in-differences and lagged dependent variable strategies in a representative panel dataset on families with young children in Germany (*Familien in Deutschland*, FiD). Firms who offer family-friendly policies and individuals who receive such an offer differ from those without the offer. Therefore the panel models are combined with matching to decrease potential bias arising from factors correlated with the offer of family-friendly firm policies and the change in the considered outcomes. The general idea behind these estimators is to compare individuals who begin to receive the family-friendly firm policy from one period to the other with nearly identical individuals who did not receive this policy and to analyze how well-being and working time changed between these two groups.

The results show that for mothers childcare support strongly increases satisfaction related to childcare and additionally raises life and job satisfaction. Particularly mothers with medium and low levels of education increase their working time when childcare support is offered. These effects are mainly driven by the usage of childcare, but also seem to be affected by the mere possibility to make use of childcare in the future. Flexible working schedules raise mothers' job satisfaction, but do not change family related satisfaction and working behavior. Fathers show nearly no reactions to either childcare support or flexible working schedules.

Several sensitivity checks with respect to the matching procedure, the specification and the chosen subsample are performed, all confirming that the results are robust. Hence childcare support seems to be a truly family-friendly practice and valued by mothers, while this is not so clear for flexible working schedules.

Summarizing, the analysis in Chapter 1 suggests that the quality and the timing, but not mainly the quantity of parental care have the potential to explain developmental differences between children with highly educated parents and children with lower educated parents. Chapter 2 reveals that substituting parental care with daycare can lead to better physical development of children, particularly for children who are at relatively high risk for adverse development. Chapter 3 indicates that childcare provided by the employer is beneficial, especially for mothers. Consequently, universal access to high-quality and flexible daycare can provide effective investments in children and simultaneously reduce problems for mothers to reconcile labor market participation and motherhood.

These insights are meaningful for policy makers aiming to enable children as well as parents to make use of their potential and reduce the work-family conflict for parents. It must be investigated further how parental time, non-parental time and other factors, such as financial investments and family environment, act together in determining human cap-

ital development in the long-run. Research needs to explore to what extent parental and non-parental care, particularly daycare, are interchangeable. Under the assumption that the marginal productivity of daycare as well as of parental care is positive, but decreasing, there may exist an optimal ratio of parental care to daycare, depending on parental background and the child's characteristics.

Furthermore, to enable policy makers to set up an efficient daycare system it is essential to explore the factors which cause the positive developmental effect of daycare. Due to restricted financial resources available for subsidizing daycare, cost-benefit analyses might be necessary to identify the essential quality aspects, e.g. quantity and training of staff, facilities or activities.

Flexible working schedules were shown to raise mothers' job satisfaction but without benefiting family related areas. The analysis did not identify a firm policy that clearly affected the work-family balance for fathers. Hence it should be investigated whether and in which situations fathers actually experience a work-life conflict. It might also be possible to increase the effectiveness of family-friendly firm policies by improving the implementation. It is also important to find out whether family-friendly workplaces attract parents as employees, such that more high-skilled workers are available to the economy.

Answering these questions may enable to create a system that allows each entity to realize its full potential and to maximize human capital. Such a system could lead to a more efficient and successful economy.

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Zusammenfassung

Die vorliegende Dissertationsschrift besteht aus drei unabhängigen Forschungspapieren, die in den Jahren 2010 bis 2014 während meiner Zeit an der Universität Konstanz als Teilnehmerin am "Doctoral Programme in Quantitative Economics and Finance" entstanden sind. Obwohl die Kapitel in sich geschlossen sind, haben sie einen gemeinsamen Fokus auf die Herausforderungen, denen Familien gegenüberstehen. Durch Zusammenführung verschiedener Datenquellen und Anwendung fortgeschrittener ökonometrischer Methoden, untersucht die Doktorarbeit empirisch Mechanismen und Maßnahmen, welche die Möglichkeiten von Kindern und ihren Eltern beeinflussen ihr Humankapital aufzubauen und zu nutzen. Die ersten zwei Kapitel behandeln Investitionen in die Entwicklung von Kindern, getätigt von den Eltern und durch Bildungsinstitutionen. Das dritte Kapitel richtet die Aufmerksamkeit auf die Eltern und auf Maßnahmen, welche die Vereinbarkeit von Elternschaft und Karriere unterstützen können. Im Folgenden wird kurz auf die ökonomische Relevanz und die Rolle der Familie für die Gesellschaft eingegangen. Anschließend werden die drei Kapitel zusammengefasst. Der letzte Teil dieser Zusammenfassung enthält einen Ausblick auf anknüpfende Forschung.

Kinder und ihre Eltern verkörpern wertvolle Ressourcen für eine Volkswirtschaft. Ob und wie diese Individuen ihr volles Potential ausschöpfen können, gehört zu den wesentlichen Fragen in Gesellschaften im demographischen Wandel. Das Humankapital der jungen Generation wird benötigt, um mit dem technologischen Fortschritt mitzuhalten und den Druck auf die intergenerativen Transfersysteme zu verringern (Smeeding, 2014). Neues Humankapital auszubauen und bestehendes Humankapital effizient zu nutzen, sind wesentliche Voraussetzungen für volkswirtschaftliches Wachstum.

Allerdings gibt es Grund zur Annahme, dass nicht alle Kinder und Eltern gleichermaßen die Möglichkeit haben ihr Potential freizusetzen und dass diese Möglichkeiten von äußeren Umständen abhängen, die das einzelne Individuum nicht beeinflussen kann. Diese Perspektiven werden durch Faktoren, wie ungenügende Investitionen in die Bildung und Gesundheit von Kindern, soziale Ungleichheiten und Arbeitsplätze, die den Anforderungen von Familien nicht genügen, beeinflusst (siehe Smeeding, 2014).

Investitionen, die innerhalb der Familie getätigt werden, haben einen großen Einfluss

auf die Aussichten der Kinder ihr volles Potential ausschöpfen zu können (siehe Heckman et al., 2006a; Cunha und Heckman, 2008; Currie, 2009). Insbesondere Investitionen in der frühen Kindheit sind mit hohen Erträgen verbunden, da sie die Fähigkeit beeinflussen später im Leben Humankapital zu akkumulieren (Cunha und Heckman, 2007, 2008). Allerdings können sich Kinder ihre Eltern nicht aussuchen und die Eltern können nicht das zukünftige Einkommen ihrer Kinder beleihen. Eltern mit einem niedrigen sozioökonomischen Hintergrund haben somit relativ geringe finanzielle Ressourcen und Fähigkeiten, um eine angemessene Quantität und Qualität an Investitionen für ihre Kinder zu gewährleisten. Somit führen ökonomische Ungleichheiten zu ungleichen Chancen für Kinder, solange sie nicht durch öffentliche Investitionen kompensiert werden. Das niedrige Humankapital der einen Generation beeinträchtigt die Entwicklung der nächsten Generation und führt zu einem starken positiven Zusammenhang zwischen dem Humankapital der Eltern und ihrer Kinder (siehe Ermisch et al., 2012)

Eltern können ihre Zeit entweder mit den Kindern verbringen, was im Allgemeinen als förderlich für die Entwicklung der Kinder angesehen wird (Leibowitz, 1974b; Del Boca et al., 2014), oder ihren Karrierewünschen folgen und das verfügbare Einkommen für die Familie erhöhen. Unabhängig von ihrem sozioökonomischen Status, sind Eltern bei ihrer Entscheidung über die Zeiteinteilung beschränkt. Auf der einen Seite existiert nur ein begrenztes Angebot an hochwertigen Substituten für die elterliche Betreuungszeit. Auf der anderen Seite erschweren unflexible Arbeitsbedingungen die Vereinbarkeit von Familie und Beruf (OECD, 2007). In einer Gesellschaft, in der Frauen vermehrt hohe Bildungsabschlüsse erwerben, bleibt somit ein nicht unwesentlicher Anteil des Humankapitals ungenutzt. Dieser *Work-Life*-Konflikt verringert das Wohlergehen der Eltern (z.B. Bertrand, 2013) und wird auch für die niedrige oder zurückgehende Fertilität in Europa und den USA mitverantwortlich gemacht (siehe Smeeding, 2014; OECD, 2015).

Viele westliche Länder verfolgen eine Familienpolitik, die häufig Anreize für Mütter setzt nicht am Arbeitsmarkt teilzunehmen (Datta Gupta et al., 2008). Diese Erwerbsunterbrechungen sind nachteilig für die beruflichen Aussichten und die Lohnentwicklung der Mütter (siehe DiPrete and Buchmann, 2006; Bertrand et al., 2010). Erst zu Beginn des 21. Jahrhunderts wurde die Familienpolitik in Deutschland, wie auch in anderen OECD Ländern, vermehrt auf Maßnahmen ausgerichtet, welche die Umsetzung von Karrierewünschen ermöglichen, ohne dabei auf eine angemessene Betreuung der Kinder zu verzichten (OECD, 2007). Neben einer Erhöhung des öffentlichen Kinderbetreuungsangebots sind familienfreundliche Arbeitsplätze ein wesentliches Element der neuen Strategie. Unternehmenspolitik kann effektiver darin sein die Vereinbarkeit von Beruf und Familie zu unterstützen als staatliche Maßnahmen, vorausgesetzt dass sie besser auf die Ansprüche des Arbeitsplatzes abgestimmt ist.

Die vorliegende Dissertation geht auf drei Fragestellungen ein, deren Beantwortung wesentlich ist für eine Politik, welche das Ziel hat den Vereinbarkeitskonflikt für die Eltern zu lösen und die Entwicklungschancen von Kindern zu verbessern: Erstens, wie unterscheiden sich die Investitionen von Eltern mit hohem sozioökonomischen Hintergrund von denen mit niedrigem sozioökonomischen Hintergrund? Zweitens, ist nichtelterliche Betreuung, insbesondere in Kindertagesstätten, ein gutes Substitut für die Betreuung durch die Eltern? Drittens, sind familienfreundliche Arbeitsplätze dazu in der Lage die Last für die Eltern zu reduzieren und setzen sie Anreize für die Eltern mehr Zeit für den Beruf aufzuwenden?

Das erste Kapitel dieser Dissertationsschrift bietet neue Erkenntnisse über die Unterschiede in den elterlichen Zeitinvestitionen in die Entwicklung von Kindern in Abhängigkeit von der Bildung der Eltern. Die Bedeutung von Zeitinvestitionen ist Ökonomen schon länger bekannt (Becker, 1965; Hill und Stafford, 1974) und es existiert Evidenz dafür, dass sich das Betreuungsverhalten von hochgebildeten und niedriger gebildeten Eltern unterscheidet (z.B. Leibowitz, 1974a; Guryan et al., 2008a). Die zugrundeliegenden Mechanismen sind jedoch noch nicht vollständig erforscht. Die Analyse in Kapitel 1 trägt dazu bei dieses Ziel zu erreichen.

Das zweite Kapitel greift Frage zwei auf und beinhaltet eine Analyse des Effekts von Kindertagesbetreuung auf Gewichtsprobleme und körperliche Fitness von Kindern. Die Studie trägt zudem zu der geringen Evidenz über den Effekt von Fremdbetreuung vor dem vierten Lebensjahr bei. Der größte Teil der Studien in diesem Bereich beschäftigt sich mit dem Effekt von Kinderbetreuung auf die Entwicklung von kognitiven Fähigkeiten und von Verhaltensauffälligkeiten und zeigt größtenteils positive Effekte auf, auch in der langen Frist (siehe Blau und Currie, 2006; Havnes et al., 2011; Apps et al., 2013). Trotz der Bedeutung von Gesundheit und insbesondere Adipositas für die Entwicklung von Humankapital und volkswirtschaftlichen Kosten (siehe Cawley, 2004; Cawley und Spieß, 2008; Currie, 2009), hat sich die Forschung in diesem Bereich erst vor kurzem physischer Gesundheit zugewandt (Herbst und Tekin, 2011; Frivold und Lumeng, 2001, Campell et al., 2014). Kapitel 2 erweitert den Erkenntnisstand in diesem Bereich.

Das dritte Kapitel beschäftigt sich mit der Unterstützung von Eltern durch den Arbeitgeber. Die Analyse fokussiert auf das Angebot von Kinderbetreuung und flexiblen Arbeitszeitregelungen sowie dem Effekt dieser familienfreundlichen Maßnahmen auf die Zufriedenheit von Eltern bezüglich Beruf und Familie und auf den Arbeitseinsatz der Eltern. Es gibt relativ viele Studien, die sich mit staatlicher Familienpolitik, wie z.B. der Elternzeit, beschäftigen (siehe Datta Gupta et al., 2008; Spieß, 2011), aber nur wenige, die analysieren ob und wie Unternehmen dazu beitragen können die Konflikte für ihre Mitarbeiter mit Kindern zu reduzieren, indem sie familienfreundliche Maßnahmen anbie-

ten. Diese Fragestellung ist im Fokus von Kapitel 3.

Im folgenden Abschnitt werden die drei Kapitel zusammengefasst.

Parental Education and How Parents Invest Time in Children

Das erste Kapitel der Dissertation wurde ohne Koautor erarbeitet und verknüpft zwei empirische Fakten: Erstens, das Humankapital eines Kindes ist stark positiv mit dem Humankapital seiner Eltern korreliert. Zweitens, elterliche Investitionen sind entscheidend für die Entwicklung des Humankapitals des Kindes. Diese Studie untersucht, ob und wie Zeitinvestitionen die Divergenz in der Entwicklung von Kindern erklären könnten. Drei mögliche Wirkungskanäle, über die hochgebildete Eltern die Entwicklung ihrer Kinder positiv beeinflussen könnten, werden analysiert und gegenübergestellt. Die Analyse beschäftigt sich erstens mit der Zeit, welche die Eltern und die Kinder gemeinsam verbringen, zweitens mit der Gesamtzeit, die für Kinderbetreuung verwendet wird und drittens mit der Verwendung der gemeinsamen Zeit für bestimmte Betreuungsaktivitäten. Die Hauptanalyse basiert auf den deutschen Zeitbudgetdaten (GTUS, 2001/02). Außerdem werden vergleichbare Schätzungen für die USA auf Basis der amerikanischen Zeitbudgetdaten (ATUS, 2003/04) durchgeführt, da nur wenig international vergleichbare Evidenz existiert.

Zeitbudgetdaten beinhalten sehr viel verlässlichere Informationen darüber, wie die Zeit verbracht wird und die Angaben sind weniger stark durch fehlerhafte Erinnerungen und Über- oder Unterschätzung beeinflusst, als in Erhebungen, welche die durchschnittliche Zeitverwendung abfragen. In Zusammenhang mit diesen Daten gibt es zwei empirische Herausforderungen. Wie häufig in Zeitbudgetdaten gibt ein nicht unerheblicher Anteil der Beobachtungseinheiten eine Zeitverwendung von null Minuten für bestimmte Aktivitäten an. Diesem Umstand wird mit sogenannten *Two-Part* Modellen begegnet. In diesen Modellen können unterschiedliche Prozesse die Entscheidungen darüber bestimmen, ob an einem bestimmten Tag eine Aktivität durchgeführt wird und wie viel Zeit für diese Aktivität verwendet wird. Für Zeitbudgetdaten hat sich gezeigt, dass *Two-Part* Modelle besser geeignet sind als das Tobit Modell, welches üblicherweise für zensierte Daten verwendet wird (Stewart, 2013). Zum anderen handelt es sich bei dem Anteil der Zeit, welche für bestimmte Kinderbetreuungsaktivitäten verwendet wird, um eine Verhältniszahl. Mit diesem Umstand wird umgegangen, indem das *Two-Part* Modell mit einem *Fractional Logit* Modell kombiniert wird.

Die Analyse untersucht den Beitrag beider Eltern und wie sie ihr Verhalten an das Alter der Kinder anpassen. Die Schätzungen für Deutschland zeigen, dass Mütter mit Universitätsabschluss weniger Zeit mit ihren Kindern verbringen als geringer gebildete Mütter. Der Effekt der mütterlichen Bildung auf die Kinderbetreuungszeit wird erst po-

sitiv, wenn die Kinder im Vorschulalter sind. Die Partner dieser Mütter kompensieren, indem sie mehr Zeit auf Kinderbetreuung verwenden, wenn die Kinder im Kleinkindalter sind. Insgesamt gibt es keine klare Evidenz dafür, dass höher gebildete Eltern mehr Zeit mit ihren Kindern verbringen. Eine Erklärung für Unterschiede in der Entwicklung von Kindern zeigt sich in der Verwendung der Zeit mit den Kindern für bestimmte Betreuungsaktivitäten. Hochgebildete Mütter fokussieren auf Aktivitäten, von denen angenommen werden kann, dass sie die Entwicklung des Humankapitals von Kindern unterstützen und hochgebildete Väter verwenden mehr Zeit darauf das körperliche Wohlergehen der Kinder zu gewährleisten.

Vergleichbare Modelle für die USA zeigen einen deutlich abweichenden Zusammenhang zwischen der elterlichen Bildung und der Gesamtzeitverwendung. In den USA hängt die mütterliche Kinderbetreuungszeit positiv mit der Bildung des Vaters zusammen, jedoch nur in Familien mit Kleinkindern. Es ist allerdings bemerkenswert, dass das Muster für die Wahl der bevorzugten Kinderbetreuungsaktivitäten dem in Deutschland ähnelt. Zudem zeigt sich, dass hochgebildete Eltern sich in beiden Ländern stärker den altersspezifischen Ansprüchen ihrer Kinder anpassen.

The Effect of Early Universal Daycare on Child Weight Problems

Das zweite Kapitel ist in Kooperation mit dem Robert-Koch Institut (RKI) entstanden, dieses wird vertreten durch Thomas Lampert. Die Analyse basiert auf der Basiserhebung der Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland. Diese große repräsentative Studie liefert Daten zur Gesundheit von Heranwachsenden und wird KiGGS genannt. KiGGS beinhaltet objektive Maße der kindlichen Gesundheit und bewahrt die Schätzungen somit davor, durch subjektives Antwortverhalten der Eltern verzerrt zu werden. Für die Untersuchungen in diesem Kapitel müssen die KiGGS Daten mit administrativen Daten zur Verfügbarkeit von öffentlich geförderter Kindertagesbetreuung verknüpft werden. Dies war in Zusammenarbeit mit dem RKI möglich.

Der Anstieg der Nutzung von Fremdbetreuung für sehr junge Kinder in den 2000ern erzeugte eine Diskussion über den Effekt auf das Wohlergehen der Kinder. Zur gleichen Zeit wird eine alarmierende Vermehrung von Adipositas in der Kindheit beobachtet. Die vorliegende Studie untersucht, ob ein Besuch von allgemein zugänglicher Kindertagesbetreuung von regulierter Qualität, wie in Deutschland, vor dem dritten Geburtstag, in der Lage ist Gewichtsprobleme und begleitende Fitnessdefizite zu reduzieren. Die nachgewiesene hohe Effektivität von Eingriffen in der frühen Kindheit, auch für die gesundheitliche Entwicklung, erlaubt es einen positiven Effekt zu erwarten. Die Studie analysiert den Effekt früher Nutzung von Kindertagesbetreuung auf die Gesundheit von Kindern im Alter von fünf bis neun Jahren. Gewichtsprobleme werden basierend auf dem Body-Mass-Index und dem Körperfettanteil bestimmt. Zusätzlich wird ein Maß für grobmotorische Fähig-

keiten einbezogen, um ein umfassendes Bild körperlicher Fitness abzubilden.

Die Charakteristika von Eltern und Kindern sind maßgeblich dafür, ob Kindertagesbetreuung schon früh genutzt wird. Es ist nicht plausibel anzunehmen, dass alle relevanten Faktoren in KiGGS beobachtet werden. Aus diesem Grund werden in der Hauptanalyse regionale Unterschiede in der Verfügbarkeit von öffentlich geförderter Kindertagesbetreuung für Kinder unter drei Jahren als Quelle exogener Variation in einer nicht-linearen Instrumentvariablenmethode verwendet. Wie in früheren Studien zeigt sich diese nicht-lineare Instrumentvariablenmethode als effizienter und führt zu präziser geschätzten Effekten als die klassische lineare *Two-Stage-Least-Squares* Instrumentvariablenmethode (siehe z.B. Mogstad und Wisswall, 2012).

Lineare Regressionsmodelle zeigen nur schwache Unterschiede auf, die auf ein leicht besseres Abschneiden der Kinder, die früh fremdbetreut werden, hinweisen. Die lokalen Treatmenteffekte, welche über die Instrumentvariablenmethode hergeleitet wurden, zeigen, dass die frühe Nutzung von Kindertagesbetreuung zu signifikant besserer physischer Entwicklung von Kindern führt, deren Betreuung durch die Verfügbarkeit von Kindertagesbetreuung beeinflusst wird. Weitere Analysen weisen darauf hin, dass die Betreuungsentscheidungen von Familien mit mittlerem und niedrigem Einkommen und von Familien mit einem übergewichtigen Vater besonders stark von der Verfügbarkeit von Kindertagesbetreuung abhängen. Somit lässt sich schließen, dass diese Gruppen der weniger privilegierten Kinder die Effekte treiben.

The Effects of Family-Friendly Firm Policies on Parental Well-Being and Working Time

Das dritte Kapitel ist in Zusammenarbeit mit Johanna Storck vom Deutschen Institut für Wirtschaftsforschung (DIW) entstanden und ein großer Teil der Studie wurde während meines Aufenthaltes am DIW in den Jahren 2013 und 2014 entwickelt. Die Studie beinhaltet neue Evidenz über den Effekt familienfreundlicher Unternehmenspolitik auf das Wohlergehen und die Arbeitszeit von Eltern. Im Herbst 2006 wurden in Deutschland verschiedene Programme aufgesetzt, welche Unternehmen darin unterstützen familienfreundlicher zu werden. Allerdings ist die existierende Forschung zu den Effekten der geförderten familienfreundlichen Maßnahmen sehr gering. Die Studie trägt dazu bei diese Forschungslücke zu füllen.

Der Fokus der Analyse ist auf zwei spezifische unternehmenspolitische Maßnahmen gerichtet: Unterstützung bei der Kinderbetreuung und flexible Arbeitszeiten. Die Analyse nutzt die Tatsache aus, dass, unterstützt durch die öffentlichen Programme, ein steigender Anteil an Arbeitgebern auf die Bedürfnisse der Mitarbeiter reagiert und ein familienfreundliches Arbeitsumfeld anbietet. Diese Veränderungen über die Zeit erlauben einen kausalen Effekt der familienfreundlichen Maßnahmen auf elterliches Wohlergehen, gemessen als Zufriedenheit in den Bereichen Leben, Arbeit, Familie, Kinderbetreuung und

Zeitdruck, und auf die Zeit, die für die Berufstätigkeit verwendet wird, zu identifizieren.

Die Schätzung basiert auf *Difference-in-Differences* und *Lagged Dependent Variable* Modellen in einem repräsentativen Paneldatensatz für Familien mit jungen Kindern in Deutschland (*Familien in Deutschland*, FiD). Unternehmen, die eine familienfreundliche Maßnahme anbieten und Individuen, welche dieses Angebot erhalten, unterscheiden sich von denen ohne ein solches Angebot. Deshalb werden die Panelmodelle mit *Matching* kombiniert um die potentielle Verzerrung zu reduzieren, welche durch Faktoren entstehen kann, die mit dem Angebot der Maßnahme und der Veränderung in den betrachteten abhängigen Variablen korreliert sind. Die Idee hinter diesem Schätzer ist es Individuen, welche die familienfreundliche Unternehmenspolitik von einer Periode zur anderen erhalten, mit nahezu identischen Individuen zu vergleichen, welche diese Maßnahme nicht erhalten und zu analysieren, wie sich das Wohlergehen und die Arbeitszeit zwischen diesen beiden Gruppen verändert.

Die Ergebnisse zeigen, dass das Angebot der Kinderbetreuungsunterstützung durch den Arbeitgeber für Mütter die Zufriedenheit mit der Kinderbetreuung stark erhöht und zusätzlich die Lebenszufriedenheit und die Zufriedenheit mit der Arbeit positiv beeinflusst. Insbesondere Mütter mit niedrigem und mittlerem Bildungsniveau erhöhen ihre Arbeitszeit, wenn Kinderbetreuung angeboten wird. Diese Effekte werden hauptsächlich durch die Nutzung der Betreuungsunterstützung getrieben, aber auch die reine Möglichkeit der zukünftigen Nutzung spielt eine Rolle. Flexible Arbeitszeiten steigern die Zufriedenheit von Müttern mit der Arbeit, aber verändern weder die Zufriedenheit in anderen Bereichen, noch die erbrachte Arbeitszeit. Väter zeigen keine eindeutigen Reaktionen, weder auf das Angebot der Kinderbetreuungsunterstützung noch auf das Angebot flexibler Arbeitszeiten.

Mehrere Sensitivitätsanalysen bezogen auf die *Matching*-Prozedur, die Spezifikation und die gewählte Stichprobe zeigen, dass die Ergebnisse robust sind. Somit scheint die Unterstützung bei der Kinderbetreuung durch den Arbeitgeber eine wahrlich familienfreundliche Maßnahme zu sein, die von Müttern wertgeschätzt wird, wobei dies nicht so eindeutig für flexible Arbeitszeiten ist.

Zusammenfassend suggeriert die Analyse in Kapitel 1, dass die Qualität und die zeitliche Verteilung und nicht vorwiegend die Quantität der elterlichen Betreuungszeit das Potenzial haben die Unterschiede in der Entwicklung von Kindern in Abhängigkeit von der Bildung ihrer Eltern zu erklären. Kapitel 2 zeigt, dass die Substitution von elterlicher Betreuungszeit durch Kindertagesbetreuung förderlich für die physische Entwicklung der Kinder sein kann, insbesondere für Kinder, die einem höheren Risiko für eine unvorteilhafte Entwicklung ausgesetzt sind. Kapitel 3 weist darauf hin, dass Kinderbetreuung, die durch den Arbeitgeber angeboten wird, besonders wertvoll für Mütter ist. Allgemeiner

Zugang zu Kinderbetreuung von hoher Qualität und Flexibilität kann somit eine effektive Investition in die Entwicklung von Kindern darstellen und gleichzeitig die Probleme von Müttern reduzieren, Arbeitsmarkteilnahme und Mutterschaft zu vereinen.

Diese Erkenntnisse sind bedeutend für Entscheidungsträger, deren Ziel es ist Kindern und ihren Eltern zu ermöglichen ihr Potential voll auszuschöpfen und den *Work-Family* Konflikt für Eltern zu reduzieren. Es sollte weiter untersucht werden, wie elterliche Zeit, nicht-elterliche Betreuung und andere Faktoren, wie finanzielle Investitionen und das familiäre Umfeld, langfristig zusammenspielen, um die Entwicklung von Humankapital zu determinieren. Es ist wichtig herauszufinden, in welchem Ausmaß elterliche und nicht-elterliche Betreuungszeit, insbesondere Kindertagesbetreuung, substituierbar sind. Unter der Annahme, dass die Grenzproduktivität sowohl von Kindertagesbetreuung als auch von elterlicher Betreuung positiv, aber abnehmend ist, könnte ein optimales Verhältnis von elterlicher Betreuung zu Kindertagesbetreuung existieren. Es ist anzunehmen, dass dieses von dem Hintergrund der Eltern und den Eigenschaften des Kindes abhängt.

Zudem ist es wesentlich die Faktoren zu bestimmen, welche den positiven Effekt von Kindertagesbetreuung verursachen, um Entscheidungsträgern zu ermöglichen ein effizientes Kinderbetreuungssystem aufzubauen. Aufgrund beschränkter finanzieller Möglichkeiten zur Subventionierung von Kindertagesbetreuung könnten Kosten-Nutzen-Analysen hilfreich sein, um die kritischen Qualitätsaspekte, wie die Anzahl und Ausbildung der Mitarbeiter, die Ausstattung oder die angebotenen Aktivitäten, zu identifizieren.

Es wurde gezeigt, dass das Angebot flexibler Arbeitszeiten die Zufriedenheit der Mütter mit der Arbeit erhöht, jedoch keinen Effekt auf andere Lebensaspekte hat. Die Analyse hat auch keine Unternehmenspolitik aufgezeigt, welche die Zufriedenheit und das Verhalten von Vätern beeinflusst. Somit wird mehr Forschung benötigt, um zu verstehen, ob und in welchen Situationen Väter tatsächlich einen *Work-Life* Konflikt erleben. Es könnte auch möglich sein, die Wirksamkeit der familienfreundlichen Maßnahmen durch eine verbesserte Umsetzung zu erhöhen. Zudem ist es wichtig zu erfahren, ob familienfreundliche Arbeitsplätze Eltern anziehen, sodass insgesamt mehr gut ausgebildete Arbeitskräfte der Volkswirtschaft zur Verfügung stehen.

Die Beantwortung dieser Forschungsfragen würde es erlauben ein System zu erschaffen, welches es jedem Mitglied erlaubt sein volles Potential zu realisieren und das verfügbare Humankapital zu maximieren. Ein solches System könnte zu einer effizienteren und erfolgreicheren Volkswirtschaft führen.

CHAPTER 1

Parental Education and How Parents Invest Time in Children

1.1 Introduction

Differences in human capital development are observable early in life and are strong predictors of differences in later life outcomes (e.g. Feinstein, 2003; Cunha et al., 2006). The human capital of children and their parents is shown to be positively correlated (see Ermisch et al., 2012; Bradbury et al., 2012), but research stresses that an individual's level of human capital is not inherent, but highly influenced by family investments and particularly parental time investments (Haveman and Wolfe, 1995; Cunha and Heckman, 2007, 2009; Del Boca et al., 2014).

Even though the relevance of parental time for child development has long been recognized by economists (see Becker, 1965; Leibowitz, 1974b; Hill and Stafford, 1974), the mechanisms underlying the relationship between time investments and child development are still under-researched (Del Bono et al., 2014).[1] However, research agrees that the quantity and the quality of childcare time are affected by parental education (e.g. Leibowitz, 1974a; Guryan et al., 2008a; Gimenez-Nadal and Molina, 2013). Hence, given the intergenerational persistence in human capital, highly educated parents' caring behavior can be assumed to be more effective in enabling children to realize their potential.

Based on these considerations, the present study's objective is to shed more light on the educational differences in caring behavior. The analysis provides new insights by contrasting three relevant aspects of time use. Firstly, the analysis investigates the total amount of time parents spend with their children, including, for example, the time in which the mother prepares a meal while the child is present. As evidence indicates that mainly those time periods in which childcare is the primary activity are decisive (Hsin and Felfe, 2014), the analysis secondly deals with the quantity of childcare time.[2] Taking this argument further, highly educated parents could make the difference without spending more time with their children by adjusting their caring style. Studies exploring specific care activities, such as reading to the child, suggest that the type rather than the amount of caring time is the crucial factor (Sénéchal and LeFevre, 2002; Hsin and Felfe, 2014). Therefore, this study thirdly focuses on the proportion of time with children devoted to care activities with different impacts on child development.

This investigation extends the existing literature by examining the contributions of both parents and how their caring behavior adjusts to the children's age-dependent needs. The children's needs may depend on their receptiveness and the availability of substitutes

[1] There exists the general belief that parental time is decisive for child development (see Bonke and Esping Andersen, 2011).

[2] Whether the amount of time spent with children is beneficial is actually ambiguous (compare Ruhm, 2008; Hsin and Felfe, 2014). Studies that link time use data to child outcomes confirm a relationship of maternal caring time and child development, but it is heterogeneous with respect to parental characteristics, e.g. race (see also Carneiro and Rodrigues, 2009; Villena-Roldán and Ríos-Aguilar, 2012).

for parental care (e.g. daycare, school). The analysis is conducted separately for three age groups: families with toddlers (0-3 years), families with a youngest child in preschool age (4-6 years) and families with a youngest child in school age (7-9 years).

This paper exploits the unique information of time use data on daily activities and provides novel evidence based on the German Time Use Survey (GTUS) 2001/02. Time use data has the advantage that the estimates are less affected by inaccuracies which are prevalent in stylized survey data. In surveys people mostly have to report the time which is usually spent on certain activities. This leads to over- or underestimations (see UN Statistical Division, 2005; Kan and Pudney, 2008). Time use data reveals exactly whether a parent, who is not devoting time to paid work, actually spends the time with his or her children and also reveals how parents spend the parent-child shared time. This is a major advantage compared to information on average time use and compared to common proxies for childcare time, such as total time net of parental working time.[3]

Most of the related evidence is conducted for the United States (US) and reveals a strong positive education gradient in childcare time (see Section 1.2.2). It is not evident whether we can learn from the US findings about other countries. Germany, for example, likewise experiences a non-negligible level of intergenerational persistence in education and income (see Blanden, 2013), but it differs in areas that are shown to impact child-care time, such as family policies. Policies that help reconcile paid work and family life seem to be associated with less time spent looking after children by mothers (Joesch and Spieß, 2006). Österbacka et al. (2012) and Boll et al. (2014) confirm that country-specific policies matter for parental caring behavior. The finding by Guryan et al. (2008a) that the education gradients in childcare time in most countries are much smaller than in the US, provides further evidence for cross-country differences.

Overall, studies comparing the effect of parental education on parental caring behavior across countries are scarce. Particularly limited is comparative research including the US. The present paper contributes to closing this research gap by applying the same estimation approach used for GTUS to the American Time Use Study (ATUS) of 2003 and 2004 and thus by providing truly comparable estimates.

There are two empirical issues in the present setting. As common in time use analyses, there is a non-negligible frequency of zero time use. In addition, the analysis deals with a fractional variable when investigating the proportion of time with children devoted to specific care activities. The first point is addressed by using a two-part approach, which explicitly models the decision to conduct an activity on the reporting day in a first step and the decision about the amount of time devoted to that activity in the second step. To deal with the fractional outcome, this two-part model is combined with a fractional logit

[3] See, for example, Ruhm (2008) for an overview of studies based on this proxy.

model. The results are robust to alternative specifications and 'one-way' modeling.

The findings can be summed up to four main results. First, the effect of maternal university education on the time spent with children is negative in Germany, particularly in families with toddlers and school age children. Differently, the effect of maternal education on actual childcare time is non-positive when there is a toddler in the family, but becomes positive when children grow older. Second, consistent with economic household models, more paternal time with children and a more frequent use of other care arrangements compensate for relatively less time devoted to children by highly educated mothers in families with a toddler. Third, there are no similarities in the pattern of total time use for the US and Germany. In the US, paternal education, not maternal education, clearly raises the mother's time with children and particularly her childcare time, but only in the group of families with toddlers.

Fourth and most strikingly, there exists a common pattern in preferred caring activities. In Germany, highly educated mothers, particularly university educated mothers, devote a larger proportion of parent-child shared time to playful activities with a toddler and on educational activities when the children are older. Similarly, US-American mothers in families with a high education background focus on physical and playful care with a toddler, but change the emphasis to educational care when children grow older. For fathers in both countries, a high education background mainly leads to a stronger contribution to physical care.

Summarizing these findings suggest that there are similarities in the effect of parental education on the preferred type of care, but not on the quantity of caring time. Common in both countries, highly educated mothers are relatively more focused on caring activities that can be assumed to foster the children's human capital development and adapt their caring behavior more strongly to the children's age-dependent needs. Fathers in families with a high education background contribute more than other fathers to securing the children's physical well-being.

The remainder of the paper is structured as follows. Section 1.2.1 briefly discusses the theoretical background. Section 1.2.2 gives a short overview of the related empirical findings. Section 1.4 introduces the data and the estimation strategy. Section 1.5 presents the results for Germany. Section 1.6 provides comparable US estimates. Section 1.7 concludes.

1.2 Theoretical and Empirical Background

1.2.1 Theoretical Considerations

In economic household models, child human capital, is one commodity among others produced using time and purchased inputs (e.g. daycare, books) and valued by the parents.[4] Childcare can be seen as a set of specific childcare activities, for example, reading or playing. This time affects parental utility directly if there are process benefits, i.e. performing childcare itself is enjoyable (Juster and Stafford, 1991). There is an indirect effect if parents value the outcome 'child quality', i.e. the child's cognitive- and non-cognitive skills, health and general well-being.[5]

The choice for parents is between investing time in producing one or the other commodity or to work in the labor market and to purchase good inputs from earnings. Each parent's optimal time input for the production of the child's human capital is a function of both parents' wages, prices and quality of market goods, exogenous household income, preferences and technology parameters.

Advanced education, by raising wages, would lead to a substitution away from parental caring time and thus to a negative education gradient. If the effect of education on childcare time is positive, there might be a strong income effect. Highly educated parents could also have stronger preferences for child quality or their expected marginal returns to time investments may be higher (Davis-Kean, 2005; Stocké, 2007).[6] A lower (perceived) elasticity of substitution between parental time and purchased inputs relative to other household outputs or a stronger education-induced increase in the productivity of parental time in child quality relative to other commodities could also lead to a positive education gradient (see Leibowitz, 1974a; Grossman, 2006; Ramey and Ramey, 2010).[7]

The impact of these different mechanisms is difficult to disentangle solely based on time use data because there is not enough information on factors such as preferences (see Folbre, 2004).[8] However, if additional (external) factors come into play, theoretical considerations provide a meaningful guide for the interpretation of the findings in the present paper. Therefore, the factors shaping the relationship between parental education and childcare will be briefly addressed.

[4] Parents could be altruistic or value the child's future income and status. See Becker (1965), Leibowitz (1974b) and Gronau (1977) for early models of the allocation of time. More recent models with a focus on child human capital development can be found in Leibowitz (2003), Folbre (2004) or Zhu and Vural (2013).

[5] Del Boca et al. (2014) find that child quality plays a significant role for the care decision.

[6] The marginal utility of spending one more minute in childcare must be higher than for other activities.

[7] A similar argumentation is possible related to effort cost.

[8] There is not much existing evidence. Del Boca et al. (2014), find, for example, no strong evidence for productivity differences when analyzing parental caring time in their structural model for the US.

Distribution of responsibilities between parents

Possessing a higher educational degree than the partner, leads to a relatively higher earnings potential and thereby to relatively higher cost of non-market work. If the couple's time inputs are substitutes, the partner with lower earnings potential should focus on non-market production. Maternal education would, ceteris paribus, have a negative effect on her own caring time, but a positive effect on the partner's caring time and vice versa.[9]

One parent's higher earnings might raise his or her own, but particularly the other parent's caring time due to an income effect, if the income elasticity of demand for child quality is positive and parental care is not too easy to substitute by non-parental care. If there are process benefits this effect should be even stronger.

The role of substitutes and exogenous household income

The decision to substitute parental care with non-parental care depends on the (perceived) quality and the availability of substitutes. In Germany the availability of daycare, particularly for children aged zero to three years, has been problematic in the observation period, but daycare quality is highly regulated compared to other countries (see Spieß, 1998). A high degree of substitutability between parental and non-parental time can lead to a negative education gradient (see Zhu and Vural, 2013). If highly educated parents are better informed about available daycare slots and are more willing to bear the (search) cost, this would also facilitate a negative effect of education on caring time.

Non-labor income decreases the incentives to participate in the labor market. This mainly affects mothers. Financial support for families with young children is relatively generous in Germany. Until 2007 eligibility depended on household income and payments were independent of former earnings. Consequently, staying out of the labor market was relatively more costly for highly educated parents in the observation period.[10]

Given that in Germany the availability of daycare rises with the child's age, but financial support decreases, lower educated mothers are expected to devote more time to market work when children grow older. Hence the effect of education on maternal caring time should increase with the children's age and particularly having children aged three or younger should make a difference.

[9] See Vermeulen (2002) for an overview of models which develop the idea that relative endowments matter further in collective and bargaining household models.

[10] The recipient of leave payments is not allowed to work full-time. This may partly explain the high proportion of part-time working mothers (e.g. OECD, 2012). Financial support for families is relatively high in international comparison, with long paid leave periods (two years paid, plus one year unpaid until 2007) and large child raising benefits. Availability of (full-time) daycare is limited. The 'income splitting' tax regime and the cost-free health insurance coverage for non-working spouses and children further reduce incentive for labor market participation. See McGinnity and McManus (2007) and Reichart et al. (2007) for comparisons of family policies. Highly educated mothers may in addition face a relatively higher wage penalty for work interruptions (Anderson et al., 2002).

Specific childcare activities

A mother (or a father) might conduct care activities herself if she perceives her own time input to be more productive than the partner's time or non-parental care time. Otherwise she might replace her time by these care alternatives.[11] In addition, highly educated parents could have a stronger preference for child human capital and hence for activities stimulating the child's development, whereas the importance of certain caring activities for child development varies with the child's age (see Kalil et al., 2012).

In that case, one would expect to observe a relatively stronger adjustment of highly educated parents' caring activities to the child's age-dependent needs. Highly educated parents might devote a larger portion of parent-child shared time to playing and reading with young children, but switch to helping with homework when children are in school age. Highly educated parents might in turn reduce the parent-child shared time devoted to less stimulating activities such as supervising. This could be interpreted as a form of allocative efficiency, i.e. a more efficient choice of inputs (e.g. Grossman, 2006) and would provide one explanation for the observed relationship between child development and parental human capital.

1.2.2 Related Empirical Findings

This section gives a brief summary of the relevant empirical research. A more detailed overview can be found in Table 1.A.1 to Table 1.A.3 in the appendix.

US evidence is dominant in this strand of research and reveals a strong positive association between socioeconomic status, predicted wages or education and the quantity of parental childcare time. Early evidence on this positive education or socioeconomic gradients in parental childcare by Leibowitz (1974a, 1975) and Hill and Stafford (1974, 1980) is confirmed in more recent studies by Kimmel and Connelly (2007), Guryan et al. (2008a) and (Ramey and Ramey, 2010).[12]

There exists less evidence for other countries and only a few comparative studies, with a particular scarcity of comparative studies including the US. Guryan et al. (2008a) reveal that for many countries the magnitude of educational differences in parental childcare time is smaller than for the US. For Germany they show, based on data from 1991, that the estimated difference between low and high educated mothers is particularly small and insignificant, while it turns out to be about three hours and five hours per week for working and non-working women respectively in the US. Sayer et al. (2004b) also show that the

[11] Similarly, how demanding/costly an activity is could also vary depending on the parent's education.

[12] In the US, parental childcare time increased and the gap between higher and lower educated parents has also widened (Ramey and Ramey, 2010). On average maternal care increased in most countries since the mid-1990s (Sayer et al., 2004a), but this does not seem to be true for Germany (Berghammer, 2013).

positive effect of education is weaker for mothers in Germany compared to Canada, Italy and Norway.[13]

These and further single country studies show that there exist positive education gradients, but not in all countries, not for all definitions of childcare and not always for both parents (e.g. Folbre et al., 2004; Craig, 2006; Gracia et al., 2011; Gimenez-Nadal and Molina, 2013). The diverging findings across countries indicate that country-specific institutions, policies and norms are not only crucial in determining the average amount of caring time as suggested by Joesch and Spieß (2006) and Österbacka et al. (2012), but also vary the effect of parental education on childcare time.

Most cross-country studies use the Multinational Time Use Study (MTUS), a dataset that harmonizes time use surveys of different countries, but at the cost of data limitations. Studies using the MTUS can, for example, only roughly control for the children's age. For this reason, the present study is based on the original GTUS and ATUS data.

Only some studies include both parent's decision making. Kitterød and Pettersen (2006), Hallberg and Klevmarken (2003) and Hsin and Felfe (2014) find that fathers compensate for the mother's working hours, i.e. less maternal time available for children. In contrast, Leibowitz (1974a) and Hallberg and Klevmarken (2003) show that parental childcare time behaves complementary. These studies do not explore how education shapes the patterns. Including education, Bonke and Esping Andersen (2011) reveal particularly high caring times in families with two highly educated parents.

Given the strong effect of education on total caring time, it is not surprising that Guryan et al. (2008b) estimate a positive education gradient for all kinds of childcare activities in the US. Some other studies on the sub-types suggests that caring activities that foster human capital development are chosen more often particularly by highly educated mothers, but the pattern is not clear (Craig, 2006; Kalil et al., 2012; Gimenez-Nadal and Molina, 2013). For fathers, education also often makes a larger difference for basic or physical care activities (Craig, 2006; Gutièrrez-Domenech, 2010; Gracia et al., 2011).

Evidence on the relationship between the age of the children and the education gradient in childcare is still rare.[14] Gracia (2014) finds the strongest education gradient among Spanish fathers in households with a youngest child aged three to five years, driven by physical care activities. Kalil et al. (2012) show for the US that the difference in teaching time by maternal education is largest when there is a child aged three to five years in the household and largest for physical care and playing when children are even younger.

The present approach extends the literature by including both parents' education and caring behavior. By exploring the distribution of the time with children, the study sep-

[13] For German fathers the effect is positive and quantitatively similar to Norway.

[14] See also Bryant and Zick (1996) for an early US study including age.

arates the effect of education on the decision about the available time for children from the decision about the usage of this time. The analysis does not rely on interaction terms, as Kalil et al. (2012), but investigates the child-age groups separately. Hence it allows factors, such as the number of siblings, to have heterogeneous effects across age groups.

1.3 Data and Relevant Variables

1.3.1 Dataset and Sample Selection

This analysis is based on the 2001/2002 wave of the German Time Use Survey (GTUS). The data is provided by the German Federal Statistical Office. This national representative survey includes 5400 households with 37700 collected diaries, based on 10 minute intervals from household members that were at least 10 years old. Each household member was asked to fill in the diary on two days during the week and one weekend day. This way of reporting makes diary data more reliable and accurate compared to stylized questions about average time use in large surveys (UN Statistical Division, 2005; Kan and Pudney, 2008). The GTUS includes 272 activity codes for primary and secondary activities. Among these activities 11 are directly related to childcare.

The present study focuses on couples with children in West Germany. Due to a different history of family policies that had a strong influence on norms and the availability of public daycare, it is not reasonable to combine the samples for East and West Germany. Less than one-fifth of the observations were made in the area of East Germany. The sample size is too small for a separate analysis.[15]

The analysis does not distinguish between social and biological parents. The woman in the couple-household is considered to be the mother and her partner is called father in the following. The analysis is based on 'usual' parents, defined by mothers, who are not more than 45 years older and fathers who are not more than 55 years older than the youngest child in the household.[16] As common in the literature, teenage parents are also not considered.[17] The analysis exploits the fact that the GTUS has the special feature of being a multi-member time use survey, by only including parents for whom the partner's time use is observed at the same day. This way the estimation actually captures the interaction of parents.[18]

Three groups of households are considered. The first one with a child aged zero to three years (toddler), the second one with a youngest child aged four to six years

[15] With an even smaller share of these individuals having children in the relevant age group.
[16] There is no biological restrictions for fathers, hence fathers are often older than mother.
[17] Parents are restricted to be 20 years older than the youngest child.
[18] Nearly all parents reported their time use on the same days.

(preschool age) and the third group with a youngest child that is between seven and nine years old (school age). These three groups represent different stages of child development and, as such, children with different needs. At the same time, as argued in Section 1.2.1, the supply of institutional care differs strongly between these groups. A separate analysis has much more potential to give insights into the role of parental caring time in the child development process than estimates for the aggregation of all households with children under the age of 18, as it is most often done in the literature.

1.3.2 Defining Educational Levels

This study follows the definition of educational levels used in the German Socio-Economic Panel (SOEP) with a slight modification in the highest education group. This definition is based on ISCED-1997 classification and is a close proxy for a measure of years of schooling. Different to the SOEP, the groups of university and technical college educated parents are split because they turn out to behave differently. Parents who are in training in the observation period are excluded because their educational level is difficult to determine. This leads to the following ranking:

1. University
2. Technical College
3. Vocational Training plus *Abitur*= Voc.+*Abitur*
4. Vocational Training without *Abitur* = Voc. } *Reference*
5. No Training } *Group*

The university-/technical-college-entrance diploma in Germany is called *Abitur*. It is the highest high-school degree and is reached after 12 or 13 years of schooling.[19]

In the analysis the reference group consists of parents with vocational training who left school before they reached the *Abitur* and individuals with no training. Table 1.3.1 reveals that the group without training is rather small. On its own it would not provide an appropriate reference group. The results are, however, robust to excluding these observations (see Section 1.5.4).

The analysis includes the parent's individual education and in addition his or her spouse's education. Including the spouse's education is an extension to most of the existing research and captures relative 'strength' of the partners.[20] There is a considerable

[19]The technical-college-entrance-exam is actually called *Fach-Abitur* and is reached after 12 years. The *Abitur* do not necessarily lead to a university or technical college degree because a large share of individuals opt for an apprenticeship or vocational training, even with *Abitur*. The distribution across educational levels seem to be representative. As common, the largest share of Germans in this age group left school after grade nine or ten. The share of parents with *Abitur*, but no university degree is also comparable to the statistics (see BMBF, 2012, Tables F1-1A and F3-1A).

[20]Groups would become too small if one would in addition allow for interactions.

Table 1.3.1: Distribution of Education for Mothers and Fathers - All Groups

	Mother		Father	
	Observations	Percent	Observations	Percent
University	166	9	282	15
Techn. College	187	10	213	11
Voc.+*Abitur*	402	21	253	13
Voc.	1,028	56	1,075	59
No Training	81	4	37	2
Total	1,908	100	1,908	100

Source: GTUS 2001/02, own calculation.

pattern of assortative mating by education (see Table 1.B.1), which is a common phenomenon in modern societies (e.g. Blossfeld and Timm, 2003).

1.3.3 Outcome Variables

The following two types of caring time are relevant for the analysis:

- Time with Children (*TwC*):
  This variable sums up all of the time for which a parent reports that a child is present (also referred to as parent-child shared time), i.e. this measure also includes the time when a mother is preparing meals and a child is in the kitchen. In the GTUS parents were only asked to tick a box if a child aged nine years or younger was present.[21] This information is not available for older children.
- Primary Care (*Care*):
  This variable sums the time spent on the three caring activities, described in the next paragraphs, when they are reported to be the primary activity. Primary activities are the parents' number one choice of time use, hence these activities can best be interpreted as intensive or focused caring. To create a comparable measure to *TwC*, only activities that are conducted when a child aged nine years or younger was present are counted.[22]

These time use variables are expressed in minutes per day. Time use data provides unique information on how parents spend the time with their children. The second part of the study focuses on how parental education affects the distribution of the time shared by parents and children to specific childcare activities. Given that a parent decided to spend a certain amount of time with his or her children, the question is which care activity he or she predominantly conducts in this time.

[21] A similar measure as *TwC* is used by (Stafford and Yeung, 2004) and Guryan et al. (2008a).

[22] This does not strongly affect the amount of childcare time. Not surprisingly in most families the majority of childcare time is also spent with the younger children.

For this analysis a measure is created which relates the time devoted to a specific care activity to the total time spent with children (*TwC*):

$$Share_z = \frac{Time\ use\ for\ Activity\ z\ with\ child\ aged \leq 9\ was\ present}{TwC} \tag{1.1}$$

where z either refers to *Care* or to one of the three considered subcategories of *Care*. Proceeding this way, one obtains a measure that can be interpreted in terms of childcare intensity and as the expression of the parent's preference for a certain type of care. Considering specific care activities is a possibility to move beyond an emphasis of quantities of parental time with children to some typology of time quality (Folbre et al., 2004). Educational differences in the size of the share of *TwC* that is devoted to a certain activity can be seen as one mechanism fostering differences in child development.[23]

Following Kalil et al. (2012) and Craig (2006) the sub-categories of *Care* are defined to allow a judgment about 'sensitive parenting', because each activity is suited to specific developmental needs, i.e. intellectual, physical or social development (Stafford and Yeung, 2004), and of varying importance depending on the child's age. The following definitions are applied:[24]

- Physical Care (*Physical*): Body care, supervision and other care.
- Playful Care (*Play*): Playing, exercising (sports) and cuddling.
- Educational Care (*Educ*): Talking to the child, reading to the child and giving instructions, teaching the child and helping with homework.

Just as for *Care* only primary activities and time periods with a child up to the age of nine years are considered. If, for example, a mother devotes 15 minutes to playing with one of her children that is not older than nine years in the morning and in the afternoon she devotes 20 minutes to playing with only an older child present, then *Play* solely counts the 15 minutes in the morning.

Physical care activities can be assumed to ensure the child's physical well-being and health, but not particularly cognitive development. Playful care includes activities that are assumed to foster the child's motor and behavioral development. Educational care activities have a stronger association with cognitive development. Particularly, playful care and educational care can be seen as investments, but can also be expected to provide utility directly. The instructional part of educational care can be assumed to be mainly performed as an investment, as its influence on human capital development is more obvious and the

[23] This is particularly the case if it is assumed that highly educated parents have better access to high-quality non-parental care.

[24] GTUS codes: *Physical*: zh380, zh381, zh389; *Play*: zh383, zh385; *Educ*: zh384, zh388, zh382.

task itself seems less enjoyable than other care activities.[25]

Physical care is particularly important for toddlers. Playful care activities are of high relevance for toddlers and preschool children, while educational care becomes more and more relevant when children grow older and are enrolled in school. If education affects how well parents adapt to children's age-dependent needs, one would expect a change in the effect of education on the time devoted to these activities with the child's age.

1.3.4 Controlling for Confounding Factors

Section 1.4 further explains the estimation approach and the econometric models. Every model discussed there is based on the following specification:

$$Care_i = \alpha + \sum_{j=1}^{3} \beta_j E_{ji} + \sum_{k=1}^{3} \gamma_k EP_{ki} + \mathbf{C_i'}\delta + \varepsilon_i \tag{1.2}$$

where E refers to the parent's own and EP to his or her partner's education in family i, as defined in Section 1.3.2. With the aim to capture as many confounding factors as possible, three sets of control variables are included in $\mathbf{C}$ (see Table 1.B.2 for summary statistics).

i) Time use data does not inform about the addressee of childcare time. In households with more than one child it is not plausible that a child benefits from all conducted childcare. As differences in child development can only be explained based on the knowledge of how much and what kind of childcare a child receives, it is necessary to control for family composition. One might underestimate the effect of education without precisely controlling for the number of children, because on average highly educated parents have fewer children. Disregarding the age of the children might lead to an overestimation, as there is evidence that highly educated mothers space births more closely (e.g. Gerster et al., 2008). Given the age of the youngest child, their children are on average younger, hence more demanding and less likely to take over caring responsibility for younger siblings. For this reason, the models do not only include a linear measure of the age of the youngest child in years, but also the number of children in different age groups living in the household (8 groups).[26]

ii) To separate the education effect from other factors related to education the specification includes the mother's and father's age (quadratic), binary variables indicating whether the parents are married and whether they are German citizens.[27] The study adheres

[25] Appointment time and travel related to childcare are not considered. Travel times are to a significant part not spent with the child. Furthermore, these activities are difficult to classify in terms of their effect on human capital development.

[26] 0-1, 2-3, 4-5, 6-7, 8-9, 10-12, 13-15, 16 years and older.

[27] Excluding parents without German citizenship leaves the estimates basically unchanged. Only two percent of GTUS is of foreign nationality, as writing German was an essential for filling out the diaries.

to the estimation of a *gross* effect of education, meaning that the analysis focuses on whether there is an educational difference in caring that could explain observed disparities in child development, but does not aim to further split this effect. Hence it is not controlled for household income and wages. A next step would be to analyze whether educational differences occur due to differences in knowledge, preferences or financial freedom. There is not enough information in the time use survey to plausibly calculate predicted hourly wages.[28] Furthermore, available income measures are endogenous, because childcare and working time and so consequently earnings, are highly correlated (e.g. Bianchi, 2000). This also applies to the labor market status, as it is a proxy for the daily working hours.[29] These variables are not included.

iii) The third set of control variable captures further channels that affect the relationship between education and childcare time. Accessibility of everyday commodities is approximated by whether a physician is in walking distance (20 minutes). Whether the family has to commute long distance is captured by a dummy indicating that a high school is not particularly far away (less than 70 minutes to walk). In addition the specification controls for other time consuming responsibilities by whether an adult in the household is in need of care and the models control for the three 'unusual' days of the week (Friday, Saturday, Sunday) and the seasons (2nd, 3rd, 4th quarter of the year).

Two further restrictions are applied to ensure comparability or overlap between educational groups. Households with sick children are excluded. A sick child strongly affects the allocation of time. Even if this event were assumed to happen randomly, on only three diary days the occurrence is disproportionally distributed across educational groups.[30] Observations are excluded if there exists no observation with similar old children (no counterfactual) in the other educational groups. This mainly affects observations of parents with low levels of education. Without this adjustment the model would rely more heavily on extrapolation.[31] Similarly, the number of children is restricted to four, because among parents with high education there are no families with more than four children. Given the restrictions about 3600 diaries remain for the analysis.

[28] Particularly exact occupational information and labor market history are missing.

[29] Gimenez-Nadal and Molina (2013) include non-labor household income, calculated by subtracting individual earnings from total household income. Income information is reported in intervals, so the measure is very fuzzy. It is also not clear whether this measure is exogenous in the present setting. Therefore, the main results presented in this study are derived without controlling for non-labor income. Including this measure does not change the conclusions.

[30] A sick child is identified by one parent caring for a sick child on the diary day. Including parents who care for a sick child does not change the main conclusions. Only in the youngest group the effects become slightly weaker.

[31] The upper limited is defined by taking the lowest value for the age of the oldest child in the highest education groups. The ages are 13, 16 and 18 years, respectively. Relaxing these constraints does not change the main conclusions (see Section 1.5.4).

In time use research it is common to use weighted data (see e.g. Guryan et al., 2008a; Ramey and Ramey, 2010; Gimenez-Nadal and Molina, 2013). The survey weights provided in the GTUS are designed to correct for disproportionate reporting behavior related to the diary day and ensure that the weighted sample is representativeness. Quota sampling, which is used for the GTUS, provides an additional argument for weighting because the employment status is a target. Econometric research dealing with sampling weights suggests that if there is endogenous sampling, which means that a sampling criterion is correlated with the outcome and as such with the error term, a weighted regression is preferred (Solon et al., 2013; Winship and Radbill, 1994). Furthermore, it is not possible to observe all factors that are relevant for sampling, particularly information on the state and the community size are not available. Weighting is one option to correct for these factors.

This setting in this analysis blocks as many channels as possible to uncover the differences by parental educational. Reverse causality, meaning that a parent changes his or her education decision, because he or she has to care for the child, is not very likely to distort the estimates. However, it cannot be ruled out that there are unobserved factors that are correlated with education and caring behavior. One's own caring experience, attitudes as well as career and family preferences could be correlated with education. These preferences might have a weaker influence on the analysis of the share of *TwC* used for specific care activities as the decision about the available time for children, i.e. the work-life decision, is taken as given. Some factors, such as the interest in the child's school performance, should rather be interpreted as mediators and not as confounders. Nevertheless, without knowing more about the parents' history and attitudes, the estimated educational differences should not solely be contributed to schooling.

1.4 Econometric Models

Time use data should be treated carefully. Estimates can be biased if the empirical method does not account for its special features. The most crucial point is the distribution of the data. For a non-negligible group of individuals the time reported for a certain activity is zero. The distribution of the dependent variable is therefore censored and skewed. Only for mothers with toddlers and preschool aged children the distribution of *TwC* is not strongly censored (see Figure 1.B.1 to Figure 1.B.3). For the subcategories of *Care* the phenomenon becomes even more pronounced.

So far there has been no general agreement on the correct approach to deal with these zero-values. Many studies rely on tobit models, but Stewart (2013) shows that the standard tobit estimates are likely to be biased in time use studies. The reasoning behind this is that the reference period in time use surveys is rather short, but one aims to make infer-

ences about time use in the long-run. In diary data observing a time use of zero mainly arises from a mismatch between the reference period (the diary day) and the period of interest. However, the tobit model assumes that a zero means that an individual never devotes any time to the considered activity. Likewise Daunfeldt and Hellström (2007) reject the tobit model because it makes the restrictive assumption that the process determining whether an individual engages in an activity is the same one that governs how much time is spent on that activity.

This paper follows researchers such as Daunfeldt and Hellström (2007) and Stewart (2013) who argue in favor of a two-part model (*2PM*) over a tobit model for time use data.[32] The term 'two-part model' is often used interchangeably with 'hurdle-model' and refers to a class of approaches that model the participation $(Care > 0)$ and the consumption decision $(Care|Care > 0)$ as separate processes, thus relaxing the extreme assumption of a single decision made by the tobit model (e.g. O'Donnell et al., 2008, chapter 11).[33] Consequently, these models allow the impact of education and other factors on the decision to perform an activity on a specific day to be different from its impact on the actual amount of time allocated to that activity once the activity is conducted.[34]

The *2PM* in this paper can be conducted in two steps: a binary model determining participation in the first step and a regression on the subset of observations with positive values in the second step. It can be represented as follows. In a first step individuals decide whether to spend any time caring:

$$D_i = \mathbf{X}_i'\beta_1 + \varepsilon_{1i} \tag{1.3}$$

where $\mathbf{X}_i$ is a vector of all right-hand variables. $D_i > 0$ indicates that $Care_i > 0$ and zero otherwise. The second part is given by

$$(Care_i|D_i > 0, \mathbf{X}_i) = \mathbf{X}_i'\beta_2 + \varepsilon_{2i}. \tag{1.4}$$

Stewart (2013) argues that the results of this approach are very similar to other estimation procedures for models of this class, such as the Cragg (1971)-hurdle model. The approach chosen in this paper has the advantage that it is not necessary to assume a normal distri-

[32] Blundell and Meghir (1987) similarly favor the two-part model when dealing with estimation of long-run consumption of goods (instead of time) from expenditure data.

[33] See Jones (2000) for discussion of these types of models. The models are mainly distinguished by the assumptions on the relationship between participation and consumption decision.

[34] The underlying assumption is independence of the two decisions. The *2PM* maintains that the level of usage, given any usage is conditional independent of the decision to use. Selection or Heckman-correction models, a variant of this class of models, allow for some interdependence between the processes by including the inverse mills ratio in the second part (e.g. O'Donnell et al., 2008; Wooldridge, 2010). Selection models only clearly outperform the *2PM* with a good exclusion restriction (e.g. Leung and Yu, 1996). There is no plausible exclusion restriction available in the present setting. Jones (2000) argues that the *2PM* is also favorable over the selection model if zero consumption is a choice rather than a non-observable response.

bution for the second part. This property is exploited in the estimation of the distribution of *TwC* to specific care activities.

Dividing the time spent on an activity by *TwC* leads to a dependent variable that can be interpreted as a fraction. Distributions of fractions can lead to heteroscedastic error terms and non-linearities in the effects. Therefore, in this case the *2PM* is extended to take into account the specific characteristics of fractional variables by using a fractional logit model (*FLogit*) for the second part (see Ramalho et al., 2011). This approach was made popular by Papke and Wooldridge (1996). It has not yet been used very frequently for the analysis of time use data. Recent exceptions are Mullahy and Robert (2010) or Cardoso et al. (2010). The approach is suitable for fractional outcome variables that are as such bounded between zero and one. For bounded variables it is not plausible to assume that the effect of any explanatory variable is constant throughout its entire range. The linear model and also its transformation to a least squares log-odds ratio model is problematic because it does not guarantee that the predicted values of the dependent variable are restricted to the unit interval (Wooldridge, 2010).[35] Hence, the motivation for the *FLogit* is similar to the one that argues in favor of the logistic model over the linear probability model for binary dependent variables.

The *FLogit* uses a quasi maximum likelihood estimation strategy based on a Bernoulli log-likelihood. The dependent variable is modeled as a logistic function, which is well defined for the boundary values of zero and one:

$$E(Care_i|\mathbf{X}_i) = \frac{exp(\mathbf{X}_i'\beta_2)}{[1+exp(\mathbf{X}_i'\beta_2)]}. \tag{1.5}$$

All models use a probit in the first step. The second part in the analysis of the total amount of *TwC* and *Care* is based on a linear regression, while the second part in the analysis of the allocation of *TWC* to the care activities is based on the *FLogit*.[36] Only the estimations of maternal *TwC* in the group with a toddler and in the group with a youngest child in preschool age are performed by ordinary least squares (OLS) because censoring here is nearly not existing (see Figure 1.B.1 to Figure 1.B.3).

Results are presented as average marginal effects, calculating the derivative of

$$E(Care_i|\mathbf{X}_i) = Pr(Care_i > 0|\mathbf{X}_i) * E(Care_i|Care_i > 0, \mathbf{X}_i) \tag{1.6}$$

with respect to education. The first part of Equation (1.6) gives the predicted probability

[35] It is also not simple to recover $E(Care_i|\mathbf{X}_i)$ (Papke and Wooldridge, 1996; Ramalho et al., 2011).

[36] Fractional logit models can be estimated in Stata using the *glm* procedure for generalized linear models with a binomial family, a logit link-function and standard errors that correct for heteroscedasticity. The more advanced two-part version can be estimated by a similar procedure implemented by the user-written procedure *tpm* (Belotti and Deb, 2013).

to allocate any time to a specific type of childcare. The second part measures the effect on the amount of childcare time given that a positive amount of time is spent on caring. The average marginal effects are derived using the finite-differences method. This is preferable for binary variables, such as education, because it calculates the change from zero to one by comparing the predicted outcome for the two groups, instead of scaling up an infinitesimally small change to correspond to a large change (Cameron and Trivedi, 2010, chapter 10).[37]

The GTUS collects diaries on three days, hence the standard errors in the regressions are corrected for clustering at the individual level to account for the dependencies between observations. It may seem intuitive to incorporate the dependence between the time use decisions of parents by allowing for cross-equation correlations between the error terms within a family. However, Zellner (1962) shows that in the present setting the estimation of the system is equivalent to estimating each equation separately, because all equations contain the same explanatory variables.

Based on her simulation exercise, Stewart (2013) prefers the OLS model to the tobit model and in some case also to the *2PM*.[38] The OLS model and a 'one-part' *FLogit* are hence performed as a robustness check. Similar to Foster and Kalenkoski (2013) and Gimenez-Nadal and Molina (2013) qualitative conclusions turn out to be consistent for the two estimation methods (see Section 1.5.4).

1.5 Empirical Findings

1.5.1 Time with Children *(TwC)*

Table 1.5.1 shows the estimation results for *TwC* based on the specification given in Equation 1.2 for the three age groups. These estimates reveal that there is no positive relationship between a parent's education and the time he or she spends with the children. Maternal university education even has a negative effect on her *TwC* in two out of three groups.

Families with a toddler

If there is a child zero to three years old in the family, the amount of time university educated mothers spend with their children is more than 65 minutes per day lower than in the reference group.[39] Though the difference for maternal technical college education

[37]The calculus method leads to slightly higher significance levels in some cases, but the estimated marginal effects are comparable. In case of OLS the coefficients equal the average marginal effects.

[38]This seems to be particularly the case when the decision to participate in an activity on a certain day strongly depends on the covariates or when the zero values can be assumed to present measurement error (see also Foster and Kalenkoski, 2013).

[39]Reference group: vocational training without *Abitur* or not training (see Section 1.3.2).

and vocational training with *Abitur* is positive, it is not statistically different from zero.

Maternal university and technical college education raise the partner's *TwC*. This effect is with more than 100 minutes particularly large for maternal university education. This reveals that fathers in families with a university educated mother (over-)compensate for their spouse's lower amount of *TwC* by devoting much more time to the children. The

Table 1.5.1: *TwC* - Average Marginal Effects

	Age Youngest 0-3		**Age Youngest 4-6**		**Age Youngest 7-9**	
TwC	Mother	Father	Mother	Father	Mother	Father
M: University	−65.63*	102.75***	−8.97	14.72	−72.36*	−54.41
	(36.97)	(38.57)	(35.18)	(27.23)	(38.69)	(34.38)
M: Techn. College	48.17	78.19*	−59.39	−21.31	1.21	26.20
	(45.58)	(46.38)	(40.26)	(32.26)	(37.40)	(30.62)
M: Voc.+*Abitur*	22.45	−16.34	16.32	−37.58*	36.46	17.09
	(27.28)	(21.55)	(28.05)	(22.66)	(25.54)	(24.25)
F: University	6.48	−47.63*	33.08	−7.52	47.94*	47.58
	(34.40)	(25.62)	(32.39)	(27.19)	(27.15)	(34.80)
F: Techn. College	20.66	3.32	72.80*	69.16**	53.95**	24.07
	(31.13)	(27.93)	(43.37)	(34.93)	(23.87)	(22.29)
F: Voc.+*Abitur*	−43.33	−0.33	−57.22*	51.02	104.81***	36.18
	(43.66)	(38.78)	(30.04)	(34.64)	(38.61)	(29.02)
Observations	666	666	564	564	601	601
Mean	522.13	284.38	383.19	239.46	303.17	193.42

Notes: M=Mother, F=Father. Results based on *2PM-OLS* models, only estimates for mothers in the groups with children aged 0-3 and 4-6 are based on one-part specifications (no censoring). Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, German nationality mother/father, weekdays, seasons, adult in need, physician/high school in walking distance. Reference group: Vocational training and no training. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: significance at the 10-/5-/1-percent level. Data is weighted. Weights are provided by the Federal Statistical Office.
Source: GTUS 2001/02.

observed lower level of *TwC* by university educated mothers occurs with a higher level of working time (see Table 1.C.2).[40] In addition, these families are significantly more likely to employ non-parental formal care and informal care (see Table 1.C.1).

Maternal university education leading to a substitution of maternal time with market goods, as well as its effect on the division of responsibilities between partners are consistent with the theoretical predictions of the economic household models. The finding that maternal university education has a particularly strong effect when her partner has a lower 'market value', i.e. is not university educated, also meets the theoretical expectations.

This pattern does not provide a clear explanation for educational differences in child

[40]There is no clear pattern for non-care related activities conducted when children are present. Highly educated mothers seem to reduce the share of *TwC* devoted to leisure activities.

development, as children of highly educated parents do not unambiguously spend more time with their parents. Although summing maternal, paternal and non-parental caring time, these children could in fact be more closely supervised. As there is no detailed information available about the time children spend in non-parental care, this cannot be further investigated.

Families with a child in preschool age

Within the group of families with the youngest child in a preschool age bracket, there does not exit a clear pattern of parental education and time spent with children, neither for mothers, nor for fathers.[41] Compared to the families with toddlers it is an interesting finding that the mother's university education has no clear negative impact anymore. This could be the result of the reduction of incentives for low educated mothers to refrain from participating in the labor market because of lower financial support and better access to daycare. In line with this argument is the smaller effect of maternal university education on working time and formal care usage (see Table 1.C.2 and Table 1.C.1) and the lower level of time spent with children on average (see last row of Table 1.5.1).

Families with a child in school age

When the youngest child is in primary school, the relationship between maternal university education and her time with children is, again, negative. In this group her partner also spends less time with children (even if this effect is not highly significant). If the father has a higher educational level than the reference group both partners seem to share more time with their children, which may be an income effect.

Similar non-positive effects on time with children have been previously found in the rare studies on parent-child shared time (e.g. Bryant and Zick, 1996; Guryan et al., 2008a), but few find negative effects (see Stafford and Yeung (2004) as an exception). One reason may be that families with children of different ages are not analyzed separately. The findings in the group of families with toddlers suggest that the compensating behavior between parents previously found, is particularly strong for highly educated parents (e.g. Hallberg and Klevmarken, 2003; Kitterød and Pettersen, 2006; Hsin and Felfe, 2014).

1.5.2 Childcare Time *(Care)*

The education gradient in *Care* in Table 1.5.2 is found to be more positive than for *TwC*. However, contrary to most US findings it is not unambiguously positive.

Families with a toddler

In families with a toddler the childcare time of mothers with a university education is lower than in the reference group, but the effect is insignificant and much smaller than

[41] Only if the father has a technical college education is *TwC* clearly higher.

for *TwC*. In addition, paternal childcare time by more than half an hour per day higher if the mother is university of technical college educated, leading to more parental childcare time in total in families of highly educated mothers.

Table 1.5.2: *Care* - Average Marginal Effects

	Age Youngest 0-3		**Age Youngest 4-6**		**Age Youngest 7-9**	
Care	Mother	Father	Mother	Father	Mother	Father
M: University	−13.49	32.61***	24.01**	1.35	25.49**	15.38*
	(16.08)	(11.97)	(10.83)	(6.91)	(12.99)	(8.32)
M: Techn. College	31.08	36.24*	10.49	−3.79	24.52**	13.32
	(23.46)	(19.29)	(12.18)	(6.70)	(12.27)	(8.45)
M: Voc.+*Abitur*	16.53	−3.88	1.59	−2.37	−4.82	2.37
	(14.15)	(7.88)	(6.11)	(5.98)	(5.51)	(3.61)
F: University	0.12	−4.42	4.00	8.67	−14.00*	−1.16
	(15.67)	(10.48)	(8.75)	(7.15)	(8.33)	(4.74)
F: Techn. College	−3.45	−5.33	−10.58	13.33**	2.40	1.43
	(18.79)	(11.53)	(9.88)	(6.65)	(7.57)	(4.07)
F: Voc.+*Abitur*	−7.14	−7.37	−26.93***	−6.46	1.33	1.38
	(15.35)	(13.25)	(9.13)	(5.53)	(8.07)	(4.94)
Observations	666	666	564	564	601	601
Mean	150.39	65.95	65.32	31.32	46.44	19.29

Notes: M=Mother, F=Father. Results based on *2PM-OLS* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, German nationality mother/father, weekdays, seasons, adult in need, physician/high school in walking distance. Reference group: Vocational training and no training. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Data is weighted. Weights are provided by the Federal Statistical Office.
Source: GTUS 2001/02.

Families with a child in preschool age

An interesting finding also emerges in the group of families with the youngest child in preschool age. Even if there is no clear difference in *TwC*, maternal education clearly increases maternal childcare time. Similar levels of *TwC*, but higher levels of *Care*, suggest that highly educated mothers spend the time with their children more intensively. The father's education only counteracts the positive effect of maternal education if he has a vocational training and *Abitur*. However, the majority of highly educated mothers are in a relationship with a man with a university or technical college education (see Table 1.B.1).

Families with a child in school age

The difference in the effect of education on *TwC* compared to its effect on *Care* is even larger in the group with school aged children. Maternal university and technical college education clearly positively influence the amount of time a mother and a father devote to childcare activities. In line with related research, the parent's childcare times act complementary in this group (see also Hallberg and Klevmarken, 2003; Bonke and

Esping Andersen, 2011). If one parent devotes more time to childcare, as it is the case for highly educated mothers, the partner also devotes more time to childcare activities.

The findings for *Care* agree with Gimenez-Nadal and Molina (2013) who argue for Spain and the UK that maternal education is the driving force behind parental caring times. The patterns across the three groups of families with children in different development stages suggest that highly educated mothers do not believe that they are able to make a difference by devoting more time to childcare when children are young, but that this perception changes when children become older. Given the varying relationship between education and caring times across child-age groups, it is not surprising that previous studies found a very small impact of education on maternal care time for Germany, when all families with children under the age of 18 years are analyzed together (e.g. Sayer et al., 2004b; Guryan et al., 2008a).

1.5.3 Distribution of *TwC* to Care Activities

The findings in Section 1.5.1 and Section 1.5.2 do not imply that children of highly educated parents spend more time with their parents during their childhood, but rather that these parents devote more time to caring when children are present. Therefore, this section follows the hypothesis that it is not mainly the quantity but rather the quality of chosen time inputs, i.e. the way of caring, that makes the difference. If parental education mainly increases the share of *TwC* devoted to care activities that are assumed to foster child human capital development, it would indicate that the behavior of highly educated parents is relatively more strongly influenced by investment motives.

Estimates presented in column one and column four of Table 1.5.3, Table 1.5.4 and Table 1.5.5 reveal that parents with high education backgrounds, i.e. either he or she is highly educated, are in nearly all groups more focused on their children. Hence when children are present, highly educated parents devote less time to other activities and more time to activities that directly address their children. Only in households with toddlers, do highly educated mothers not allocate significantly more *TwC* to *Care*.

Examining the average proportion of the time with children that is used for specific care activities reveals that all parents, independent of their educational background, adjust to the children's age-dependent needs (last rows in Table 1.5.3 to Table 1.5.5). In the group of families with a toddler, on average, a large proportion of *TwC* is used for physical care. This share decreases when children become older. A similar picture can be found for playful activities, while the average share of *TwC* used for educational care increases with the age of the youngest child.

The conditional estimates, however, reveal that there exist educational differences in the strength of adjustment. For mothers, a positive education gradient can be found in the

Table 1.5.3: Activities as Share of *TwC* (Age 0-3) - Average Marginal Effects

	Mother (*n=671*)				**Father (*n=644*)**			
	Care/ TwC	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*	*Care/ TwC*	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*
M: University	0.002	−0.034*	0.043*	−0.002	−0.004	0.017	−0.023	0.007
	(0.029)	(0.020)	(0.023)	(0.007)	(0.032)	(0.020)	(0.024)	(0.010)
M: Techn. College	0.028	0.001	0.029	0.001	0.038	0.021	0.034	−0.007
	(0.030)	(0.020)	(0.018)	(0.008)	(0.036)	(0.019)	(0.025)	(0.009)
M: Voc.+*Abitur*	0.019	0.001	0.028*	0.001	−0.008	0.006	0.008	−0.005
	(0.024)	(0.017)	(0.016)	(0.005)	(0.028)	(0.019)	(0.020)	(0.008)
F: University	0.015	0.016	−0.003	−0.004	0.082**	0.095***	−0.029	0.026**
	(0.028)	(0.021)	(0.013)	(0.006)	(0.036)	(0.029)	(0.020)	(0.013)
F: Techn. College	0.004	−0.006	0.010	−0.003	0.026	0.023	−0.009	0.016
	(0.030)	(0.017)	(0.016)	(0.005)	(0.030)	(0.022)	(0.022)	(0.014)
F: Voc.+*Abitur*	0.031	0.037*	−0.009	0.007	−0.005	−0.007	−0.010	0.037*
	(0.027)	(0.021)	(0.014)	(0.007)	(0.030)	(0.019)	(0.021)	(0.020)
Mean	0.290	0.179	0.086	0.025	0.256	0.118	0.116	0.023

Notes: M=Mother, F=Father. Results based on *2PM-FLogit* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, German nationality mother/father, weekdays, seasons, adult in need, physician/high school in walking distance. Reference group: Vocational training and no training. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Number of observations slightly reduced compared to Table 1.5.1 and Table 1.5.2 because the ratio is only available for non-zero values of *TwC*. Data is weighted. Weights are provided by the Federal Statistical Office.
Source: GTUS 2001/02.

share of *TwC* devoted to playful activities in the group of families with toddlers. In this group, particularly university educated mothers seem to save time for other activities by reducing physical care activities. Physical care activities are less likely to yield 'process benefits' and it may be easier to find appropriate substitutes for these activities than for others.

When the youngest child is in preschool age, maternal education starts to make a difference in the share of *TwC* devoted to educational activities. Mothers in the control group use the smallest share of *TwC* for educational care. However, only for university educated mothers is the difference (with 3.7 percentage points) significantly different from zero. A more detailed analysis, not presented here, shows that this is mainly driven by reading to and talking to children.

An even more distinct picture appears in the group with school aged children. Here families with university educated mothers are outstanding. The mothers in these families invest more intensely in their children's human capital development by distributing more available time with children to educational activities. Not surprisingly, additional estimates, not shown here, reveal that this is mainly driven by differences in teaching and

Table 1.5.4: Activities as Share of *TwC* (Age 4-6) - Average Marginal Effects

	Mother (*n=603*)				**Father (*n=576*)**			
	Care/ TwC	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*	*Care/ TwC*	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*
M: University	0.082***	0.020	0.022	0.037**	0.043	0.003	0.016	0.015
	(0.029)	(0.019)	(0.018)	(0.018)	(0.039)	(0.023)	(0.025)	(0.018)
M: Techn. College	0.080*	0.031	0.026	0.024	−0.000	−0.011	0.006	0.001
	(0.042)	(0.025)	(0.019)	(0.017)	(0.035)	(0.018)	(0.021)	(0.013)
M: Voc.+*Abitur*	0.015	−0.009	0.004	0.013	−0.003	−0.011	0.007	−0.010
	(0.019)	(0.011)	(0.009)	(0.010)	(0.022)	(0.015)	(0.016)	(0.008)
F: University	−0.004	0.009	−0.025***	0.007	0.047	0.054**	−0.012	0.010
	(0.021)	(0.014)	(0.008)	(0.013)	(0.034)	(0.023)	(0.016)	(0.011)
F: Techn. College	−0.039	−0.010	−0.010	−0.021*	0.038	0.017	0.019	−0.000
	(0.026)	(0.017)	(0.010)	(0.011)	(0.033)	(0.026)	(0.022)	(0.009)
F: Voc.+*Abitur*	−0.041**	−0.002	−0.018*	−0.022**	−0.049**	−0.036***	−0.014	0.001
	(0.020)	(0.013)	(0.010)	(0.009)	(0.023)	(0.013)	(0.017)	(0.010)
Mean	0.182	0.094	0.044	0.044	0.162	0.072	0.063	0.026

Notes: M=Mother, F=Father. Results based on *2PM-FLogit* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, German nationality mother/father, weekdays, seasons, adult in need, physician/high school in walking distance. Reference group: Vocational training and no training. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Number of observations slightly reduced compared to Table 1.5.1 and Table 1.5.2 because the ratio is only available for non-zero values of *TwC*. Data is weighted. Weights are provided by the Federal Statistical Office.
Source: GTUS 2001/02.

helping with homework.

In line with findings for Spain (Gracia, 2014) and Australia (Craig, 2006), highly educated German fathers seem to make a difference by distributing a significantly larger proportion of *TwC* to physical care, when the youngest child is not yet in school. With a difference of nearly 10 percentage points this effect is particularly strong for university educated fathers in families with a toddler (see column six in Table 1.5.3). In addition they provide relatively more educational care when there is a toddler in the family. In families with school aged children it is the mother's and not the father's education that has a similar effect. Hence fathers with a high educational background mainly differ from those with lower education by contributing more parent-child shared time to activities that are argued to foster the child's security, physical well-being, and emotional stability (see Craig, 2006).

In summary, these findings suggest that highly educated mothers' caring behavior is more affected by investment motives than the caring behavior of lower educated mothers. The pattern becomes more distinct when children grow older and are more receptive to

Table 1.5.5: Activities as Share of *TwC* (Age 7-9) - Average Marginal Effects

	Mother (*n=607*)				**Father (*n=569*)**			
	Care/ TwC	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*	*Care/ TwC*	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*
M: University	0.093**	0.027	−0.006	0.077*	0.087**	0.069***	−0.009	0.023
	(0.040)	(0.019)	(0.010)	(0.042)	(0.038)	(0.026)	(0.017)	(0.026)
M: Techn. College	0.048	0.057***	0.015	−0.017	0.045	0.079***	−0.022**	−0.018
	(0.035)	(0.018)	(0.013)	(0.027)	(0.032)	(0.024)	(0.009)	(0.019)
M: Voc.+*Abitur*	−0.015	−0.005	0.005	−0.018	0.015	0.018	0.008	−0.018
	(0.020)	(0.009)	(0.008)	(0.017)	(0.021)	(0.011)	(0.014)	(0.016)
F: University	−0.034	−0.009	0.015	−0.024	−0.028	−0.013	0.010	−0.028*
	(0.026)	(0.011)	(0.016)	(0.021)	(0.023)	(0.013)	(0.017)	(0.015)
F: Techn. College	−0.012	−0.018**	0.003	−0.002	−0.007	−0.023**	0.028	−0.003
	(0.024)	(0.008)	(0.010)	(0.022)	(0.024)	(0.011)	(0.018)	(0.018)
F: Voc.+*Abitur*	−0.006	−0.009	0.022	−0.015	−0.004	0.001	0.025	−0.034***
	(0.028)	(0.010)	(0.017)	(0.024)	(0.028)	(0.014)	(0.024)	(0.012)
Mean	0.175	0.059	0.022	0.095	0.128	0.050	0.034	0.045

Notes: M=Mother, F=Father. Results based on *2PM-FLogit* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, German nationality mother/father, weekdays, seasons, adult in need, physician/high school in walking distance. Reference group: Vocational training and no training. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Number of observations slightly reduced compared to Table 1.5.1 and Table 1.5.2 because the ratio is only available for non-zero values of *TwC*. Data is weighted. Weights are provided by the Federal Statistical Office.
Source: GTUS 2001/02.

educational investments. As more than half of the university educated mothers are in a relationship with a university or technical college educated father, the findings also suggest that highly educated parents complement one another more than other parents by focusing on different types of care.

1.5.4 Robustness

Excluding parents with no training from the control group leaves the results essentially unchanged. For mothers and fathers with a toddler and for mothers with school aged children, the effect on the allocation of *TwC* to the care activities becomes slightly less pronounced. Lifting the restrictions on the age of the oldest child makes nearly no difference. As expected, if effects change, they become slightly less distinct. For the estimated differences in the share of *TwC* devoted to the care activities, the change lies in the small range of 0.001 to 0.003 percentage points. Controlling for family structure in detail already seems to lead to a good balance between the reference group and the groups with

higher educational levels.[42]

The estimation of a 'one-part'-model, i.e. OLS model, for total time use, leads to some minor changes in the estimated effects. However, only the difference in *TwC* for university educated mothers with the youngest child in school age is noticeably smaller in absolute terms (-42 minutes). The 'one-part' *FLogit* estimation for the allocation of *TwC* to specific care activities also shows that results are robust. The main effects become even more pronounced, but there are only changes at the third decimal place. According to Stewart (2013) the *2PM* might be biased when the covariates have an impact on whether zero time use is reported, while in this case the OLS is unbiased. However, these checks show that the qualitative conclusions in the present paper are principally the same for both approaches.

Re-estimation without weights does not change the estimated patterns but leads to a slight weakening of the effect of maternal university education, mainly in families with a toddler. This may be the case because the weights ensure representativeness also with respect to the employment level, which is not given by quota sampling. Couples with only one employed partner were, for example, over-sampled.[43]

1.6 Comparable Estimates for the United States

1.6.1 The US Sample

This section provides comparable estimates for the US. To keep the observation period as similar as possible, the 2003 and 2004 waves of the American Time Use Survey (ATUS) are combined to perform a similar analysis.[44] The ATUS provides nationally representative estimates of how, where, and with whom Americans spend their time. The ATUS can be linked to information from the Current Population Survey (CPS). This is particularly important as the ATUS is not a multi-member survey. Hence it neither contains the spouse's time use nor his or her education. Fortunately, it is possible to extract the information on the partner's education from the CPS data. However, it is not possible to investigate the caring behavior of parents in the same household. Another difference to the GTUS is that people surveyed had to recall the day in question in a telephone interview and were asked for each activity whether childcare was a secondary task. This might also lead to a slightly different reporting of childcare as the primary activity, but should

[42] Excluding precise controls for the children's age and further background factors slightly increases the estimated education gradient.

[43] As discussed earlier this may speak for a case of endogenous sampling (Solon et al., 2013).

[44] The ATUS is provided by the Bureau of Labor Statistics. The sample size in the preschool and school group is not very large, even after combining the two ATUS waves. The share of couple parents within the sample seems to decrease with child age.

not strongly affect the main results (see Harvey, 1993; Kitterød, 2001).[45]

In the ATUS individuals reported directly whether and which household member or other person was present when the activity was performed. From this knowledge comparable measures for *TwC* and *Care* can be calculated. As with the GTUS for *TwC* all time periods for which a respondent states that an own-household child, i.e. a child that belongs to the household, aged nine years or younger is present, are summarized. *Care* includes physical, playful, and educational care activities conducted with a child up to the age of nine years present.

The three caring types are defined such that they are comparable to the types for Germany.[46] Home schooling is not considered because it is not allowed in Germany and thus not comparable. There are small differences in the activity coding between the GTUS and the ATUS. The ATUS has, for example, no category of cuddling, but separates playing into more subcategories. Still, the patterns across these categories should be comparable to Germany.

Three educational levels are defined, each with a similar share in the sample. The reference group here consists of individuals with no college degree. The maximum level of education in this group is high-school graduate. The highest educational level is defined as Bachelor's degree or beyond (*Bachelor+*), i.e. Master's, Doctorate, followed by having an Associate degree[47] or some college education (*Associate*). Parents who are in training are excluded.

Again only couple households are considered.[48] Parents with sick children, more than four children and a relatively old child are also excluded.[49] The control variables are essentially the same as in the German setting. Instead of German nationality it is controlled for being black or otherwise non-caucasian. Region is controlled for using binary indicators for metropolitan status and the four cardinal directions. In addition a 2003 dummy is included to allow for differences between the two waves, for example, due to weather. Unfortunately, there is no similar information available about other caring responsibilities.

[45] Particularly the results of an analysis of the share of time with children used for several childcare activities should not be strongly affected.

[46] *Physical*: Physical care (t030101), Organization and planning (t030108), Looking for children (t030109), Other care (t030199), *Play*: Playing, no sports (t030103), Arts and crafts (t030104), Sports (t030105) and *Educ*: Reading to/with (030102), Talking/Listening (t030106), Helping/Teaching (t030107, only available in 2003, in the following years included in t030106), Homework (t030201).

[47] Bachelor's degree is most often a four year degree and Associate a two year degree.

[48] No people other than respondent, spouse and own household children live in the household.

[49] The exclusion of families with a relatively old child shall again ease comparison. In the US the oldest children are older in all education groups, hence the thresholds are 18, 21 and 23 years.

1.6.2 Findings for US Parents

In the US there exists a positive association between parental socioeconomic background and maternal *TwC* (see Table 1.6.1). However, it is the father's education that makes the difference. The mother's education even seems to counter this effect. The results given in Table 1.6.2 reveal a similar pattern for *Care*, but in this case maternal education has no significant negative effect. For both measures there is only a strong positive education gradient in households with a toddler.

Table 1.6.1: *TwC* - Average Marginal Effects (US)

	Age Youngest 0-3		**Age Youngest 4-6**		**Age Youngest 7-9**	
TwC	Mother	Father	Mother	Father	Mother	*TwC* Father
M: Bachelor+	−42.41**	−45.47	−46.94*	10.76	17.20	3.11
	(20.53)	(29.37)	(25.11)	(27.98)	(31.33)	(29.78)
M: Associate	−46.93**	4.23	−3.51	−24.15	−39.07	−36.28
	(19.29)	(22.06)	(23.89)	(22.75)	(24.49)	(24.89)
F: Bachelor+	62.70***	31.32	6.09	−37.93	−26.52	−4.25
	(19.00)	(24.41)	(24.33)	(25.27)	(26.17)	(28.07)
F: Associate	19.26	−4.40	−0.30	−21.92	−5.44	−20.07
	(20.36)	(19.12)	(23.55)	(22.33)	(25.46)	(23.32)
Observations	1505	1426	763	728	685	560
Mean	516.78	295.38	399.60	253.33	320.34	228.08

Notes: M=Mother, F=Father. Results based on *2PM-OLS* models, only estimates for mothers in the groups with children aged 0-3 and 4-6 are based on one-part specifications (no censoring). Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, black and other non-caucasian, weekdays, seasons, city, geographic directions, 2003-dummy, interactions of 2003-dummy with seasons. Reference group: No college. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Data is weighted. Weights are provided by the Bureau of Labor Statistics.
Source: ATUS 2003 & 2004.

In families with a high educational background, it may be the father's role to release financial pressure to the family and as such to allow the mother to devote more time to childcare. In the US, similar positive effects of the husband's income was found by (Hill and Stafford, 1980) and (Kimmel and Connelly, 2007). Different to Germany, there is no stronger substitution pattern for parents with a high education background compared to parents with lower education background in the group of families with a toddler. On the contrary, fathers with advanced education devote 17 minutes more to childcare in addition to their spouse's higher level of childcare time.

Similar to the findings by Hurst et al. (2010) and Kalil et al. (2012), these estimates suggest that the positive education gradient in childcare found in previous US studies is driven by parents with young children. Novel is that the effect of the father's education is dominant. If previous studies did not control for the father's education, this effect may

Table 1.6.2: *Care* - Average Marginal Effects (US)

	Age Youngest 0-3		**Age Youngest 4-6**		**Age Youngest 7-9**	
Care	Mother	Father	Mother	Father	Mother	Father
M: Bachelor+	−11.44	−5.38	7.28	2.95	6.13	9.82
	(11.96)	(9.89)	(9.10)	(8.91)	(7.71)	(16.37)
M: Associate	−15.78	10.64	1.92	2.92	8.09	−3.97
	(10.79)	(9.51)	(9.07)	(8.29)	(7.67)	(11.29)
F: Bachelor+	53.95***	17.52*	−6.25	1.26	−6.42	−14.30
	(10.88)	(9.73)	(9.04)	(7.91)	(7.13)	(12.42)
F: Associate	27.71**	6.92	−7.30	3.82	−3.21	−5.01
	(10.76)	(9.73)	(8.81)	(7.79)	(8.25)	(12.61)
Observations	1505	1426	763	728	685	560
Mean	166.86	70.48	88.99	39.82	53.74	31.67

Notes: M=Mother, F=Father. Results based on *2PM-OLS* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, black and other non-caucasian, weekdays, seasons, city, geographic directions, 2003-dummy, interactions of 2003-dummy with seasons. Reference group: No college. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Data is weighted. Weights are provided by the Bureau of Labor Statistics.
Source: ATUS 2003 & 2004.

have been partly attributed to the mother's education, because of assortative mating by education levels.[50]

Institutions and attitudes could account for the differences between the US and Germany. Higher daycare availability and all-day schooling as well as lower financial support for families, fewer part-time work possibilities and weaker motherhood wage penalties in the US may play a role (see McGinnity and McManus, 2007). There is also evidence suggesting that in the US non-maternal income reduces the probability to use non-maternal care (NICHD, 2001). In the US, education also raises the likelihood that mothers use paid leave (Lynda Laughlin, 2011). In addition there is evidence that norms related to gender-roles in Germany and the US diverge. Lück (2006) reveals, for example, that between 1988 and 2002 there was a strong decrease in the support for the male-breadwinner model in Germany, but not in the US. Calculations presented in the appendix (Table 1.D.1) show that education more strongly affects women's disagreement with the statement that working harms preschool children in Germany than in the US.[51]

The educational pattern in the distribution of time with children in the US is more

[50]The education gradient in families with older children may be weaker than previously found, because according to Ramey and Ramey (2010) and Kalil et al. (2012) it is facilitated by organization and travel time. Travel time is not considered in the present study and organization time only as long as it is performed with a child present.

[51]The average level of agreement is higher in Germany. Reichart et al. (2007) show that being a housewife seems also to be more accepted in the US. Furthermore, they argue that particularly parents of young children in the US are more likely to act on these preferences.

similar to the pattern in Germany (see Tables 1.6.3 to Table 1.6.5). When there is a toddler in the household highly educated mothers focus on physical care activities and playful care. With a youngest child in preschool age or school age, they make a difference in their focus on educational care. Different to Germany, the educational gradient in the share of educational care is stronger in the group of families with preschool aged children. This might be the case because many children in the US are already enrolled in school at the age of five years. In addition, maternal education raises the share of *TwC* used for playful care activities in this group.

As with highly educated German fathers, highly educated US-American fathers devote a larger share of *TwC* to physical care activities. This is particularly the case in families with children in preschool age, but the difference is also positive (but less significant) for families with toddlers. Only for fathers with school aged children there exist no clear similarities.

Table 1.6.3: Activities as Share of *TwC* (Age 0-3) - Average Marginal Effects (US)

	Mother (*n=1496*)				**Father (*n=1329*)**			
	Care/ TwC	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*	*Care/ TwC*	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*
M: Bachelor+	0.021	0.022*	−0.005	0.004	0.008	0.023	−0.000	−0.006
	(0.020)	(0.013)	(0.015)	(0.005)	(0.032)	(0.021)	(0.022)	(0.009)
M: Associate.	0.002	0.012	−0.010	0.002	−0.004	0.002	0.007	−0.011
	(0.019)	(0.013)	(0.014)	(0.005)	(0.028)	(0.019)	(0.021)	(0.007)
F: Bachelor+	0.056***	0.017	0.035**	0.008	0.049*	0.030	0.003	0.006
	(0.018)	(0.013)	(0.015)	(0.005)	(0.030)	(0.019)	(0.020)	(0.009)
F: Associate	0.041**	0.021	0.027	0.001	0.002	−0.003	−0.009	0.006
	(0.019)	(0.013)	(0.017)	(0.005)	(0.029)	(0.018)	(0.018)	(0.009)
Mean	0.336	0.210	0.102	0.024	0.276	0.138	0.106	0.031

Notes: M=Mother, F=Father. Results based on *2PM-FLogit* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, black and other non-caucasian, weekdays, seasons, city, geographic directions, 2003-dummy, interactions of 2003-dummy with seasons. Reference group: No college. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Number of observations slightly reduced compared to Table 1.6.1 and Table 1.6.2 because the ratio is only available for non-zero values of *TwC*. Data is weighted. Weights are provided by the Bureau of Labor Statistics.
Source: ATUS 2003 & 2004.

Summarizing there are more similarities between the countries related to the relationship between parental education and how and when mothers and fathers chose their caring activities than in the effect of education on the total amount of caring time. In both countries, highly educated mothers focus on human capital stimulating activities, particularly with preschool and school aged children. Fathers in families with a high education background focus on physical care.

Table 1.6.4: Activities as Share of *TwC* (Age 4-6) - Average Marginal Effects (US)

	Mother (*n=747*)				**Father (*n=666*)**			
	Care/ TwC	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*	*Care/ TwC*	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*
M:Bachelor+	0.063**	−0.003	0.040**	0.036***	0.048	0.022	0.021	0.003
	(0.026)	(0.018)	(0.016)	(0.014)	(0.034)	(0.023)	(0.020)	(0.015)
M:Associate	0.026	0.006	0.026*	0.005	0.046	0.002	0.025	0.012
	(0.022)	(0.016)	(0.014)	(0.010)	(0.031)	(0.018)	(0.021)	(0.016)
F:Bachelor+	−0.014	0.009	−0.018	−0.003	0.047	0.046**	−0.010	0.010
	(0.024)	(0.017)	(0.012)	(0.010)	(0.033)	(0.022)	(0.018)	(0.015)
F:Associate	0.004	0.018	−0.018**	0.002	0.050	0.045**	0.011	0.005
	(0.022)	(0.017)	(0.009)	(0.011)	(0.031)	(0.022)	(0.019)	(0.014)
Mean	0.254	0.149	0.039	0.067	0.199	0.097	0.055	0.047

Notes: M=Mother, F=Father. Results based on *2PM-FLogit* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, black and other non-caucasian, weekdays, seasons, city, geographic directions, 2003-dummy, interactions of 2003-dummy with seasons. Reference group: No college. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Number of observations slightly reduced compared to Table 1.6.1 and Table 1.6.2 because the ratio is only available for non-zero values of *TwC*. Data is weighted. Weights are provided by the Bureau of Labor Statistics.
Source: ATUS 2003 & 2004.

Table 1.6.5: Activities as Share of *TwC* (Age 7-9) - Average Marginal Effects (US)

	Mother (*n=665*)				**Father (*n=495*)**			
	Care/ TwC	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*	*Care/ TwC*	*Physical/ TwC*	*Play/ TwC*	*Educ/ TwC*
M: Bachelor+	0.038	−0.006	0.006	0.032*	−0.000	0.023	−0.017	−0.033*
	(0.028)	(0.019)	(0.009)	(0.018)	(0.035)	(0.023)	(0.016)	(0.017)
M: Associate	0.064**	0.025	0.008	0.029*	−0.004	0.002	−0.044***	−0.002
	(0.028)	(0.020)	(0.009)	(0.016)	(0.032)	(0.017)	(0.011)	(0.016)
F: Bachelor+	−0.041	−0.020	0.006	−0.013	−0.015	−0.015	0.008	0.010
	(0.027)	(0.021)	(0.008)	(0.015)	(0.030)	(0.016)	(0.017)	(0.017)
F: Associate	−0.011	0.023	−0.005	−0.021	0.038	−0.004	0.061**	0.016
	(0.026)	(0.021)	(0.007)	(0.013)	(0.034)	(0.016)	(0.024)	(0.019)
Mean	0.214	0.128	0.018	0.068	0.160	0.060	0.038	0.058

Notes: M=Mother, F=Father. Results based on *2PM-FLogit* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, black and other non-caucasian, weekdays, seasons, city, geographic directions, 2003-dummy, interactions of 2003-dummy with seasons. Reference group: No college. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Number of observations slightly reduced compared to Table 1.6.1 Table 1.6.2 because the ratio is only available for non-zero values of *TwC*. Data is weighted. Weights are provided by the Bureau of Labor Statistics.
Source: ATUS 2003 & 2004.

1.7 Conclusions

This paper investigates the association between parental education and parental time investments in children. The main analysis is based on the 2001/2002 wave of the German Time Use Survey. Special emphasis is placed on the partner's interaction by exploring the relationship between both partners' educational background and their childcare time. Childcare is the most obvious time use to influence child development, even though there are many other activities parents perform with their children. By dividing the sample into three age groups with respect to the age of the youngest child (0-3, 4-6 and 7-9 years), it is possible to analyze whether the impact of education on caring varies with the availability of non-parental care substitutes and whether parents with advanced education adapt better to the child's age-dependent needs.

The analysis explores the impact of education on three different aspects of parental time investments: Firstly, the total time spent with children, secondly, the total amount of childcare time and thirdly, the allocation of the time spent with children to specific childcare activities. A higher share of the time with children devoted to an activity can be interpreted as favoritism of this type of care.

The empirical findings show that there is no clear positive relationship between the parent's own education and his or her time spent with children in Germany. Maternal university education even reduces her time with children. However, in the group of families with a toddler, at the same time and in line with economic household models, maternal education raises the spouse's time with children. Hence fathers actually seem to be willing to take charge of young children when economic circumstances allow them to. This is a crucial insight for policy makers, as parents may prefer policies that facilitate a more equal distribution of responsibilities within the family.

The father's childcare time is clearly increasing with the mother's educational background in families with toddlers and in families with school aged children. For mothers there is no positive educational gradient in families with a toddler, but when children grow up highly educated mothers, particularly university educated mothers, start to devote more time to childcare.

The analysis of the time with children devoted to specific childcare activities reveals that highly educated mothers focus more strongly on caring activities that can be assumed to foster child development and that their caring investments more adaptive to the child's age-dependent receptiveness and needs. Fathers in families with a high education background make a difference by allocating a larger share of their time with children to physical care activities.

Comparable estimates based on the American Time Use Survey reveal two facts. Firstly, the influence of parental education on the total amount of caring time differs

clearly between the two countries. If there is a toddler in the family, US-American parents, particularly mothers, devote more time to caring when the father is highly educated, but there is no positive education gradient in the groups of families with older children. Distinctive norms, family policies, particularly differences in the (financial) support for families and the availability of non-parental care may account for the differences.

Secondly, this study shows that the educational pattern in the care activities predominantly chosen by parents is much more comparable. Similar to highly educated German mothers, highly educated US-American mothers adjust more strongly to the children's age by moving from a focus on playful care activities with toddlers to educational care when children are in preschool or school age. In analogy to Germany, fathers in families with a high education background devote more time with children to ensuring the children's physically well-being.

These findings favor the argument that not the quantity, but the chosen type and the timing of care investments over the child's life, are the common element across countries in explaining the transmission of human capital from one generation to another by time investments. Related research in other settings seems to support this hypothesis (e.g. Craig, 2006; Gimenez-Nadal and Molina, 2013; Hsin and Felfe, 2014; Del Bono et al., 2014). Given that education affects how parents care, policy makers could reduce inequalities in the children's prospects to realize their full potential by promoting the assimilation of caring styles across educational groups.

Observing differences in childcare behavior is certainly only the first step. If policy makers aim at influencing the caring behavior, data is required that allows us to determine the role of parental preferences, caring attitude and other external factors in shaping these educational patterns.

The comparison between Germany and the US also suggests that, to a certain degree, it does not matter whether the mother or the father provides childcare, as the distribution of caring responsibilities between parents differs between the two countries. Still, we need to link parental time inputs to child outcomes to explore whether parental caring time is actually interchangeable. Furthermore, additional information on the interplay between parental care and non-parental care in producing a child's human capital is necessary to acquire a better understanding of the impact of time investments on child human capital development.

Appendix 1.A Literature

Most studies on childcare focus on childcare as the primary activity. These are activities an individual is predominantly engaged in at a certain point of time.[52] In addition, most surveys allow to calculate a measure of 'time with children'. It is based on the information provided about whom the respondent was with when he or she performed an activity.[53] Only some surveys collect secondary activities, but these are less frequently analyzed.[54]

Research on the effect of socioeconomic status or education on overall childcare time, particularly by the mother, started in the 1970s and 1980s but was not heavily pursued until the 2000s. The majority of the studies are based on US data. The type of childcare and specific childcare activities also began to attract more attention in time use research in the 2000s.

Table 1.A.1: Literature: Total Amount of Childcare Time (US Studies)

Study	Data/Sample	Method	Findings
Leibowitz (1974a) Leibowitz (1975)	Time Budget Data, Cornell University. All women, at least 1 child <18 years	Descriptive/ OLS	Maternal education has a weakly significant positive impact on childcare, mainly physical care and other care. The difference in the partner's education is even smaller. The husband's caring time is positively related to the mother's caring time.
Hill and Stafford (1974)	National Probability Sample, University of Michigan. Married, at least 1 child <18 years	Descriptive/ OLS	Women with high socioeconomic status, defined according to the occupation of the husband, devote more time to housework time, which includes childcare.
Hill and Stafford (1980)	TUS US, Michigan (1975/76). Married, at least 1 child <18 years	Descriptive/ OLS	College educated mothers devote more time to childcare. This is driven by playing, teaching and travel time. The educational difference is largest in families with preschool children.
Bryant and Zick (1996)	TUS US (ESTUS) (1977/78). Couples ,2 children, both <18 years	Tobit	Highly educated mothers devote relatively more time to childcare if the younger child of a family is present, while highly educated fathers spend relatively more caring time with the older child.

Continued on the next page.

[52]Time use data is either collected using diary techniques, as it is standard in the European time use surveys, or via recall at the next day, as it is done in the American Time Use Survey.

[53]This time is also referred to as parent-child shared time or accessible time.

[54]The interpretation of these activities, which are carried out 'along the way', is not that clear.

Table A1 (continued): Literature: Total Amount of Childcare Time (US Studies)

Study	Data/Sample	Method	Findings
Stafford and Yeung (2004)	PSID, CDS (1997). Couples, children aged 0-12 years	Tobit	Conditional on parenting attitudes. Highly educated mothers spend less time with their children. This is the case for engaged and accessible time. Parents who have a high value of child rearing spend more time with their children.
Kimmel and Connelly (2007)	ATUS (US) (2004/05). Mothers, at least 1 child <13 years	SUR-OLS/Logit	A mother's predicted wage has a strong positive effect on maternal childcare time. Given predicted wages, education has only a small positive effect. Higher wages are also associated with less time devoted to leisure and home production and more time spent working. The husband's income raises maternal childcare time.
Guryan et al. (2008a)	ATUS (2003-2006) + MTUS Data*. All adults, at least 1 child <18 years	OLS	Among 5 education groups (<12, 12, 13-15, 16 and 16+ years of education) there is a strong positive relationship between education and maternal childcare time for working and non-working mothers in the US. Fathers' educational gradient is positive but less steep than for mothers. Additional analysis suggests that a positive effect of education on childcare does not exist for all countries.
Ramey and Ramey (2010)	TUS US - Several sources 1965-2008. All adults, at least 1 child <18 years	OLS	An estimation including interaction terms of education and time reveals the educational differences in childcare amplify over time for mothers and fathers, particularly since the mid-1990s. It is argued that care for older children and travel time shape the pattern.

*MTUS (Multinational Time Use Survey): Austria (1992), Canada (1998/99), Chile (1999), Estonia (1999/2000), Italy (2002/03), France (1998/99), Netherlands (2000), Norway (1990/91), Palestine (1999/2000) Slovenia (2000/01), South Africa (2000), United Kingdom (2000/01)

Table 1.A.2: Literature: Total Amount of Childcare Time (International Studies)

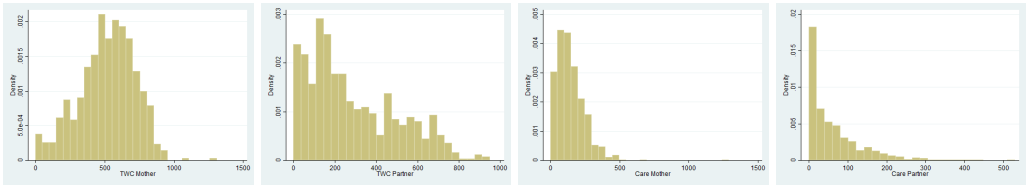
Study	Data/Sample	Method	Findings
Sayer et al. (2004b)	MTUS Data: Canada(1992), Germany(1991,) Italy (1989), Norway(1990). Married, at least 1 child <18 years	Tobit	Controlling for the wife's occupation and both parent's employment status, education is positively related to childcare. The effect for German mothers is small, only the lower educated mothers devote slightly less time to childcare. For fathers there is a positive education gradient, which is larger for Canadian and Italian than for German fathers but is non-existent in fathers in Norway.
Neuwirth (2004)	Austria (1992). Couples, all children <16 years	OLS/ 2SLS	Conditional labor market participation, the correlation between education and childcare time is positive for both parents.
Bonke and Esping Andersen (2011)	Denmark (2001). Couples, all children <18 years	SUR	In a model including wages, individual education is only positively associated with childcare time for fathers. If both parents are highly educated, mother and father devote more time to childcare and there is also more joint caring.
Gracia et al. (2011)	MTUS Data: Denmark (2001), Spain (2002/03), UK (2000/01) and TUS Flanders (2004/05). Couples, 1 child <16 years	OLS	Conditional on labor market status, maternal college education raises both parent's childcare time in Spain and the UK. The father's education has only an impact on his caring time in Spain. These effects are mainly driven by routine, not interactive care. The interaction effect between work hours and college education is significantly negative for mothers in most countries.

Table 1.A.3: Literature: Types of Care

Study	Data/Sample	Method	Findings
Folbre et al. (2004)	TUS Australia (1997). Couples, 1 child <5 years	OLS	University education makes a difference for both parent's physical care (referred to as high contact and low intensity care), but not for developmental care or travel and communication.
Craig (2006)	TUS Australia (1997). Couples, 1 child <12 years	OLS	Advanced education is associated with more childcare time in a household. At the individual level, the strongest positive effect of a high university degree can be found for developmental care. There is also a positive educational gradient in passive care for fathers.
Gutièrrez-Domenech (2010)	TUS Spain (2002/03). Couples, 1 child <17 years	OLS	Conditional on working time the parent's own education has a weak positive effect on maternal physical care activities, but not on educational care. Fathers with a university degree devote significantly more time on physical and educational care. The effect is not linear but u-shaped. Maternal education mainly raises secondary care activities.
Kalil et al. (2012)	ATUS 2003-2007 . Married women, 1 child <13 years, only biological children, 3 age groups, (0-2, 3-5, 6-13)	Tobit	There is a large positive difference in maternal education for her physical care and playing time in the youngest group, which decreases with the children's age. The educational difference is largest for teaching in the middle group and management time in the oldest group.
Gimenez-Nadal and Molina (2013)	TUS Spain (2002/03) and UK (2000). Couples, 1 child <18 years	SUR-Tobit	Maternal education is associated with an increase in the educational childcare time provided by fathers in both Spain and the UK. It also raises the time devoted to educational childcare by mothers in Spain. The paternal education has no effect on educational childcare time for either parent.
Gracia (2014)	TUS Spain (2002/03). Fathers (in couples), 3 age groups (0-2, 3-5, 6-11)	OLS/ Logit	Conditional on mother's and father's employment status, paternal education is positively associated with his physical care time in the two younger groups. The paternal education raises the time he devotes to interactive care in the middle group. The mother's advanced education is also positively correlated with the father's physical care time in the youngest group.

Appendix 1.B Distribution and Summary Statistics

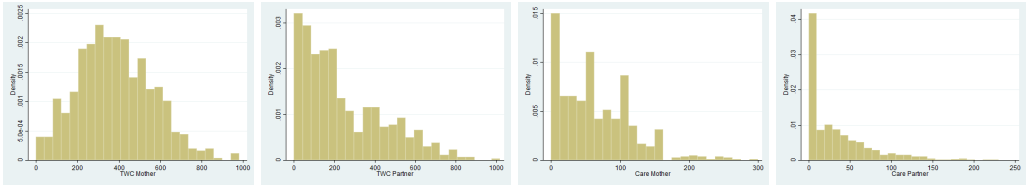
Figure 1.B.1: *Time with Children* and *Care*: Age 0-3 Toddlers



(a) *TwC* Mother (b) *TwC* Father (c) *Care* Mother (d) *Care* Father

Source: GTUS 2001/02, own calculations. Data is weighted.

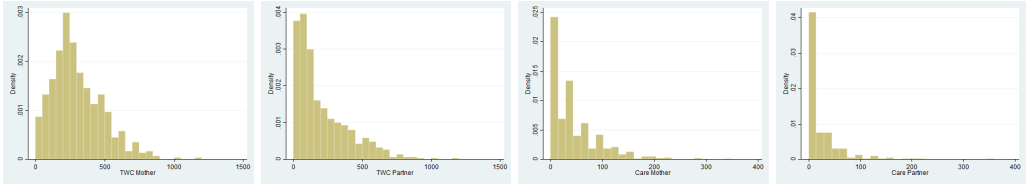
Figure 1.B.2: *Time with Children* and *Care*: Age 4-6 Preschool Age



(a) *TwC* Mother (b) *TwC* Father (c) *Care* Mother (d) *Care* Father

Source: GTUS 2001/02, own calculations. Data is weighted.

Figure 1.B.3: *Time with Children* and *Care*: Age 7-9 School Age



(a) *TwC* Mother (b) *TwC* Father (c) *Care* Mother (d) *Care* Father

Source: GTUS 2001/02, own calculations. Data is weighted.

Table 1.B.1: Assortative Mating by Education

Father / *Mother*	University	Techn. College	Voc.+ *Abitur*	Lower (Control)	Total
University	58	13	6	23	100
Techn. College	20	20	30	30	100
Voc.+*Abitur*	18	18	16	48	100
Lower	7	6	11	75	100
Total	15	11	14	60	100

Source: All groups included. Numbers present row percentages.
Source: GTUS 2001/02, own calculations. Data is weighted.

Table 1.B.2: Summary Statistics by Age Groups

	Mothers			Fathers		
Age of Youngest Child	0-3	4-7	7-9	0-3	4-7	7-9
Mother: University	0.09	0.08	0.08	0.12	0.10	0.08
Mother: Techn. College	0.14	0.07	0.06	0.12	0.07	0.07
Mother: Voc.+*Abitur*	0.23	0.19	0.21	0.23	0.20	0.21
Father: University	0.14	0.15	0.18	0.14	0.15	0.16
Father: Techn. College	0.12	0.08	0.12	0.12	0.09	0.14
Father: Voc.+*Abitur*	0.15	0.13	0.10	0.15	0.13	0.12
No. of Children Aged 0-1	0.50	0.00	0.00	0.47	0.00	0.00
No. of Children Aged 2-3	0.59	0.00	0.00	0.62	0.00	0.00
No. of Children Aged 4-5	0.31	0.71	0.00	0.31	0.73	0.00
No. of Children Aged 6-7	0.26	0.56	0.43	0.24	0.57	0.40
No. of Children Aged 8-9	0.16	0.37	0.72	0.16	0.34	0.72
No. of Children Aged 10-12	0.08	0.32	0.57	0.08	0.30	0.54
No. of Children Aged 13-15	0.02	0.13	0.23	0.01	0.13	0.21
No. of Children 16 & older	0.00	0.03	0.07	0.00	0.01	0.07
Age Youngest Child	1.51	4.97	7.83	1.62	4.94	7.87
Married	0.96	0.98	0.97	0.95	0.99	0.98
Age Mother	33.39	36.32	38.49	36.21	38.32	41.42
Age Mother sq.	1133.11	1333.44	1500.15	1333.99	1487.78	1741.34
Age Father	36.18	38.90	41.44	33.81	36.51	38.85
Age Father sq.	1331.74	1531.73	1739.11	1161.35	1344.65	1528.76
Physician in Walking Distance	0.61	0.77	0.71	0.63	0.77	0.75
High School in Walking Distance	0.48	0.57	0.56	0.50	0.59	0.59
Person in HH need Care	0.01	0.02	0.01	0.01	0.02	0.01
German Nationality Mother	0.96	0.98	0.95	0.97	0.95	0.97
German Nationality Father	0.97	0.97	0.95	0.97	0.99	0.97
Friday	0.13	0.14	0.13	0.14	0.14	0.13
Saturday	0.13	0.15	0.16	0.13	0.15	0.15
Sunday	0.20	0.19	0.15	0.21	0.19	0.18
2nd Quarter	0.26	0.19	0.23	0.27	0.20	0.22
3rd Quarter	0.25	0.23	0.17	0.25	0.21	0.21
4th Quarter	0.23	0.37	0.23	0.21	0.35	0.23
TwC	527.67	387.07	311.76	300.56	254.16	215.05
Care	151.99	65.98	47.75	69.70	33.24	21.44
Care/TwC	0.29	0.18	0.18	0.26	0.16	0.13
Physical/TwC	0.18	0.09	0.06	0.12	0.07	0.05
Play/TwC	0.09	0.04	0.02	0.12	0.06	0.03
Educ/TwC	0.02	0.04	0.09	0.02	0.03	0.04
Observations	671	603	607	634	576	569

Source: GTUS 2001/02, own calculations. Data is weighted.

Appendix 1.C Non-Parental Care and Working Time

Table 1.C.1: Formal and Informal Care Usage - Average Marginal Effects

	Age Youngest 0-3		**Age Youngest 4-6**		**Age Youngest 7-9**	
	Formal	Informal	Formal	Informal	Formal	Informal
M: University	0.18**	0.20*	0.04	0.22**	0.04	0.11
	(0.08)	(0.11)	(0.06)	(0.11)	(0.06)	(0.14)
M: Techn. College	−0.05	−0.19*	0.03	0.06	0.00	0.18
	(0.06)	(0.11)	(0.07)	(0.13)	(0.06)	(0.13)
M: Voc.+*Abitur*	−0.10*	0.05	0.02	0.08	0.07	0.03
	(0.05)	(0.08)	(0.05)	(0.09)	(0.05)	(0.06)
F: University	0.03	0.10	−0.07	0.04	0.04	0.02
	(0.06)	(0.10)	(0.07)	(0.11)	(0.05)	(0.08)
F: Techn. College	0.07	0.01	−0.02	−0.06	−0.05	0.12*
	(0.06)	(0.10)	(0.08)	(0.11)	(0.03)	(0.07)
F: Voc.+*Abitur*	0.01	0.07	0.11**	0.13	0.07	0.31***
	(0.08)	(0.09)	(0.05)	(0.09)	(0.07)	(0.09)
Observations	678	672	608	592	622	619

Notes: M=Mother, F=Father. Results based on probit models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, German nationality mother/father, weekdays, seasons, adult in need in household, physician/high school in walking distance. Reference group: Vocational training and no training. Formal care is defined as using center-based care or family care/childminder. Informal care is defined as receiving help by private persons for childcare in the last four weeks. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Data is weighted. Weights are provided by the Federal Statistical Office.
Source: GTUS 2001/02.

Table 1.C.2: Working Time - Average Marginal Effects

	Age Youngest 0-3		**Age Youngest 4-6**		**Age Youngest 7-9**	
Job	Mother	Father	Mother	Father	Mother	Father
M: University	118.86***	−66.02	94.10**	51.19	64.64	54.69
	(37.00)	(47.03)	(40.57)	(32.79)	(42.63)	(35.31)
M: Techn. College	28.98	−2.71	68.58	49.68	−72.26***	−13.23
	(28.75)	(50.61)	(48.72)	(36.79)	(21.98)	(45.27)
M: Voc.+*Abitur*	−9.08	11.35	−10.57	27.94	25.17	35.43
	(17.22)	(27.18)	(20.63)	(22.75)	(23.52)	(25.07)
F: University	−9.41	−7.90	−17.05	47.46	−23.56	4.51
	(18.53)	(37.56)	(29.59)	(35.85)	(23.75)	(33.16)
F: Techn. College	−6.58	3.64	−39.85	−77.58**	17.17	24.90
	(20.35)	(39.17)	(27.64)	(38.56)	(29.20)	(35.08)
F: Voc.+*Abitur*	14.22	−2.10	4.89	−68.38*	19.94	8.36
	(26.41)	(38.59)	(29.54)	(40.84)	(34.40)	(36.83)
Observations	678	678	608	608	622	622

Notes: M=Mother, F=Father. Results based on *2PM-OLS* models. Control variables: Age mother/father (linear, quadratic), number of children (groups, 0-1 till 16 plus), age of youngest child, married, German nationality mother/father, weekdays, seasons, adult in need in household, physician/high school in walking distance. Reference group: Vocational training and no training. Standard errors that allow for clustering at the individual level in parentheses. */ **/ ***: Significance at the 10-/5-/1-percent level. Data is weighted. Weights are provided by the Federal Statistical Office.
Source: GTUS 2001/02.

Appendix 1.D Attitudes

Table 1.D.1: Women Work - Preschool Child Suffers (ISSP): Women

	Germany				US			
	Agree	Indifferent	Disagree	Total	Agree	Indifferent	Disagree	Total
Uni	35	11	54	100	32	24	43	100
No Uni	52	12	35	100	34	25	41	100
Total	51	12	37	100	34	25	42	100

Note: Table displays agreement rates for women in row percentages.
Source: International Social Survey Programme (ISSP) 2002, own calculations.

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CHAPTER 2

The Effect of Early Universal Daycare on Child Weight Problems

2.1 Introduction

Non-parental care alternatives are crucial for enabling both parents to participate in the labor market.[1] Childcare arrangements also have the potential to influence child development because they alter the composition of inputs a child receives early in life. Existing research shows that daycare, under certain circumstances, can have a positive impact on child development, particularly for disadvantaged children. However, this research by far does not cover all relevant aspects of child development. Physical health outcomes are largely disregarded (e.g. D'Onise et al., 2010) even though obesity has become a global epidemic, which also affects children at an increasing rate (e.g. Ng et al., 2014).

The present study contributes to the existing literature by estimating causal effects in a setting with two factors that are rarely analyzed together: Early universal daycare and children's weight and fitness status. The study explores the German daycare system which can be described as universal because children are eligible independent of their background and most programs operate under similar structural conditions. Daycare in Germany is mainly publicly subsidized center-based daycare and its quality is regulated by local authorities (Spieß et al., 2002; Schober and Spieß, 2014). Germany, as many other Western countries, has invested in expanding daycare provisions for very young children since the mid-2000s, but evidence on its effects is still scarce. This paper adds new insights to the literature and to the political discussion about the expansion of daycare provision by investigating the effect of daycare usage before the age of three.

Childhood obesity is strongly associated with adult weight problems (e.g. Singh et al., 2008) and is related to severe health consequences, such as cardiovascular disease risk factors, type 2 diabetes, and obstructive sleep apnea (Ebbeling et al., 2002; Reilly and Kelly, 2011). By increasing the need for medical treatment, obesity creates a non-negligible burden to the health care system (Finkelstein et al., 2005).[2] Furthermore, research reveals additional costs of weight problems in children. Childhood obesity not only hinders a child's verbal, social, and motor skill attainment (Cawley and Spieß, 2008), but also affects future education and income (Cawley, 2004; Currie, 2009; Currie et al., 2010).

Early childhood investments are argued to be particularly effective because of self-productivity and complementarity to investments later in life (Cunha and Heckman, 2007; Heckman and Masterov, 2007). Interventions in the years zero to five are shown to be

[1] This seems to be desired by the majority of parents. Even in the 1990s the male-breadwinner model was shown to be the least preferred employment pattern in most OECD countries (OECD, 2001, chapter 4). The increasing level of education among women, the awareness of the role of disruption for income and the challenges of demographic change even made female labor market participation an explicit political goal in many OECD countries (see OECD, 2014; Smeeding, 2014).

[2] For Germany Konnopka et al. (2011) estimate obesity to cause €4,854 million in direct costs, corresponding to 2.1 percent of the overall German health expenditures in 2002.

highly beneficial in the prevention of obesity (e.g. Davis and Christoffel, 1994; Nemet et al., 2005; Waters et al., 2011) and there is also evidence suggesting that eating habits develop in this early period of life (Birch, 1999). The limited research on daycare and weight problems reveals that intensive high-quality care programs targeted at economically disadvantaged children reduce obesity prevalence (Frisvold and Lumeng, 2011; Campbell et al., 2014). So far there is almost no evidence on the effect of non-targeted universal programs on weight issues and physical fitness.

Dietary intake and physical activity are shown to account for a large share in changes in a child's Body-Mass-Index (e.g. Klesges et al., 1995; Finkelstein et al., 2005). In daycare children's eating behavior is monitored and regulated and children may be more active than at home, playing with their peers and teachers. The German version of the Early Childhood Environment Rating includes space and time for playing as well as interactions with children in gross motor activities as assessment criteria (Tietze et al., 1997). German daycare centers scored relatively high on these factors in the time period relevant for the present study (Tietze et al., 1996). Since for the vast majority of children under three years lunch was provided in daycare, early daycare usage also bears good prospects to influence eating habits.[3]

Under the assumption that the marginal productivity of parental care is positive but decreasing, some daycare may be beneficial for most children. Particularly children who experience low quality care at home could benefit from substituting daycare for parental care (e.g. Loeb et al., 2007). Positive effects of daycare are reinforced if families change to a dual income household, with all the attendant benefits of increased affluence.[4] Activities conducted in daycare, e.g. playing with other children, may complement parental care. Furthermore, once a child is sent to daycare, mothers seem to reduce passive care but not stimulating care activities (Felfe and Lalive, 2012).

The present analysis exploits a unique dataset on child health, the National Health Interview and Examination for Children and Adolescent, named KiGGS. KiGGS is representative for Germany and was conducted in the years 2003 to 2006. This large dataset collects a broad range of objective health measures. This is advantageous as subjective reports of weight are found to be inaccurate (Goodman et al., 2000). In the present setting parental reports on child weight problems could be correlated with whether or not daycare was used early, which may lead to biased estimates.

Since it is stressed that one indicator is not enough to determine weight problems (Burkhauser and Cawley, 2008), we aim to provide a broad picture of the children's weight and fitness status. As is common in the literature, weight problems are identi-

[3] See own calculations based on the German Socio-Economic Panel in Table 2.A.1 in the appendix.

[4] See Currie and Lin (2007) for an overview of the literature on the child health income gradient.

fied based on the Body-Mass-Index. In addition, unhealthy weight is assessed using the percentage of body fat. Finally a test of gross motor skills is included. These skills can be viewed as a complementing measure of physical activity and fitness, which in turn is related to weight problems and health risks (Stodden et al., 2009; D'Hondt et al., 2009).

The identification of causal effects of early daycare usage is not straightforward. Parents try to contrast costs and benefits of daycare usage. In this calculation not only the child's development matters, but also the parents' personal objectives, work aspirations, caring attitudes, and their desire for spending time with their children. The precision of the parental assessment of costs and benefits varies with parental characteristics and is based on information that is often not observable to the researcher. A simple comparison of the development of children with and without early daycare may be biased due to sorting and selection problems.

The identification problem is addressed by exploiting regional differences in the availability of publicly subsidized center-based daycare across German counties as a source of exogenous variation in early daycare usage. For children younger than three years the supply of publicly subsidized daycare is rather limited. There are less than three slots per 100 children available in some areas over the observation period and the number of private providers is negligible (e.g. Schober and Spieß, 2014). There is evidence that demand strongly exceeds supply, consequently parents are constrained in their childcare choice (Wrohlich, 2008).[5] In contrast, since 1996 children aged three to six years are legally entitled to a daycare slot and nearly 90 percent of these children are in daycare. The probability that children begin daycare before they reach the age for legal entitlement increases with the availability of daycare for children under the age of three. The strongest variation is found at the threshold of 30 months. This threshold defines the binary treatment.

Official statistics on the regional supply with daycare slots are available since the mid-1990s for most counties. Since we are not interested in the immediate effects of daycare, but rather in medium-term effects, the sample includes children who were born between 1996 and 2000 and who were between five to nine years old when the KiGGS was surveyed.

The binary nature of the treatment is dealt with by implementing a non-linear instrumental variable strategy. The standard linear two-stage least squares procedure is extended by a stage zero. In stage zero the probability to use daycare before the age of three is estimated using a probit model which includes the available slots per child in the respective county as an explanatory variable. The predicted probability is then exploited as the actual instrument in the standard first stage (Wooldridge, 2010). This is shown to

[5]This is true for West Germany as well as for East Germany (Wrohlich, 2008).

be a more efficient procedure than the linear two-stage least squares approach and leads to estimates of higher precision (e.g. Mogstad and Wiswall, 2012).

The estimates based on the instrumental variable approach show that children 'at the margin', i.e. children whose daycare usage is affected by regional daycare provision, gain from enrollment with 30 months or earlier in terms of significantly fewer weight problems and a better performance in the gross motor skills test. The investigation of effect heterogeneity reveals that the instrument creates the strongest variation in the group of children in low and middle income households as well as in families with an overweight father. Ordinary least squares (OLS) estimates find on average no clear association between early daycare enrollment and weight problems, but estimates for low and middle income families confirm stronger reductions of weight problems in these groups. Based on these findings we are able to conclude that the physical development of less privileged children benefits from spending time in daycare before the age of three.

The remainder of this paper is structured as follows. Section 2.2 gives a brief overview over the institutional background and the related empirical evidence. Section 2.3 describes the dataset and Section 2.4 discusses the estimation procedure. Section 2.5 proceeds with presenting first and second stage results and includes a discussion of the sensitivity of the main findings. Section 2.6 concludes.

2.2 Background Information

2.2.1 Daycare in Germany

In Germany, most formal daycare is publicly subsidized center-based care. The private market is underdeveloped and childminders, also known as family daycare, which is a third party caring for children in their private home, are rarely employed (see Spieß et al., 2002; Schober and Spieß, 2014).[6]

The daycare programs in Germany operate under similar conditions and children are eligible for participation independent of their background. The provision and fees vary between regions but the fees are relatively low in international comparison because of subsidies. Availability and not affordability is the major problem in the daycare market, particularly for children up to the age of three years in the observation period (see Kreyenfeld and Hank, 2000). The decision about provisions and funding is mostly made by local authorities. Daycare quality is generally regulated at the state level with a focus on structural features, e.g. staff-to-child ratios or group size. Quality regulation is high

[6]In the US childminders are often referred to as family daycare. The present paper sticks to the term childminder to clearly distinguish from care provided by the family. Childminders in Germany are required to have some training, but they are not as well trained as nursery teachers in daycare centers.

compared to other countries, such as the US (see Spieß, 1998). Given less variation in quality in a regulated daycare market, there seem to be fewer outliers of very low quality in Germany (see Kreyenfeld et al., 2002; Blau, 2001; Blau and Currie, 2006).[7]

Since the 1960s the provision of center-based daycare for children aged three to six years has increased strongly. In 1996, the German government enacted legislation that grants children in this age group the right to a part-time slot in publicly subsidized daycare centers. On average about 90 percent of these children are in daycare (DJI, 2005).[8]

However, publicly subsidized daycare for children under the age of three was rationed in the period which is relevant in the present setting. The provision of daycare, particularly in West Germany, was very low with less than three percent of children supplied with a slot in some areas.[9] The provision did not increase very strongly before the mid-2000s, when the expansion of daycare was made an explicit political goal (see DJI, 2005).[10] Even though the supply in East Germany was higher than in West Germany, evidence suggests that there was an excess demand in both West Germany and East Germany (see Wrohlich, 2008). Consequently, the overall market faced strong supply side constraints.

The present setting makes use of the fact that a higher supply of publicly subsidized daycare for children younger than three years can be assumed to pull the daycare starting age to an earlier point than the more 'traditional' starting age of three years. Hence, differences in provision generate an exogenous variation in the early use of daycare.

2.2.2 Related Evidence

The literature on the effect of care arrangements on child development provides very little on its effect on physical health outcomes (e.g. D'Onise et al., 2010). Most research focuses on cognitive and behavioral outcomes. The estimated effects vary across countries and with the daycare program under consideration. Crucial factors include the quality of daycare and the amount of time spent in daycare. The majority of the related literature does not deal with universal daycare, but with programs targeted at specific groups. There is limited research on the effects of daycare enrollment before the age of three.

Studies on high-quality programs in the US, such as *Head Start* or the *Carolina Abecedarian (ABC) Project*, that target economically disadvantaged children reveal mainly positive effects in all kinds of areas including obesity (see Heckman, 2000; Currie and Al-

[7] This study does not analyze the effect of a strong expansion in daycare supply, which is found to reduce child well-being in Canada (Baker et al., 2008), potentially because of a decrease in daycare quality and crowd out of higher quality arrangements (see Datta Gupta and Simonsen, 2010).

[8] Daycare centers, at least in West Germany, were mainly institutions aiming to foster education and socialization, but were not designed to ease reconciliation of work and family. Therefore, most of the provisions were part-time (see Kreyenfeld et al., 2002).

[9] In 1998 the provision in East Germany was on average at around 35 percent (DJI, 2005).

[10] Since August 2013 a daycare slot for children under the age of three is also granted by law.

mond, 2011). In the case of these programs one cannot speak of universal daycare and the targeted group is not representative. These interventions are also more intensive than more general daycare programs. *ABC*, for example, has a specific nutrition and health care component (see Campbell et al., 2014). However, these studies provide clear evidence for the ability of daycare programs to affect child weight and fitness development, even in the long-run. Frisvold (2006) reveals a strong reduction in obesity by 28 percentage points among black children aged five to 19 years, who were enrolled in *Head Start*.[11] The structural estimates by Carneiro and Ginja (2015) point out that *Head Start* reduces the risk of being overweight for 12- to 13-year-old children by 26 percentage points on average. This is confirmed by their reduced form estimates. Research by Campbell et al. (2014) highlights that the *ABC* intervention at age zero to five significantly reduced child and adult weight problems for males. They find, for example, a reduction of overweight prevalence by 29 percentage points among eight-year-old boys. There are no strong effect for females.

Contrasting findings by Herbst and Tekin (2010, 2011) highlight the crucial role of daycare quality. Analyzing children of single low-income mothers who are in kindergarten (age five to six in the US), they reveal an increase in weight problems and negative effects on cognitive skills if the mother received a childcare subsidy in the year before kindergarten.[12] Herbst and Tekin (2011) argue that the chosen low quality center-based care is a key mechanism. In the German setting with quality highly regulated by regional authorities this is less likely to be the case.[13]

Studies dealing with reduced maternal time available for children by analyzing maternal employment reveal that a working mother can increase child weight problems. The negative effects are particularly pronounced for relatively long maternal working hours and very early return to the labor market (Anderson et al., 2003; Berger et al., 2005; Ruhm, 2008; Mindlin et al., 2009). In general there are fewer negative effects found in Europe.[14] Mahler (2008) shows for Germany that the aggregate number of years the mother worked full-time until the child was 15 years old increases the risk of obesity for young adults, yet there is no effect for part-time work.[15] The substitute for maternal time is unknown in

[11] Children can enroll in *Head Start* at age three, four or five (Carneiro and Ginja, 2015).

[12] Effects are heterogeneous. In the same sample Herbst and Tekin (2012) show that only children of low-skilled mothers suffer. They hypothesize that high-skilled mothers have greater returns to work and may hence better provide for their children.

[13] Without a focus on weight problems, Datta Gupta and Simonsen (2010) show that children in Denmark gain from pre-school, but not from lower quality family daycare. For Germany, Peter (2013) reveals that a low child-staff ratio is a crucial determinant of positive effects of daycare. Chetty et al. (2011) highlight the importance of class size and teacher quality.

[14] European studies analyzing parental leave, find no positive effects for child development if mothers postpone their return to paid work (Würtz-Rasmussen, 2010; Dustmann and Schönberg, 2012).

[15] It is possible that this study does not capture all unobservable factors driving mothers into full-time work. In Germany maternal full-time work is a rather uncommon phenomenon (see OECD, 2001).

these studies. If this substitute is daycare, it is shown that a medium amount of hours in daycare is in general beneficial for child development (Lumeng et al., 2004; Datta Gupta and Simonsen, 2010). For *Head Start*, full-day participation even outperforms part-day participation in terms of obesity prevention (Frisvold and Lumeng, 2011).[16] In Germany, most maternal employment and daycare usage is part-time, particularly in West Germany (OECD, 2001; Spieß et al., 2002; DJI, 2005). The return to paid work is also later than for the US counterparts because of longer paid parental leave.[17]

In this setting the effect of daycare has good prospects of being positive on average, even if the program is less intensive than the targeted US interventions. Felfe and Lalive (2012, 2014) show that daycare usage before the age of three can be beneficial in Germany. Felfe and Lalive (2014) use information on the school readiness test, conducted in the state Schleswig-Holstein from 2009 to 2012, to estimate the effect of early daycare on conspicuous development in several areas related to cognitive and non-cognitive skills. All indicators suggest that early daycare participation lowers the risk of adverse development.[18] However, their evaluation does not allow conclusions about physical development in the spirit of the present paper. Hence, the this study focuses on a relationship that has been under-researched so far.

Further evidence on universal daycare programs mostly confirms that this type of care is beneficial for child development, also in the long-run.[19] However, studies estimating a causal effect of universal daycare before the age of three are limited and particularly few of these studies focus on health outcomes.[20] Noboa-Hidalgo and Urzua (2012) estimate an immediate effect of daycare attendance in the age range of five to 14 months in Chile. They find positive effects on skill development including gross motor skills and eating behavior. Even though the education system and the environment in Chile are difficult to compare to the German setting, this study reveals that factors related to weight and fitness problems can be influenced by early daycare usage.

[16]Rapp et al. (2005) show for Germany that the obesity risk for children is not associated with either being in part-time or full-time daycare at the age of three to five years. However, it is not clear how selection affects the results.

[17]Daycare is shown to be more likely to have negative effects if children are very young (Loeb et al., 2007).

[18]Based on the German Socio-Economic Panel Felfe and Lalive (2012) find significantly positive effects on social skills, but not on all indicators of motor, language and daily skills. However, there were no negative effects.

[19]See Havnes et al. (2011), Dumas and Lefranc (2012) and Apps et al. (2013). Analyzing non-health outcomes, Felfe et al. (2015) reveal positive effects for 15-year-old adolescents in Spain. In Spain, as in Germany, daycare is expected to crowd out maternal care. The negative effects found by Baker et al. (2008) in Canada might be explainable by a reduction in quality (Datta Gupta and Simonsen, 2010).

[20]One other existing study on the effect of early daycare reveals positive effects on language skills and numeracy in Norway (Drange and Havnes, 2015).

2.3 Data and Sample Selection

This study aims to estimate causal effects of using daycare before the age of three. The sample selection is determined by three facts. i) We are not interested in an immediate or short-term effect, but intend to investigate effects in the mid-term. Hence the decision about using daycare before the age of three should date back at least two years to observe whether there are persistent developmental differences. ii) The KiGGS data is surveyed in the years 2003 to 2006. iii) Information on publicly subsidized center-based daycare and further regional characteristics needed in the instrumental variable setting is only available from the Federal Statistical Office since the mid-1990s (see Section 2.4.3). Therefore, the analysis focuses on children born between 1996 and 2000. These children were five to nine years old when KiGGS was conducted, but children who were eight and nine years old are under-represented (see Table 2.A.3).

2.3.1 Data

The KiGGS data is a survey conducted by the Robert Koch Institute (RKI) on the health of children and adolescents in Germany. The survey is representative for the country as a whole. The analysis in the present paper is based on version 4 of the baseline survey (Kurth et al., 2013). Across all states of the German Federation, 17,641 children and adolescents aged between zero and 17 years participated in 167 sample points. They completed a questionnaire independently if they were at least 11 years old. Otherwise the parents assumed this task. In addition, parents provided information on their own background and the child's development since birth. This information was completed by an interview, examinations, and tests conducted by a trained person.

The KiGGS data has the advantage of providing objective health measures, reported by a third, trained person, not the parent. It has been shown that there can be errors in self-reported health (e.g. Goodman et al., 2000; Burkhauser and Cawley, 2008). If truly random, measurement error would not bias the estimates. However, related to the childcare decision it is not unlikely that this decision is correlated with how parents report their child's weight. If the parent's knowledge about the access to daycare and desired health outcomes were positively correlated, children in daycare might be more likely to have parents who understate the child's weight if he or she is overweight. In such as case, subjective information could lead to incorrect conclusions about the daycare effect in reducing weight problems. This can be avoided using objective measures.

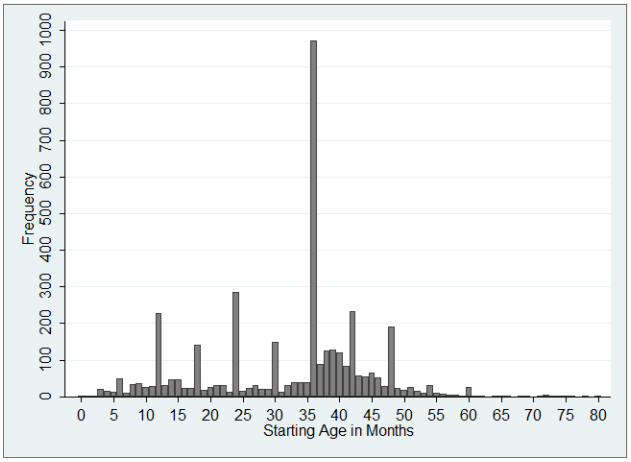
In KiGGS, parents were asked if their child is or was cared for solely by the family before school enrollment. If the answer was "no", parents were asked about the type of non-family care: either center-based daycare or a childminder. Since this paper focuses

on a variation in center-based daycare, children for whom parents only report that a childminder was the type of care are excluded in the main specification. However, as common in Germany, of all children surveyed in the relevant age-group, less than two percent were solely in care of a childminder. Herein, daycare will consequently refer to being solely in center-based care or being in center-based care and in care of a childminder.

In addition, parents reported how old the child was when the non-family care began. Information has been collected about the point of first usage, but not about the hours in non-family care. It was shown that once children begin daycare there are not many interruptions (see Müller et al., 2013, Chapter 3.2.1), thus the starting age also captures duration of daycare.[21]

As discussed in Section 2.2.1, in Germany, particularly in the observation period, children usually do not begin daycare much before the age of three. This is reflected in the distribution of the age at which daycare is used the first time in the present sample (see Figure 2.3.1). There is a strong peak at the age of three and some individuals already seem to begin daycare a few months before reaching this threshold.

Figure 2.3.1: Distribution of the Daycare Starting Age



Source: KiGGS Version 4, own calculations.

Only approximately two thirds of the parents report the starting age in months, all others report years. The assumption was made that children for whom parents report that they were in enrolled in daycare with either two years or 30 months belong to the early starters. This treatment is referred to as *Early Care*. Children for whom parents report that they began daycare at three years or 31 months and later are assumed to take the more 'traditional' way. It is controlled for whether the parents report the month. Instrumental variable methods are fortunately not very sensitive to measurement error in right-hand side variables. It is also possible to show that the results are robust to slightly

[21] One should keep in mind that daycare for younger children differs in some aspects. The child-teacher ratio is, for example, required to be lower if children are younger.

other ways of rounding (see Section 2.5.4), but the variation generated by the instrument is strongest at the threshold of 30 months. The defined threshold is policy relevant given the increase in the availability and usage of daycare for children before the age of three in many countries, including Germany.

The control group is restricted to children who are already in daycare when they are 4,5 years old. This is because the instrument is not likely to induce any behavioral change in the childcare decision at higher starting ages. Also, with this strategy it is ensured that each child in the sample has experienced at least some daycare at the time of observation and so the effect of more time spent in daycare is estimated. As displayed in Figure 2.3.1, only approximately two percent of the children participating in KiGGS began daycare when they were older than 54 months. These observations and the cases in which parents reject daycare at all are excluded, as these children may be difficult to compare to the children in *Early Care*.[22]

Children who live with their grandparents or in a Children's Home and children who are disabled are also excluded because they demand different care arrangements compared to the majority of children. Children living with one parent at the time of observation remain in the sample, as long as there is the relevant information available for both parents. Parents who are single at the time of sampling were not necessarily single parents when the child was in daycare. In the analysis it is controlled for whether children live with separated or step-parents. Given the set of control variables, this leaves 2,377 observations of which 845 belong to the early group, with slight variations in the number of observations because of missing values for some outcomes.[23]

2.3.2 Outcomes

The KiGGS provides a large set of child health indicators. The present study focuses on the measures related to weight and fitness (see Table 2.3.1). These measures are all drawn from an examination by a physician or a test conducted by a trained person.

The first set of indicators of weight problems are based on the Body-Mass-Index (BMI). The BMI is calculated by dividing the weight (kilograms) by the squared height (meters). The BMI is most commonly used to determine weight issues. It is not appropriate to classify obesity for children according to the standard index for adults (BMI above 30 = obese). Therefore, 'obesity' is defined by a BMI that lies above the 97th percentile of the relevant age-gender distribution and 'overweight' is defined as a BMI above the 90th percentile. The relevant threshold values were derived by Kromeyer-Hauschild (2005) for

[22] About 13 percent of observations in the sample were not in non-family care before school enrollment.

[23] In West Germany there are 207 children in the treatment group and 1,292 in the control group, while in East Germany the ratio is 638 to 240.

Germany. In our sample the probability to be overweight is 12 percent and the probability to be obese is four percent on average (see Table 2.A.2). The BMI variable itself is standardized to a mean of zero within the age-gender distribution, using half-year steps in age.[24] In addition, it is controlled for the age of children in months (cubic term) and child height to rule out that age differences or growth, a rather positive development, distort the results.

Table 2.3.1: Outcome Variables

Weight indicators	
BMI*	Weight(kg)/Height(m)^2
Obese	BMI>97-percentile in the relevant age-gender group (Kromeyer-Hauschild, 2005).
Overweight	BMI>90-percentile in the relevant age-gender group (Kromeyer-Hauschild, 2005).
Body Fat (BF)*	Percentage body fat (Slaughter et al., 1988).
BF>90	Body fat>90-percentile in the relevant age-gender group within KiGGS.
Motor skills test	
Side Jumps (Jump)**	Number of jumps in 15 seconds, higher score = better

* Standardized to a mean zero within the age-gender group (0.5 year steps).
** Standardized to a mean zero and a standard deviation of one within the age-gender group (0.5 year steps).

Burkhauser and Cawley (2008) argue that the percentage of body fat is a better fatness indicator than the BMI because the BMI does not distinguish between muscle, bone, and fat mass. However, results based on the BMI are easier to compare and the analysis is more standardized. Evidence on both measures is provided to make the results more reliable. The age and gender dependent value of the percentage of body fat is calculated according to Slaughter et al. (1988) using two skin fold measures. The same standardization procedure as for the BMI was used. Furthermore, a risk value is calculated. There are no threshold values as there is for the BMI. Therefore, the 90th-percentile in the same age-gender-group within the KiGGS is defined to be the relevant threshold.

The data also contains a unique sequence of tests for fine and gross motor skills.[25] The gross motor skills test that can best be related to physical fitness is the side-to-side jump test. This test was used to assess gross motor coordination under a time constraint. The children were asked to perform as many jumps from side-to-side as possible during two 15 second intervals. The numbers for the two intervals were averaged (Woll et al., 2011). The test score is standardized to a mean of zero and a standard deviation of one in the same age-gender distribution, where age is again measured in half-year steps.

[24] The same procedure was used by Kromeyer-Hauschild (2005) in order to derive the threshold values.

[25] This module is not part of the public use file, but a supplementary module. The criterion for the selection of these motor tests was their capability to assess as many aspects of motor development and physical fitness as possible.

2.4 Estimation Strategy

2.4.1 The Identification Problem

The aim of this study is to provide evidence on the causal effect of early daycare usage on child health development. This can be illustrated in a Roy (1951) model of potential outcomes with Y_1 representing the health outcome in case of treatment D (*Early Care*) and Y_0 the health outcome if the child is non-treated.[26]

$$\begin{aligned} Y_1 &= \alpha + \beta + u_1 \qquad if \qquad D = 1 \\ Y_0 &= \alpha + u_0 \qquad if \qquad D = 0 \end{aligned} \tag{2.1}$$

with $E(u_1) = E(u_0) = 0$ in the population. In a simple form the choice of an individual would be:

$$\begin{aligned} D &= 1 \qquad if \qquad Y_1 - Y_0 > 0 \\ D &= 0 \qquad otherwise \end{aligned} \tag{2.2}$$

An individual would decide for the treatment if the outcome with the treatment is better than the outcome without the treatment. In this case, it may actually be more appropriate to think of the outcome as the parents' utility derived from child's health and well-being because it is the parents who contrast costs and benefits.

Only one outcome per individual is observed. Simply comparing the average outcomes of the treated and non-treated individuals potentially provides a biased estimator of the treatment effect.

$$\begin{aligned} E(Y|D=1) - E[Y|D=0) &= E(\beta) + E(u_1|D=1) - E(u_0|D=0) \\ &= \beta + \underbrace{E[u_1 - u_0|D=1]}_{Sorting\ Bias} + \underbrace{E[u_0|D=1] - E[u_0|D=0]}_{Selection\ Bias}. \end{aligned} \tag{2.3}$$

The *Selection Bias* arises when the outcomes of the treatment and the control group already differ in the untreated stage. There is a *Sorting Bias* if the gain from treatment differs between the treatment and the control group. If there is selection into treatment that depends on this gain, this induces a correlation between the treatment D and the error-term and leads to a biased estimate of the average treatment effect. Methods based on the selection on observables assumption, i.e. ordinary least squares (OLS) or matching, lead to biased estimates if not all of the factors driving selection are observed.

The most common example for these biases stems from the estimation of returns to higher education. In this case it is argued that individuals in the treatment group have higher unobserved ability, and so higher wages without the treatment and are more likely

[26] For simplification the control variables X are not included in this representation.

to select into the treatment because their gains from schooling are higher. For daycare the direction of this bias is not clear. Early daycare may not primarily be chosen based on the parental beliefs about the child's gain. It is possible that children who would benefit the most stay away from daycare because their parents have low career aspirations or underestimate the treatment effect.[27]

It has to be assumed that using KiGGS, OLS or matching cannot credibly identify causal effects of early daycare usage, as not all relevant factors are observed in the data. Early childhood health is only reported retrospectively and very approximately. There is some evidence that the mother's personality has an impact on childcare choice (Bjerre et al., 2011), but in the KiGGS there is no information on caring or health attitudes nor is there information on the employment history of the parents. If only very healthy children were selected into daycare early, the OLS estimator would be upward biased. If very 'caring' or 'sportive' mothers refrain from using daycare early, the estimated effect would be downward biased. Consequently, reverse causality, selection and sorting issues cannot be disregarded.

2.4.2 Implementation of the IV-Estimator

To deal with the identification problem, an estimator that exploits an exogenous variation in early daycare usage is preferable. In the present setting, information on the regional differences in the availability of publicly subsidized daycare for children before the age of three years is used as an instrumental variable (IV).
The instrument Z has to fulfill the following assumptions:

1. Independence Assumption (CIA) $[\{Y(D,Z);\forall D,Z\},D(Z=1),D(Z=0)] \perp X|Z$: The instrument Z is as good as randomly assigned, conditional on X.
2. Exclusion Restriction $Y(Z,D=d) = Y(Z',D=d)$ with $Z \neq Z'$: Conditional on X, there is no effect of Z on the outcome Y other than through the treatment.
3. Relevance of the First Stage: The effect of instrument Z on the treatment status is non-zero.

[27] The observed outcome can also be written as

$$Y = DY_1 + (1-D)Y_0 = D(\alpha+\beta+u_1) + (1-D)(\alpha+u_0) = D(\beta+u_1-u_0) + \alpha + u_0$$
$$= \alpha + \beta D + [u_0 + D(u_1-u_0)].$$

Then three potential sources of biases can be described. Firstly, the treatment status D could be correlated with u_0, e.g. if only people with genetic conditions that lead to lower weight problems select into treatment. Secondly, D could be correlated with (u_1-u_0) and therefore β if families partially anticipate the treatment effect β and the probability to choose the treatment depends on β. Thirdly, β could be directly correlated with u_0, e.g. if those with the worst outcome in the untreated state have higher returns. Then β depends on the outcome in the untreated state (see Carneiro et al., 2003).

For the individual family, the availability of publicly subsidized daycare seems to be random, as the decision about supply is made by regional authorities and cannot be directly influenced. However, the provision could be correlated with individual or regional characteristics and could in this way also be correlated with the child's physical health Y. Therefore, as further discussed in Section 2.4.3, it is assumed that the first and the second assumptions hold *conditionally* on the set of control variables X. The relevance of the instrument is demonstrated in the same section.

This method would identify the Average Treatment Effect (ATE) only if there was no heterogeneity in the treatment effect. If the treatment effect varies across individuals because of unobservable individual specific factors, even after conditioning on X, it is also referred to as essential heterogeneity (Heckman et al., 2006a). In this case only a form of the local average treatment effect (LATE) can be identified by imposing an additional monotonicity assumption.[28]

4. Monotonicity: With $Z > Z'$, $P_i(Z,X) \geq P_i(Z',X)$ for all i: The instrument shifts the participation probability P for all subjects i in the same direction.[29]

Based on this assumption the instrumental variable estimation identifies the causal effect for those individuals who change their treatment status to *Early Care* induced by a higher availability of publicly subsidized daycare. It is assumed that there are 'compliers', those who start using daycare early at a higher supply with daycare for children under the age of three. The assumption rules out that there are any 'defiers', referring to parents who stop using daycare early at a higher availability. All other parents are assumed to not react at all ('always-taker' or 'never-taker').

The instrument in this study is continuous. Hence the full variation in daycare supply is exploited. The estimated effect can be interpreted as a weighted average over Marginal Treatment Effects (MTE) at different levels of the instrument (Angrist and Pischke, 2008). The MTE is the limit form of the LATE parameter. It refers to the average effect of the treatment for those children who are indifferent between participating and not participating in early daycare.[30]

The analysis relies on a non-linear estimation procedure in three steps to deal efficiently with the binary nature of the treatment variable. A 'stage 0' is performed, estimating the probability to participate in daycare early in a probit model which includes the regional availability of daycare for children under the age of three (Z). Subsequently the first and second stage are conducted, as known from the standard linear two-stage

[28] The LATE effect was defined by Imbens and Angrist (1994) for the case of binary instruments.
[29] $P_i(Z,X) \leq P_i(Z',X)$ for all i would also be possible, but is not plausible in this case.
[30] The MTE is a choice-theoretic parameter that was first introduced by Björklund and Moffitt (1987).

least squares (TSLS) estimator, but using the predicted probability to begin daycare early $P(D=1|X,Z)$ as the actual instrument. This leads to the following estimation steps:

Stage 0: Estimate $P(D=1|X,Z)$ via probit and predict $\hat{P}_i = \Phi(\alpha_0 + \beta_0 Z_i + \gamma_0 X_i)$

Stage 1: Estimate $D_i = \alpha_1 + \beta_1 \hat{P}_i + \gamma_1 X_i + \varepsilon_{1i}$ via OLS. Predict $\hat{D}_i$.

Stage 2: Estimate $Y_i = \alpha_2 + \beta_2 \hat{D}_i + \gamma_2 X_i + \varepsilon_{2i}$.

with Φ being the cumulative distribution function (cdf) of the standard normal distribution. An alternative non-linear procedure would be to include $P(D=1|X,Z)$ directly in the second stage, hence to substitute the linear first stage by a non-linear first stage. Compared to this approach, the three-step approach used in the present setting is less vulnerable against misspecification and leads to a robust estimator even if the model for $P(D=1|X,Z)$ is not the correct one.[31] It has the additional advantage that the standard errors of the linear TSLS model do not have to be adjusted for the generated instrument (Wooldridge, 2010).

This non-linear two-stage least squares method (NTSLS) is shown to be more efficient than the TSLS estimator because the probit is a better fitted model for the binary treatment than a linear OLS model (Newey, 1990; Angrist and Pischke, 2008; Wooldridge, 2010). Next to Wooldridge (2010), Carneiro et al. (2011), Mogstad and Wiswall (2012), Fitzsimons and Vera-Hernandez (2013) and Attanasio et al. (2013) provide examples of analyses using the predicted participation probability as the instrument. Congruently, they find substantial improvements in precision compared to the TSLS estimates. Heckman et al. (2006a), in addition, argue that the usage of the predicted probability as the instrument ensures that all MTEs are assigned a positive weight.[32]

Subgroup analyses are performed to narrow down the group of children for whom the treatment effects are identified via the instrumental variable estimation. This analysis confirms that the estimates should be interpreted as local effects for the subgroup of individuals affected by the instrument. In addition, some rough evidence for the existence of effect heterogeneity related to unobservable characteristics is derived by estimating the distribution of the MTEs. The sample size is too small and the instrument does not have enough support to derive plausible estimates for other treatment effects based on the MTE, but this exercise may give some insight into whether there exists heterogeneity along the estimated propensity score.[33] The patterns presented in the appendix are derived by relying on a parametric approach, assuming normality.[34]

[31] The estimator is an efficient IV-estimator if $Var(u_0|X,Z) = Var(u_0|X)$ and the probit model for the participation probability $P(D=1|X,Z)$ is correct.

[32] It ensures monotonicity or uniformity. This in turn avoids a misinterpretation of the effect sign.

[33] Heckman et al. (2006a) show that all treatment effects can be calculated by appropriately weighting the MTE given a strong instrument that affects the participation decision over the full support.

[34] The sample is also too small for a reasonable non-parametric analysis. Essentially a switching regres-

2.4.3 Specification

The information on the availability of publicly subsidized center-based daycare for children under the age of three is available at the county level ($n \approx 470$ counties). The data is drawn from the Child and Youth Welfare Statistics which is provided by the Regional Database of the Federal Statistical Office and the German Youth Institute (DJI). The actual instrument is calculated by dividing the available slots for children under the age of three in a county by the number of children in the respective age group living in that county (*slot-child-ratio*). The available slots are measured at three relevant dates: 1994, 1998 and 2002. Statistics on a yearly basis do not exist. Information for the remaining years is derived by simple interpolation, e.g. the average of the values in 1994 and 1998 is assigned to the year 1996. Robustness tests reveal that results are not sensitive to this procedure (see Section 2.5.4) because there were only small changes over time in the relevant time period (see DJI, 2005).

Figure 2.4.1 depicts the distribution of slots for children under the age of three in 1998. It shows that the level between former East and West Germany differs, but also that there is variation within states. The KiGGS is sampled at 167 points. Hence a large fraction of the regional variation can be exploited. Table 2.4.1 presents the distribution of the *slot-child-ratio* within states in the KiGGS data and confirms that there are substantial regional differences.

This instrument would not be valid if the level of provision was correlated with the children's health. A direct connection is rather implausible. There is no evidence that parents relocate into areas with a high daycare provision. Based on German micro level data, Felfe and Lalive (2012) find that only a few parents with young children move at all and that the mobility decision is unrelated to the number of daycare slots in the region.[35]

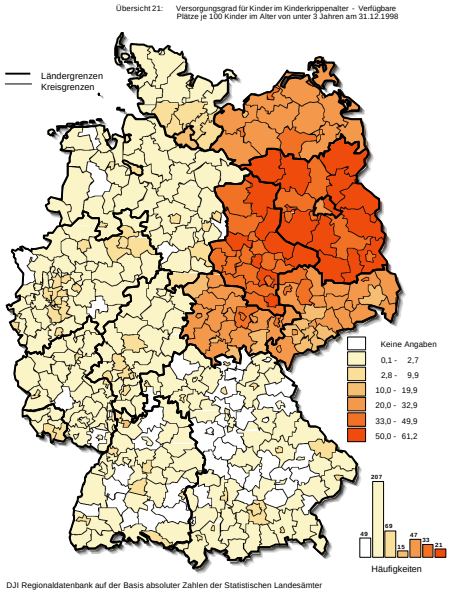
However, there may be indirect channels through which a correlation arises. Since the decision about the provision of publicly subsidized daycare was mainly taken by regional authorities, differences in regional wealth levels or female labor market participation could be such factors. Therefore, to meet assumptions one and two, it is controlled for income (per capita), the unemployment rate, the employment rate (i.e. participation rate), the female employment rate[36], the share of inhabitants with foreign nationality, the share of children aged zero to three years, and the population density at the county level.

sion model with a control function based on the inverse mills-ratio for the treatment and the control group is estimated (see Heckman et al., 2006b; Brave and Walstrum, 2014).

[35]They analyze birth cohorts from the years 2002 to 2008. In this period daycare became a rather important public topic in Germany. Their arguments are therefore even more likely to hold for an earlier time period. There is no information in the KiGGS about mobility. Based on administrative data it is possible provide crude evidence for the rejection of a relationship of mobility and daycare provision.

[36]The Federal Statistical Office only provides information for broad age groups. We opt for the employment rate of women aged 30 to 50 years, hence who have a high likelihood to be mothers.

Figure 2.4.1: Daycare Availability across German Regions (1998)



Source: Zahlenspiegel, Deutsches Jugendinstitut, 2002.

Table 2.4.1: Variation of the *Slot-child-ratio* within States

Federal State (*'Bundesland'*)	Mean	Min.	Max.	Sd.
Schleswig-Holstein	0.019	0.007	0.033	0.010
Hamburg	0.119	0.117	0.124	0.002
Lower Saxony	0.020	0.000	0.060	0.020
Bremen	0.077	0.075	0.084	0.003
North Rhine-West	0.021	0.000	0.062	0.015
Hesse	0.025	0.006	0.078	0.020
Rhineland-Palatinate	0.023	0.002	0.073	0.024
Baden-Wuerttemberg	0.014	0.000	0.084	0.019
Bavaria	0.011	0.000	0.075	0.018
Saarland	0.029	0.007	0.043	0.012
Berlin	0.319	0.307	0.349	0.010
Brandenburg	0.509	0.409	0.624	0.057
Mecklenburg-West Pomerania	0.330	0.217	0.511	0.080
Saxony	0.259	0.117	0.401	0.062
Saxony-Anhalt	0.501	0.429	0.602	0.047
Thuringia	0.280	0.175	0.433	0.054
Total	0.149	0.000	0.624	0.183

Source: KiGGS Version 4 & Federal Statistical Office, own calculations.

These variables are provided by the Federal Statistical Office. KiGGS is linked with the regional information for the first year of the child's life.[37] As some children are already

[37]Most information is available from 1995 on.

in daycare when they turn one, it is assumed that the decision about early daycare usage is made based on the information available in the year of the child's birth. However, most county-level characteristics only change slowly over time. In addition, a measure of urbanization is included from the KiGGS.

State fixed effects are included because the state government has an impact on the decision about the financial support for daycare. Consequently the identification strategy only relies on the variation in daycare provision within states. Inference is based on standard errors that are clustered at the county level. Given the different caring systems and related norms in East and West Germany, interactions between the regional characteristics and a binary variable indicating that the child lives in East German are included. Hence, for example, regional income is allowed to have a different impact on daycare supply in East Germany than in West Germany.

Furthermore, it is controlled for a set of individual and family specific characteristics. These are: basic child characteristics, child early health indicators, parental socioeconomic background variables, parental health and health behavior proxies, measures of family composition, and indicators of the caring mode (see Table 2.A.4 for details). It is argued that including these variables blocks the channels through which the instrument could potentially be correlated with the outcome.

Table 2.B.1, in the appendix, reveals that after conditioning on regional characteristics and including state fixed effects, the *slot-child-ratio* is orthogonal to child and family characteristics. Only children with a malformation seem to make a significant but small difference. All other crucial determinants, such as parental socioeconomic status and parental health have no significant impact on the level of provision once it is controlled for regional differences. These estimates also reveal that there is a small time trend indicating that for children born before the year 2000 the regional supply is slightly lower on average. Regional characteristics matter, particularly female employment, and have a stronger influence on supply in East Germany than in West Germany.

A few studies successfully employ a similar instrument in the context of caring decisions. For Germany, there are the studies by Felfe and Lalive (2012, 2014), analyzing the effect of early daycare usage on a child's cognitive and behavioral development. Kröll and Borck (2013) estimate the effect of daycare on maternal well-being and mother-child interactions. Dustmann et al. (2012) study the effect of daycare usage in the age of three to six years on child development. Datta Gupta and Simonsen (2010) perform a similar analysis estimating the effect of different types of care in Denmark.

The instrument in some of the mentioned German studies differs from ours with respect to two aspects. Felfe and Lalive (2012) and Kröll and Borck (2013) use administrative information on the number of children in center-based daycare as a proxy for

availability, while in the present paper the actual supply of slots is exploited.[38] Dustmann et al. (2012) and Felfe and Lalive (2014) do not combine their data with administrative data, but use the average in daycare usage of all children in their sample at one child's place of living as a proxy for availability.[39] Their instrument does not only include publicly subsidized center-based care, but also other care alternatives that are not part of the official statistics. This approach is performed as a robustness check in the present study. The usage of *Early Care* of all four- to 13-year-old children at the KiGGS sample point is averaged, excluding the individual's own observation. As daycare supply is rationed, demand can be assumed to equal supply, and as such, provides a second measure of availability (referred to as the second instrument).

2.5 Results

2.5.1 First-Stage Estimates

Table 2.5.1 depicts the first-stage coefficients for the full sample, using the *slot-child-ratio* directly as the instrument and using the predicted participation probability as the instrument. The estimates reveal that both instruments have a strong and highly significant impact on whether *Early Care* is used. In Section 2.5.2 and Section 2.5.3, in every table containing estimation results, the F-statistic is provided based on the estimation for BMI. This F-statistic detects by a 'rule of thumb' a weak instrument problem at a value of 10 or lower (Staiger and Stock, 1997). For the predicted participation probability this number outgrows the critical value by far. This instrument has a much stronger predictive power than the *slot-child-ratio* and leads to more precisely estimated effects in the second stage (see Table 2.5.2). For this reason Mogstad and Wiswall (2012) refer to the predicted probability as the "efficient instrument". The F-statistic for the *slot-child-ratio* is also above 20 and so also clearly exceeds the critical threshold. It performs weaker in some of the analyzed subsamples (see Table 2.B.2 and Section 2.5.3).

Technically, in the non-linear instrumental variables approach, the treatment effect would be identified even if there was no variable providing exogenous variation. In this case identification would be achieved off the non-linearity of the predicted probability $P(D = 1|X,Z)$. However, such an estimator cannot easily be justified and is therefore not desirable (Wooldridge, 2010, Chapter 21). Fortunately, the strong impact of the *slot-child-ratio* on using *Early Care* reveals that a strong exogenous variation is exploited in the present setting. This reassures that the non-linearity is not the sole mechanism

[38] Until 2002 the Federal Statistical Office provided information on the supply of slots in daycare centers, from 2006 on they provide the number of children who are in daycare. Even if the market is very restricted, this does not have to be the same.

[39] Both capture the variation generated by the expansion over time.

Table 2.5.1: First Stage Results - TSLS and NTSLS

	Full Sample
Slot-child-ratio (TSLS)	1.071***
	(0.314)
Predicted probability (NTSLS)	1.220***
	(0.084)
Observations	2377

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are based on OLS estimations. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

driving identification in the NTSLS estimation.[40]

Further coefficients of the first stage estimation reveal some selection patterns (see Table 2.B.3). These estimates show that highly educated mothers and mothers who are still in training use daycare before the age of three more often. Small families, single or separated parents, mothers who breastfed and parents who state to smoke regularly at home are all more likely to use *Early Care*. The unemployment rate in the county is only significantly positive associated with *Early Care* usage in East Germany. In regions with higher population density *Early Care* is used a little more often. Whether the parent reported the starting months is also positively related to *Early Care*. It seems that the early users are better informed about the exact starting age. All other regional effects are small and not statistically different from zero, thus individual attendance is unrelated to most county level variables once daycare supply and state fixed effects are accounted for.

2.5.2 Treatment Effects of Early Universal Daycare

Table 2.5.2 gives the estimation results for the full sample. The unconditional OLS coefficients displayed in the last row indicate a tendency of worse physical outcomes if children are in daycare earlier. However, controlling for available observable characteristics turns these tendencies around. The estimates are not statistically different from zero, but the change in sign indicates that there are observable differences between the treatment and control group. This suggests that there might also be selection on unobservables. Main drivers for the differences in the effects in the conditional and the unconditional OLS are regional factors. Living in East Germany or cities is, for example, positively correlated with daycare usage, but also with weight.

The NTSLS estimates using the *slot-child-ratio* as the source of exogenous variation in stage zero, reveal a stronger picture for the children 'at the margin'. There is a reduction

[40] See Carneiro et al. (2003) for a similar argumentation.

Table 2.5.2: Effect of *Early Care* - Full Sample

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
NTSLS - Main instrument						
Early Care	−1.064**	−0.130**	−0.094**	−2.404**	−0.116*	0.467**
	(0.443)	(0.065)	(0.042)	(1.105)	(0.061)	(0.219)
NTSLS - 2nd instrument						
Early Care	−0.936**	−0.135**	−0.103**	−1.951*	−0.113*	0.262
	(0.441)	(0.066)	(0.041)	(1.123)	(0.062)	(0.227)
TSLS - Main instrument						
Early Care	−1.176	−0.158	0.080	−1.833	−0.103	1.145*
	(1.265)	(0.203)	(0.139)	(3.402)	(0.192)	(0.664)
OLS						
Early Care	−0.066	−0.012	−0.006	−0.354	−0.005	0.040
	(0.130)	(0.021)	(0.013)	(0.335)	(0.019)	(0.056)
OLS - no controls						
Early Care	0.114	0.003	−0.004	0.304	0.006	−0.034
	(0.104)	(0.015)	(0.009)	(0.289)	(0.013)	(0.058)
Observations	2372	2372	2372	2348	2348	2335

F-Stat.(NTSLS): 202.09 , F-Stat.(TSLS): 21.64, F-Stat.(NTSLS 2): 191.61, F-Stat.(TSLS 2): 29.27

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. The estimation method (NTSLS, TSLS, OLS) is displayed. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

in the level of the BMI and the percentage of body fat by more than one point and more than two percent (columns one and four). The probability of being overweight is 13 percentage points lower and the probability of being obese is about 9 percentage points lower if children are in daycare early. In a similar range is the reduction in the probability to belong to the 90th-percentile of the body-fat-distribution by 12 percentage points. This picture of better physical development is confirmed by a positive effect of *Early Care* on the number of side-to-side jumps. Within the relevant age-gender group the children in *Early Care* score 47 percent of a standard deviation better on average.

The effects estimated by NTSLS and based on the second instrument are very similar and confirm all effects derived in the main specification, except on motor skills development. However, the tendency for the effect of *Early Care* on side-to-side jumps is also positive. For all other outcomes the point estimates resemble the NTSLS estimates based on the *slot-child-ratio*.

The standard TSLS estimates are in line with the estimates derived by NTSLS. As expected they are less precisely estimated. Particularly the effect on the side-to-side jumps seems to be overestimated. Only for obesity does the TSLS estimate indicate another

direction. However, this TSLS estimate is far from being significantly different from zero. The NTSLS estimate lies clearly within the 95-percent interval, hence it cannot be rejected. Overall the picture confirms better weight and fitness outcomes.

The effect sizes in the NTSLS model lie between not having an overweight or obese mother or father (see Table 2.B.4). It becomes apparent that these effects are non-negligible once realizing that parental weight problems are one of the crucial determinants for a child's weight problems (see Klesges et al., 1995; Freeman et al., 2011). Only a small portion of children in the sample have weight problems. Therefore, it does not seem appropriate to interpret these relatively large estimates as average treatment effects, but rather as local treatment effects for a group of children with a relatively high obesity risk. The subgroup analysis in Section 2.5.3 supports this interpretation.

It is not an unusual finding that OLS estimates are smaller than instrumental variable estimates for the returns to education (see Card, 2001; Felfe and Lalive, 2012, 2014). One explanation for this finding is also related to the group of children for whom different methods identify the treatment effect. Instrumental variable estimators provide the effect for the marginal individual, while OLS identifies a, potentially biased, estimate of the average treatment effect. If children whose parents are indifferent between using or not using daycare early gain more than the children gain on average this might explain the gap. One reasoning would be that individuals who gain most face a relatively high cost of using *Early Care*.[41] Even though daycare fees are low and income-dependent in Germany, the paid amount corresponds to a larger share of household income in low-income households (see Kreyenfeld et al., 2001, Chapter 7.2).[42] In addition, due to generous financial support which was independent of former income in the relevant time period, mothers with a high earnings potential faced a relatively higher cost of staying at home.[43] Hence incentives to rely on daycare early varied with the family's socioeconomic background.

It should be kept in mind that this is a weighted effect, averaging over the MTEs for different groups. Therefore, it is not possible to infer anything about the OLS bias, comparing the estimated OLS effects with the effects derived by the instrumental variables strategy.

We next try to figure out for which groups of children these treatment effects are particularly strong. It turns out that it is not possible to conduct reliable estimates of causal effects for all subgroups because only some of these groups actually react to the differences in publicly subsidized daycare supply. This finding prevents us from discussing

[41] This could be the case, if there were credit constraints (see e.g. Card, 2001).

[42] In 1996 about 3% of household income was used for daycare, on average.

[43] In the observation period, there existed job protection for 36 months and parental leave payments for 24 months. Eligibility for these flat payments of €300 per months depended on household income. 24% of parents did not receive the benefit at all (see e.g. Kluve and Tamm, 2013). The recipient was not allowed to work full-time (working up to 19 hours per week was allowed till 2001, then it increased to 30 hours).

effect heterogeneity in its usual way, by comparing effect sizes between groups. Still it allows to better locate the population for which the estimated effects are relevant. It is shown in the following section that the reaction to the availability of daycare for children before the age of three is much stronger in families without high household income and with an overweight father. There is no clear evidence for differences in the effects by gender or region.

2.5.3 Locating Affected Groups

Using an instrumental variable strategy, the effects for individuals who react most strongly to the change in the instrument are implicitly weighted more heavily. Hence it is of interest whether we can infer anything about the characteristics of this group. In developed countries socioeconomic status is negatively related (Shrewsbury and Wardle, 2008; Currie, 2009) and parental weight is positively related to weight problems in children (Klesges et al., 1995; Freeman et al., 2011). These groups are partly overlapping as income is also negatively related to adult weight problems (e.g. Nocon et al., 2007). Hence, income and parental weight are crucial factors determining a child's risk to develop weight and fitness issues. For policy conclusions it is of primary interest whether effects for advantaged children, i.e. children who have good prospects anyway, or more disadvantaged children are estimated.

A separate analysis is conducted for a less wealthy group of families, defined to have less than €3000 of monthly household income. The effects are compared to the group of wealthy families with a household income of at least €3000.[44] A look at the first stage regression for these two groups already reveals that the instrument has a much stronger effect in the group of less wealthy families (see Table 2.B.2). Excluding the children of wealthy families does not alter the estimated effects very much compared to the estimates in the full sample. Only in the subsample of less wealthy families early daycare turns out to lead to better physical health development (see Table 2.5.3). It should be emphasized that the estimates presented in Table 2.5.3 for families with high household income are not reliable causal effects because the instrument only generates a very weak variation in this subgroup.[45] Consequently, it should not be concluded that early daycare raises the probability to become overweight for these children.

These results are in line with the pattern provided by the subgroups analysis via OLS.

[44] Household income is provided as an ordinal variable. Further analysis suggests that the larger group with low and middle income react relatively similar to daycare provision, while the smaller group with higher income differs. Hence this way of grouping seems appropriate.

[45] A specification with interaction terms, using the interaction between the *slot-child-ratio* and high income as an instrument is consequently not applicable because the interaction term would not be a valid instrument.

The OLS estimates also indicate that *Early Care* leads to fewer weight problems and better fitness for children in middle and lower income households (see Table 2.C.1). An additional analysis, not presented here, reveals a similar pattern for maternal education.

Table 2.5.3: Effect of *Early Care* by Household Income

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
NTSLS - Monthly Household Income $\geq$ €3000						
Early Care	0.808	0.162*	0.034	0.122	0.015	0.628*
	(0.577)	(0.095)	(0.055)	(1.713)	(0.084)	(0.349)
Observations	754	754	754	747	747	745
	F-Stat.(NTSLS): 69.51, F-Stat.(TSLS): 0.80					
NTSLS - Monthly Household Income $<$ €3000						
Early Care	−1.268**	−0.189**	−0.099*	−1.875	−0.115*	0.374
	(0.573)	(0.089)	(0.058)	(1.364)	(0.069)	(0.258)
Observations	1618	1618	1618	1601	1601	1590
	F-Stat.(NTSLS): 148.37, F-Stat.(TSLS): 24.48					

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

This finding is not implausible. Wealthy families' decision about using daycare early may be less dependent on subsidized daycare because high-income families have better access to private care solutions and the career aspirations, particularly of mothers, are higher. For these reasons wealthy families are more likely to belong to the 'always-takers' or 'never-takers'. The results also support the assumption that migration into areas with a high provision of daycare does not bias the results. Given that education and income are crucial determinants of geographical mobility in Germany (see e.g. Jürges, 2006), these findings suggest that the effects are driven by the less mobile groups.

It is of further relevance whether the effect for children who are at risk from a health point of view is estimated. Interestingly, there are no large differences related to the mother's BMI, but a strong pattern related to the father's BMI, which is presented in Table 2.5.4.[46] The estimates in Table 2.5.4 show that the treatment effects that are more pronounced in the group of children with a father who is overweight (BMI > 25). The estimated coefficients are even larger than in the combined sample. A comparison of the F-statistics for the two subsamples shows, similar to the finding in the analysis with respect to household income, that the explanatory power of the instrument is much stronger in the group with overweight fathers.

[46]Some evidence points out that the father's BMI may play a more important role (see e.g. Freeman et al., 2011), however it could also be the case that these families are just more constrained.

Based on the findings in these subsamples, the main estimates should be interpreted as beneficial effects for children with a relatively high risk of developing weight issues.

Table 2.5.4: Effect of *Early Care* by Paternal Weight

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
NTSLS - BMI Father ≤ 25						
Early Care	−0.269	−0.022	−0.013	−0.442	−0.010	0.441
	(0.444)	(0.064)	(0.028)	(1.262)	(0.069)	(0.290)
Observations	1018	1018	1018	1006	1006	1002
	F-Stat.(NTSLS): 105.40, F-Stat.(TSLS): 2.97					
NTSLS - BMI Father > 25						
Early Care	−1.294**	−0.101	−0.150**	−2.715*	−0.184**	0.404
	(0.648)	(0.096)	(0.070)	(1.536)	(0.089)	(0.260)
Observations	1354	1354	1354	1342	1342	1333
	F-Stat.(NTSLS): 125.26, F-Stat.(TSLS): 16.75					

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Previous studies found differences in the effects of daycare by gender. Whether boys or girls benefit more depends on the outcome and the setting under consideration (see Datta Gupta and Simonsen, 2010; Felfe et al., 2015). Table 2.5.5 depicts the treatment effects estimated separately for boys and girls. The first stage estimates presented in Table 2.B.2 already suggest that the strength of the instrument weakens in the separate analyses by gender. Based on this rather weak instrument, which at least for girls still passes the 'rule of thumb' threshold, one would conclude that both boys and girls gain from *Early Care* by reduced weight problems and also better motor skills performance. For boys, the second instrument performs better, according to the F-statistics, but the effects are very similar.[47] The point estimates for girls and boys diverge slightly, but do not differ statistically in most cases.

Due to historical reasons supply and utilization of daycare strongly differ between East and West Germany. It is of interest whether the effects of *Early Care* differ between these regions as well. The instrument performs weaker if the sample is split. This may not be surprising, as fewer regions are included in each subsample and so there is less regional variation (see Table 2.5.6). The difference in the F-statistics between NTSLS and TSLS are much smaller in East than in West Germany. The improvement in precision by using NTSLS seems to be much larger in West Germany, where *Early Care* is less common.

[47] Results are available on request.

Table 2.5.5: Effect of *Early Care* by Gender

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
NTSLS-Girls						
Early Care	−1.139**	−0.226***	−0.133**	−2.074	−0.137*	0.388
	(0.572)	(0.084)	(0.058)	(1.494)	(0.081)	(0.299)
Observations	1200	1200	1200	1187	1187	1185
	F-Stat.(NTSLS): 106.08 , F-Stat.(TSLS): 12.41					
NTSLS-Boys						
Early Care	−1.534**	−0.104	−0.043	−2.631	−0.153*	0.320
	(0.680)	(0.097)	(0.064)	(1.632)	(0.092)	(0.290)
Observations	1172	1172	1172	1161	1161	1150
	F-Stat.(NTSLS): 101.63 , F-Stat.(TSLS): 6.99					

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.5.6: Effect of *Early Care* by Region

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
NTSLS-West						
Early Care	−0.750	−0.053	−0.015	−3.682**	−0.182*	0.079
	(0.592)	(0.096)	(0.058)	(1.739)	(0.100)	(0.334)
Observations	1494	1494	1494	1474	1474	1467
	F-Stat.(NTSLS): 126.84 , F-Stat.(TSLS): 7.51					
NTSLS-East						
Early Care	−0.466	−0.099	0.007	−1.000	−0.073	0.887**
	(0.894)	(0.141)	(0.095)	(2.344)	(0.132)	(0.413)
Observations	878	878	878	874	874	868
	F-Stat.(NTSLS): 35.34, F-Stat.(TSLS): 10.92					

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

This is consistent with the insights derived by Mogstad and Wiswall (2012), who argue that the increase in efficiency by NTSLS is largest in the case of low probability events. However, the effects in both areas of Germany are not of high statistical significance and are not statistically distinguishable from each other. In West Germany the second instrument performs better, but leads to similar results.[48] After all, none of these estimates

[48]Results are available on request. The first instrument also performs better if regions with zero supply are excluded.

indicates that children in one or the other region suffer from *Early Care*.

The estimation of the distribution of the MTE, pictured in Section 2.D, reveals that it is likely that there is also some heterogeneity in the treatment effects related to unobservable differences. It seems, for example, that the reduced BMI effect arises in areas with a high propensity score or for families who decide to participate at high unobservable cost (u_D). In the present setting, the main insight to take from this exercise is that the estimated effects should actually be interpreted as local treatment effects. The derived confidence bands show that it is not possible to estimate a distribution that is significantly different from zero, even under the strong assumption of normality. Further calculations using the distribution of the MTEs has to be left to future research based on a larger sample.

2.5.4 Sensitivity Analyses

As the results rely on an instrument that is partly a linear interpolation between three points in time, robustness of the results to different specifications of the instrument is checked. Firstly, only the *slot-child-ratio* in 1998 is used. Secondly, because of the differences between East and West Germany, the interaction between the binary East Germany indicator and the *slot-child-ratio* is included as an additional instrument. Thirdly, a squared term of the *slot-child-ratio* is added to the linear term to capture non-linearity (see Table 2.C.3). In addition the stage zero was specified as a logit model. The results are very robust to these changes.

Sensitivity to different specifications is also analyzed. With a limited set of control variables none of the results contradict the main findings (see Table 2.C.2). As expected more control variables increase the precision of the estimates. Adding more regional variables, particularly the mean BMI of very young children (aged zero to two) and the mothers' and fathers' average BMI at the sampling point to the main specification reveals that the results are robust to the inclusion of these measures. We take this as evidence in favor of the assumption that the estimates are not driven by regional differences in weight problems. If district fixed effects are included (regional authorities between counties and states) effects remain comparable, but there is a loss of precision because of the reduced regional variation. The results are also robust to excluding small city states with mainly temporal variation.

Slightly more than 1.2 percent of observations lie outside the region of common support, i.e. either the participation probability in the treatment group exceeds the maximum probability value in the control group or the probability for some individuals in the control group is lower than the minimum probability of the treatment group. The results are robust to excluding these observations (see Table 2.C.2).

Even though the cutoff point of 30 months is well justified, robustness with respect to

the rounding procedure is checked. The main effects are re-estimated based on an 'earlier than three years' and a 'with two years or younger' threshold. The results given in Table 2.C.4 reveal that there are only slight changes in the point estimates and significance, but the qualitative conclusion based on the main analysis are confirmed.

Reducing the sample to children of primary-school age (aged six to nine years), shows that the effects are not only driven by children who are still in daycare (see Table 2.C.6). It should be kept in mind that these effects do not allow for conclusions to be drawn about the persistence of the effects because the individuals reacting most strongly to differences in daycare supply could actually be the same as in the main analysis.[49]

Sensitivity of the results is also investigated with respect to the choice of the subsample. Children for whom the parents report that the child was only in care of a childminder, children who were born in the year 1995, and children who began daycare when they were older than 54 months were alternatively included in the sample.[50] In all three cases the point estimates are very similar to the main results, but the estimates are a little less precise. This may be a result of a slightly weaker instrument. The availability of publicly subsidized daycare for children aged zero to three should not strongly affect the decision to make use of a childminder and the decision in the group, that for some unobservable reason, belongs to the late starters. In addition, in the earlier years there were more areas in West Germany with zero supply, such that the distribution of the instrument is more strongly skewed and there is less variation between regions.

2.6 Conclusions

In this paper the effect of early universal daycare usage beginning at 30 months or younger, on a child's physical development is estimated using a representative health dataset for children in Germany. Two strongly related aspects of physical health are analyzed: Weight and fitness. As recommended by the literature, the judgment of weight problems is not only based on the Body-Mass-Index, but also includes indicators based on the percentage of body fat (Burkhauser and Cawley, 2008). In addition, a test of gross motor skills as a proxy for the child's fitness is included. As such a broad picture of the child's physical health is provided. All indicators are recorded by a trained person. Hence, the estimates are not prone to a bias due to parental subjective reporting. As we compare children who are in daycare early with those who start later the estimates also capture the effect of the duration in daycare before school enrollment. The focus is on the medium-term perspective, therefore effects for five- to nine-year-old children are estimated.

[49] Further excluding the small group of nine-year old children does not strongly affect the results (results are available on request).

[50] Including the 1995 cohort, missing regional information is filled by the values for the subsequent years.

After conditioning on a large set of early health, parental, family and regional characteristics, there are no significant differences in outcomes between children that were in daycare earlier and those who started later revealed in ordinary least squares estimations. However, all effects point to a reduction of weight problems and a better performance in the gross motor test.

The main analysis is based on an instrumental variable strategy to deal with the selection into early daycare. Regional differences in the supply of publicly subsidized center-based daycare for children before the age of three are exploited as the source of exogenous variation in early daycare usage. The estimated local average treatment effects are derived by a non-linear instrumental variable strategy. The results show a significant reduction of weight problems and also a significantly better performance in the test for gross motor skills. These estimates should be interpreted as effects for children of parents who are indifferent between using daycare earlier and later, but chose to enroll their child in daycare early induced by a relatively higher supply of publicly subsidized center-based daycare. Moreover, the results provide additional evidence demonstrating that this non-linear instrumental variable approach is more efficient in the case of a binary treatment than the standard linear instrumental variable strategy (see e.g. Wooldridge, 2010; Mogstad and Wiswall, 2012). The effects are much more precisely estimated, but the point estimates for the two methods coincide.

The instrument does not change behavior for all individuals. The decision to use daycare early is particularly strongly influenced by differences in publicly subsidized daycare supply in families that do not belong to the highest income group and families with an overweight father. Only for these groups it is possible to provide reliable causal evidence because the instrument performs weakly in the groups of wealthy households and with non-overweight fathers. The treatment effects for the affected groups are very similar to the baseline results. Hence it is plausible to conclude that these groups drive the beneficial effects of early daycare usage in the main analysis. This conclusion is supported by OLS estimates that reveal a lower occurrence of weight problems in the middle and lower income groups due to early attendance in daycare. Further estimates do not indicate large differences by gender or between East and West Germany. However, the instrument performs weaker and estimates are less precise in these subsamples.

Our results contradict Herbst and Tekin (2011) who find detrimental effects of center-based care usage on children's weight in the United States. They analyze the effect of a daycare subsidy for economically disadvantaged single mothers, which is argued to have led to an intensive usage of low-quality daycare. The German daycare system has relatively high quality standards and was originally designed to educate children and not with the aim of enabling mothers to work long hours. Evidence suggests that shorter hours

and higher quality can be assumed to make a crucial difference. Research by Felfe and Lalive (2014) confirms that daycare in Germany can be beneficial for child development, by revealing positive effects of early daycare usage on the performance in the school readiness examination.

The results of the present study agree with the findings for the targeted early education programs in the United States, but the estimated effects are smaller than those of Frisvold (2006), Carneiro and Ginja (2015) or Campbell et al. (2014). This is not surprising. Compared to the German daycare system, these programs included more explicit guidelines aiming to change the children's diet as well as their exercising behavior and were targeted at a group with low socioeconomic background, which is shown to be at higher risk to develop weight problems (e.g. Currie, 2009).

In present study, one of the benefiting groups are children of fathers with weight problems, so early usage of daycare may reduce the transmission of these problems within families. The question of whether differences in the diet and in daily exercise by being more active with other children or other changes in behavior and preferences are responsible for the effects must be left to future research, as our dataset does neither provide information about the daycare intensity nor about the daily routine in the daycare centers. Exploring these mechanisms would enable policy makers to design daycare such that it becomes even more effective.

Despite these limitations, the present study provides evidence for the group of children in families whose childcare choice is affected by the availability of publicly subsidized daycare, confirming that early usage of universal daycare is not only not harmful, but provides benefits in terms of physical development. Daycare programs, similar to the German program, seem to be able to prevent children from gaining too much weight and facilitate higher fitness levels. Daycare attendance before the age of three could serve as a supplemental policy instrument to prevent further exacerbation of the obesity epidemic and related economic cost.

Appendix 2.A Descriptive Statistics and Definitions

Table 2.A.1: Lunch Provided in Daycare

Percent	1997	2002
No	13.6	13.8
Yes	86.4	86.2
Total	100.0	100.0

Note: Column percentages. Included are children in daycare aged 0-35 months at the time of observation. There is no information on whether children make use of lunch.
Data is weighted (unweighted observations: 47, 121).
Source: SOEPv28, own calculations.

Table 2.A.2: Distribution of Outcomes in Full Sample

	Early Care		
	Yes	No	Total
BMI	−0.02	−0.12	−0.08
Overweight	0.12	0.12	0.12
Obese	0.04	0.05	0.04
BF	−0.05	−0.27	−0.19
BF>p90	0.10	0.10	0.10
Jump	−0.02	0.01	0.00

Source: KiGGS Version 4, own calculations.

Table 2.A.3: Age Distribution

Age (Years)	Freq.	Percent
5	571	24.02
6	582	24.48
7	589	24.78
8	413	17.37
9	222	9.34
Total	2,377	100.00

Source: KiGGS Version 4, own calculations.

Table 2.A.4: Control Variables

Description	Scale	Variable
Child Characteristics		
Gender of child	Binary	Boy
Age of child (month)	Continuous , cubic	Age Child
Birth Period	Binary	Born before 2000
Child has low birth weight	Binary	Low Weight
Child had malformation after birth	Binary	Malformation
Child' height (cm)	Continuous , linear	Height
Use Childminder/Family daycare	Binary	Childminder
Child is in school age/ in school^{+}	Binary	School-age, School-now
Parents & Family		
First Born	Binary	First Child
No. Brothers and Sister	Continuous, linear	Siblings
Lives with single or step parent	Binary	Separated Parents
Migration background *	Binary	Migrant
Age Mother and Father (years)	Continuous, quadratic	Age
Education Mother and Father	Binary	Uni/College, Vocational, In Training, only school (info), Reference: No training/school
Parents have allergies	Binary	Parents Allergy
Weight Mother and Father	Binary	Overweight ($>$ 25BMI$<$ 30), Obese ($\geq$ 30BMI$<$ 35), Highly Obese (BMI$\geq$ 35), Reference: BMI$<$ 25
Child was breastfed	Binary	Breastfed
Parental smoking in flat	Binary	Sometime, Regularly, Reference: Never
Month reported	Binary	Months
Regional Controls (county level)		
Unemployment Rate^{i}	Continuous, linear	Unempl. Rate
Share of Working Population^{i}	Continuous, linear	Employment Rate
Share of Working Women aged 30-50^{i}	Continuous, linear	Female Empl.
Share of population of foreign nationality^{i}	Continuous, linear	Foreigners
Income per Capita (in €1000)^{i}	Continuous, quadratic	Income
Population Density^{i}	Continuous, linear	Density
Share of Population aged 0-3^{i}	Continuous, linear	Pop. 0-3
City Size/Urbanization^{i}	Binary	Small City (5000-20000), Mid. City (20000-100000), Large City (>100000), Reference Group: Urban: (<5000)
Federal states	Binary	15 Dummies (16 States)
Instrument		
Slots divided by no. of children age <3	Continuous	*slot-child-ratio*

* Child migrated to Germany and at least one parent was not born in Germany or both parents are migrated or have not the German citizenship.
^{i} These variables are also interacted with an indicator for East Germany.
$^{+}$ Only asked in the questionnaire for children that are seven years old or older.
Source: KiGGS Version 4 & Federal Statistical Office.

Appendix 2.B Daycare Provision and Full Results

Table 2.B.1: Determinants of Daycare Provision

	Slot-child-ratio		*Slot-child-ratio*	
Boy	−0.006	(0.007)	0.002	(0.001)
Age Child	−0.242	(0.355)	−0.016	(0.063)
Age Child^2	0.028	(0.049)	0.001	(0.009)
Age Child^3	−0.001	(0.002)	−0.000	(0.000)
Born before 2000	−0.016	(0.015)	−0.006**	(0.003)
Low Weight	−0.013	(0.014)	0.001	(0.002)
Malformation	0.022*	(0.012)	0.004**	(0.002)
Height	0.002***	(0.001)	0.000	(0.000)
Childminder	−0.035**	(0.014)	−0.000	(0.003)
School-age	0.017	(0.019)	0.001	(0.003)
School-now	−0.012	(0.018)	0.005	(0.003)
First Child	0.023**	(0.012)	−0.002	(0.002)
Siblings	−0.003	(0.004)	−0.001	(0.001)
Separated Parent	0.013	(0.013)	0.003	(0.002)
Migrant	−0.101***	(0.014)	−0.001	(0.003)
Mother Age	−0.023***	(0.009)	0.001	(0.002)
Mother Age^2	0.000**	(0.000)	−0.000	(0.000)
Father Age	−0.005	(0.006)	0.001	(0.001)
Father Age^2	0.000	(0.000)	−0.000	(0.000)
Mother Uni/College	0.123***	(0.018)	0.001	(0.003)
Mother Vocational	0.048***	(0.015)	−0.001	(0.003)
Mother in Training	0.030	(0.041)	−0.010	(0.007)
Mother only school	0.121***	(0.042)	0.000	(0.007)
Father Uni/College	0.001	(0.021)	−0.003	(0.004)
Father Vocational	0.020	(0.019)	−0.002	(0.003)
Father in Training	−0.010	(0.054)	0.007	(0.010)
Father only school	0.019	(0.051)	−0.006	(0.009)
Father no info	0.010	(0.056)	0.002	(0.010)
Parent Allergy	−0.019***	(0.007)	−0.001	(0.001)
Mother Overweight	0.006	(0.009)	0.001	(0.002)
Mother Obese	0.005	(0.014)	−0.000	(0.003)
Mother Highly Obese	0.010	(0.022)	0.001	(0.004)
Father Overweight	0.013*	(0.008)	−0.000	(0.001)
Father Obese	0.037***	(0.013)	−0.003	(0.002)
Father Highly Obese	0.057**	(0.027)	−0.001	(0.005)
Smoke Sometimes	0.003	(0.011)	0.001	(0.002)
Smoke Regularly	0.002	(0.012)	−0.002	(0.002)
Breastfed	0.024**	(0.010)	0.000	(0.002)
Breastfed no info	0.105*	(0.056)	−0.006	(0.010)
Month	−0.024***	(0.008)	0.002	(0.001)
Unempl. Rate			0.000	(0.001)
Empl. Rate			0.000	(0.000)
Female Empl.			0.000**	(0.000)
Foreigners			−0.006	(0.042)
Income			−0.007	(0.007)
Income^2			0.000	(0.000)
Density			0.005*	(0.003)
Small City			−0.001	(0.002)
Mid. City			0.002	(0.003)

Determinants of Daycare Provision (continued)

Big City			−0.001	(0.006)
Pop. 0-3			−0.007	(0.005)
Unempl. Rate * East			0.000	(0.001)
Empl. Rate* East			0.005***	(0.000)
Female Empl. * East			−0.003***	(0.000)
Foreigners * East			1.368***	(0.269)
Income * East			0.085***	(0.030)
Income^2 * East			−0.004***	(0.001)
Density * East			−0.062***	(0.006)
Small City * East			0.039***	(0.004)
Mid. City * East			−0.002	(0.004)
Big City * East			0.074***	(0.010)
Pop. 0-3* East			−0.106***	(0.009)
State Fixed Effects	NO		YES	
Constant	1.157	(0.850)	0.070	(0.168)
Observations	2377		2377	

Notes: Results are based on OLS estimations. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.B.2: First Stage Results for Subgroups

	Household Income		BMI Father		Girls	Boys	West	East
	High	Low	> 25	≤ 25				
Slot-child-ratio	0.471	1.257***	0.650*	1.230***	1.137***	0.893*	1.959**	0.954***
(TSLS)	(0.541)	(0.369)	(0.332)	(0.374)	(0.343)	(0.471)	(0.829)	(0.325)
Predicted prob.	1.148***	1.118***	1.067***	1.261***	1.160***	1.078***	1.278***	1.212***
(NTSLS)	(0.117)	(0.099)	(0.091)	(0.107)	(0.116)	(0.111)	(0.154)	(0.221)
Observations	756	1621	1021	1356	1202	1175	1499	878

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are based on OLS estimations. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.B.3: Full Results: First Stage TSLS

	Early Care	
Slot-child-ratio	1.071***	(0.314)
Boy	−0.018	(0.016)
Age Child	−1.001	(0.648)
Age Child^2	0.136	(0.089)
Age Child^3	−0.006	(0.004)
Born before 2000	−0.017	(0.031)
Low Weight	−0.016	(0.029)
Malformation	−0.063***	(0.020)
Height	0.003	(0.002)
Childminder	0.450***	(0.045)
School-age	0.033	(0.040)
School-now	−0.043	(0.032)
First Child	0.027	(0.028)
Siblings	−0.038***	(0.011)
Separated Parent	0.061**	(0.025)
Migrant	−0.039	(0.029)
Mother Age	0.022	(0.019)
Mother Age^2	−0.000	(0.000)
Father Age	−0.020	(0.017)
Father Age^2	0.000	(0.000)
Mother Uni/College	0.094**	(0.041)
Mother Vocational	0.028	(0.030)
Mother in Training	0.169**	(0.084)
Mother only school	0.148	(0.115)
Father Uni/College	−0.061	(0.048)
Father Vocational	−0.065	(0.043)
Father in Training	−0.080	(0.117)
Father only school	−0.160	(0.112)
Father no info	−0.005	(0.117)
Parent Allergy	0.008	(0.014)
Mother Overweight	−0.005	(0.015)
Mother Obese	0.006	(0.025)
Mother Highly Obese	−0.044	(0.037)
Father Overweight	0.004	(0.015)

Full Results: First Stage TSLS (continued)

Father Obese	0.019	(0.022)
Father Highly Obese	0.044	(0.061)
Smoke Sometimes	0.016	(0.021)
Smoke Regularly	0.048**	(0.021)
Breastfed	0.049***	(0.017)
Breastfed no info	−0.154	(0.113)
Month	0.098***	(0.018)
Unempl. Rate	−0.008	(0.007)
Empl. Rate	−0.002	(0.002)
Female Empl..	0.001	(0.001)
Foreigners	−0.690	(0.506)
Income	−0.086	(0.062)
Income^2	0.003*	(0.002)
Density	0.068***	(0.024)
Small City	0.006	(0.025)
Mid. City	0.004	(0.027)
Big City	0.026	(0.044)
Pop. 0-3	−0.004	(0.047)
Unempl. Rate * East	0.018*	(0.010)
Empl. Rate * East	−0.003	(0.004)
Female Empl. * East	0.001	(0.002)
Foreigners * East	1.379	(4.306)
Income * East	0.137	(0.392)
Income^2 * East	−0.004	(0.015)
Density * East	−0.036	(0.075)
Small City * East	−0.084	(0.055)
Mid. City * East	−0.046	(0.057)
Big City * East	−0.156	(0.132)
Pop. 0-3 * East	0.055	(0.119)
State Fixed Effects	YES	
Constant	2.925*	(1.707)
Observations	2377	

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by OLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.B.4: Full Results: Second Stage

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
Early Care	−1.064**	−0.130**	−0.094**	−2.404**	−0.116*	0.467**
	(0.443)	(0.065)	(0.042)	(1.105)	(0.061)	(0.219)
Boy	−0.133	−0.009	−0.002	−0.305	−0.020	−0.042
	(0.084)	(0.013)	(0.009)	(0.219)	(0.012)	(0.040)
Age Child	−3.447	−0.284	−0.856**	−9.517	−0.126	0.513
	(4.066)	(0.615)	(0.379)	(11.037)	(0.581)	(1.954)
Age Child^2	0.382	0.028	0.115**	1.035	0.002	−0.121
	(0.574)	(0.086)	(0.053)	(1.569)	(0.080)	(0.270)
Age Child^3	−0.018	−0.001	−0.005**	−0.046	0.000	0.007
	(0.026)	(0.004)	(0.002)	(0.073)	(0.004)	(0.012)
Born before 2000	−0.126	−0.010	−0.006	0.110	0.009	0.088
	(0.153)	(0.026)	(0.016)	(0.394)	(0.026)	(0.089)
Low Weight	0.193	0.021	−0.002	0.426	0.009	0.087
	(0.164)	(0.027)	(0.017)	(0.419)	(0.025)	(0.077)
Malformation	0.035	−0.008	−0.006	0.376	0.006	−0.068
	(0.134)	(0.021)	(0.013)	(0.367)	(0.020)	(0.067)
Height	0.124***	0.016***	0.007***	0.292***	0.013***	−0.008**
	(0.009)	(0.001)	(0.001)	(0.023)	(0.001)	(0.004)
Childminder	0.440	0.041	0.031	0.757	0.028	−0.130
	(0.270)	(0.039)	(0.024)	(0.629)	(0.035)	(0.133)
School-age	0.122	0.014	0.011	0.379	0.016	0.201*
	(0.189)	(0.031)	(0.018)	(0.469)	(0.032)	(0.108)
School-now	0.020	0.019	−0.004	−0.198	−0.008	0.087
	(0.194)	(0.032)	(0.020)	(0.529)	(0.029)	(0.099)
First Child	0.016	0.011	−0.009	0.194	−0.019	0.054
	(0.125)	(0.021)	(0.013)	(0.341)	(0.019)	(0.064)
Siblings	−0.074	−0.020***	−0.004	−0.273**	−0.023***	0.003
	(0.050)	(0.007)	(0.005)	(0.128)	(0.006)	(0.026)
Separated Parent	0.128	0.010	0.007	0.318	0.030	0.026
	(0.157)	(0.026)	(0.015)	(0.422)	(0.023)	(0.071)
Migrant	0.252	0.050*	0.027	1.193**	0.059**	0.056
	(0.186)	(0.028)	(0.021)	(0.473)	(0.028)	(0.086)
Mother Age	−0.000	−0.018	0.006	−0.145	0.000	0.101**
	(0.097)	(0.018)	(0.011)	(0.249)	(0.016)	(0.044)
Mother Age^2	−0.000	0.000	−0.000	0.002	0.000	−0.001**
	(0.001)	(0.000)	(0.000)	(0.003)	(0.000)	(0.001)
Father Age	−0.063	0.008	−0.002	−0.053	−0.002	−0.020
	(0.086)	(0.011)	(0.010)	(0.223)	(0.011)	(0.033)
Father Age^2	0.001	−0.000	0.000	0.001	0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
Mother Uni/College	0.315	−0.001	0.024	0.440	−0.037	0.027
	(0.233)	(0.035)	(0.026)	(0.596)	(0.034)	(0.106)
Mother Vocational	0.153	0.007	0.011	0.440	−0.014	0.062
	(0.199)	(0.029)	(0.022)	(0.513)	(0.030)	(0.085)
Mother in Training	−0.268	0.033	0.089	0.238	−0.002	−0.134
	(0.446)	(0.077)	(0.066)	(1.165)	(0.067)	(0.180)
Mother only school	0.188	−0.059	0.027	−0.139	0.041	−0.062
	(0.547)	(0.068)	(0.058)	(1.233)	(0.072)	(0.196)

Full Results Second Stage (continued)

Father Uni/College	−0.385	−0.020	−0.025	−0.973	−0.063	0.184
	(0.281)	(0.040)	(0.031)	(0.796)	(0.040)	(0.120)
Father Vocational	−0.302	−0.026	−0.014	−0.695	−0.047	0.140
	(0.268)	(0.038)	(0.030)	(0.769)	(0.039)	(0.110)
Father in Training	−0.618	−0.010	−0.050	−2.063*	−0.127***	0.028
	(0.477)	(0.078)	(0.038)	(1.171)	(0.048)	(0.264)
Father only school	−0.069	0.068	−0.014	−0.119	−0.075	−0.189
	(0.650)	(0.099)	(0.060)	(1.570)	(0.082)	(0.215)
Father no info	0.086	0.064	0.036	−0.218	0.009	−0.303
	(0.768)	(0.129)	(0.097)	(1.805)	(0.113)	(0.215)
Parent Allergy	−0.129	−0.001	−0.007	−0.291	0.005	0.118***
	(0.083)	(0.013)	(0.008)	(0.221)	(0.012)	(0.041)
Mother Overweight	0.445***	0.033**	0.026**	0.982***	0.033**	−0.080
	(0.104)	(0.016)	(0.011)	(0.282)	(0.015)	(0.049)
Mother Obese	1.260***	0.170***	0.055**	3.062***	0.133***	−0.038
	(0.194)	(0.034)	(0.023)	(0.509)	(0.031)	(0.076)
Mother Highly Obese	1.235***	0.182***	0.073*	2.951***	0.104**	−0.401***
	(0.355)	(0.054)	(0.044)	(0.815)	(0.051)	(0.112)
Father Overweight	0.378***	0.055***	0.020**	0.845***	0.033***	−0.041
	(0.086)	(0.013)	(0.008)	(0.231)	(0.012)	(0.044)
Father Obese	0.836***	0.112***	0.070***	1.561***	0.076***	−0.145**
	(0.179)	(0.028)	(0.021)	(0.447)	(0.026)	(0.073)
Father Highly Obese	1.352***	0.198***	0.081*	2.753**	0.118*	0.034
	(0.433)	(0.067)	(0.048)	(1.234)	(0.063)	(0.172)
Smoke Sometimes	0.504***	0.066***	0.027*	1.246***	0.044**	−0.077
	(0.150)	(0.022)	(0.016)	(0.382)	(0.021)	(0.066)
Smoke Regularly	0.602***	0.088***	0.064***	1.212***	0.040*	−0.078
	(0.160)	(0.025)	(0.020)	(0.414)	(0.023)	(0.065)
Breastfed	−0.086	−0.006	−0.018	−0.526	−0.019	−0.042
	(0.122)	(0.019)	(0.014)	(0.326)	(0.018)	(0.057)
Breastfed no info	−0.859	−0.111	−0.122***	−2.338	−0.105	0.132
	(0.677)	(0.131)	(0.032)	(1.826)	(0.123)	(0.173)
Month	0.156	0.011	0.007	0.372	0.003	0.016
	(0.103)	(0.017)	(0.011)	(0.266)	(0.015)	(0.051)
Regional Characteristics	YES	YES	YES	YES	YES	YES
State Fixed Effects	YES	YES	YES	YES	YES	YES
Constant	2.077	−0.458	1.727*	8.423	−0.681	−0.434
	(10.725)	(1.616)	(1.007)	(28.759)	(1.570)	(5.357)
Observations	2372	2372	2372	2348	2348	2335

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Appendix 2.C Robustness

Table 2.C.1: OLS Estimates by Household Income and Paternal Overweight

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
OLS - Monthly Household Income $\geq$ €3000						
Early Care	0.321*	0.062*	0.015	0.252	0.032	−0.062
	(0.173)	(0.032)	(0.015)	(0.503)	(0.022)	(0.119)
Observations	754	754	754	747	747	745
OLS - Monthly Household Income $<$ €3000						
Early Care	−0.286*	−0.059**	−0.021	−0.800*	−0.029	0.090
	(0.171)	(0.027)	(0.017)	(0.470)	(0.027)	(0.070)
Observations	1618	1618	1618	1601	1601	1590
OLS - Monthly Household Income $<$ €1750						
Early Care	−0.920**	−0.149**	−0.057	−3.069***	−0.154***	0.111
	(0.440)	(0.065)	(0.038)	(1.030)	(0.051)	(0.117)
Observations	348	348	348	349	349	346
OLS - BMI Father $\leq$ 25						
Early Care	0.003	0.005	0.005	0.016	0.012	−0.051
	(0.186)	(0.027)	(0.012)	(0.525)	(0.027)	(0.091)
Observations	1018	1018	1018	1006	1006	1002
OLS - BMI Father $>$ 25						
Early Care	0.002	−0.048	−0.006	−0.184	−0.030	0.070
	(0.185)	(0.034)	(0.024)	(0.470)	(0.030)	(0.086)
Observations	1246	1246	1246	1231	1231	1223

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by OLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.C.2: Sensitivity with Respect to the Set of Control Variables

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
Only Child Characteristics and parental education						
Early Care	−0.794	−0.099	−0.072	0.300	−0.073	0.776
	(1.044)	(0.142)	(0.088)	(2.762)	(0.106)	(0.480)
No regional						
Early Care	−0.887**	−0.107	−0.097**	−1.414	−0.085*	0.520**
	(0.441)	(0.066)	(0.041)	(1.213)	(0.051)	(0.243)
Standard +plus interactions of socioeconomic and health with East						
Early Care	−1.044***	−0.124**	−0.094**	−2.653**	−0.124**	0.519**
	(0.376)	(0.060)	(0.040)	(1.033)	(0.054)	(0.221)
More regional [a]						
Early Care	−0.914**	−0.103*	−0.100***	−2.470**	−0.122**	0.601***
	(0.378)	(0.057)	(0.037)	(1.081)	(0.053)	(0.215)
Standard plus dummies for districts ('Regierungsbezirk')						
Early Care	−0.719*	−0.068	−0.072*	−1.239	−0.049	0.446*
	(0.415)	(0.065)	(0.037)	(1.080)	(0.056)	(0.226)
Observations	2372	2372	2372	2348	2348	2335
No city states (Hamburg, Bremen, Berlin)						
Early Care	−1.129**	−0.155**	−0.092*	−2.148*	−0.095*	0.470*
	(0.463)	(0.074)	(0.047)	(1.118)	(0.054)	(0.250)
Observations	2080	2080	2080	2056	2056	2046
Region of Common Support						
Early Care	−1.250***	−0.168**	−0.106**	−2.575**	−0.136**	0.504**
	(0.465)	(0.070)	(0.046)	(1.255)	(0.064)	(0.247)
Observations	2342	2342	2342	2318	2318	2305

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
[a]: GDP (linear and squared), Fraction of population age 30 to 50, population size (interacted with East), Income pc in 2002, average household income and BMI of mother, fathers and children, two years old or younger in at the sample point.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.C.3: Sensitivity with Respect to the Instrument

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
Slot-child-ratio 1998						
Early Care	-1.119^{***}	-0.131^{**}	-0.099^{**}	-2.146^{*}	-0.108^{**}	0.432^{*}
	(0.392)	(0.061)	(0.039)	(1.101)	(0.053)	(0.225)
F-Stat.(NTSLS): 213.69, F-Stat.(TSLS): 29.68						
Plus Interaction East						
Early Care	-0.937^{**}	-0.109^{*}	-0.078^{*}	-2.171^{**}	-0.105^{*}	0.452^{**}
	(0.405)	(0.064)	(0.040)	(1.082)	(0.056)	(0.220)
F-Stat.(NTSLS): 205.87, F-Stat.(TSLS): 11.44						
Plus Slot-child-ratio squared						
Early Care	-0.874^{**}	-0.114^{*}	-0.080^{*}	-2.315^{**}	-0.112^{**}	0.461^{**}
	(0.420)	(0.063)	(0.042)	(1.121)	(0.056)	(0.219)
Observations	2372	2372	2372	2348	2348	2335
F-Stat.(NTSLS): 205.61, F-Stat.(TSLS): 13.36						

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.C.4: Sensitivity with Respect to Threshold Definition

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
Later Cutoff (< 3 years / < 36 months)						
Early Care	-0.891^{**}	-0.115^{*}	-0.070^{*}	-2.085^{**}	-0.077	0.419^{*}
	(0.372)	(0.060)	(0.040)	(0.982)	(0.050)	(0.215)
Observations	2372	2372	2372	2348	2348	2335
F-Stat.(NTSLS): 196.14 , F-Stat.(TSLS): 17.21						
Different Rounding (≤ 2 years / ≤ 24 months)						
Early Care	-1.407^{***}	-0.181^{**}	-0.101^{**}	-2.843^{**}	-0.150^{**}	0.605^{**}
	(0.496)	(0.076)	(0.049)	(1.366)	(0.069)	(0.281)
Observations	2372	2372	2372	2348	2348	2335
F-Stat.(NTSLS): 119.53 , F-Stat.(TSLS): 16.86						

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.C.5: Sensitivity with Respect to Sample

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
Allow for children who were only in care of childminder/family daycare						
Early Care	-0.975^{**}	-0.101^{*}	-0.080^{**}	-2.166^{**}	-0.096^{*}	0.356^{*}
	(0.376)	(0.057)	(0.038)	(1.012)	(0.052)	(0.214)
Observations	2487	2487	2487	2460	2460	2450
	F-Stat.(NTSLS): 232.47 , F-Stat.(TSLS): 23.51					
Allow for children born in 1995						
Early Care	-0.790^{*}	-0.082	-0.082^{**}	-2.019^{*}	-0.100^{*}	0.357
	(0.443)	(0.057)	(0.037)	(1.092)	(0.054)	(0.232)
Observations	2733	2733	2733	2702	2702	2691
	F-Stat.(NTSLS): 193.92 , F-Stat.(TSLS): 25.07					
Allow for children who started daycare later than with 54 months						
Early Care	-0.903^{**}	-0.111^{*}	-0.074^{*}	-2.066^{*}	-0.102^{*}	0.392^{*}
	(0.421)	(0.064)	(0.042)	(1.133)	(0.057)	(0.219)
Observations	2427	2427	2427	2402	2402	2388
	F-Stat.(NTSLS): 203.46, F-Stat.(TSLS): 18.02					

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Table 2.C.6: Effects for School-age Children

	Body-Mass-Index			**Body Fat**		**Motor**
	BMI	Overweight	Obese	BF	BF>p90	Jump
NTSLS-Age 6-9						
Early Care	-1.254^{**}	-0.155^{**}	-0.132^{***}	-3.571^{***}	-0.189^{***}	0.435^{*}
	(0.529)	(0.074)	(0.048)	(1.332)	(0.066)	(0.234)
Observations	1803	1803	1803	1785	1785	1775
	F-Stat.(NTSLS): 178.16 , F-Stat.(TSLS): 23.20					

Notes: Conditional estimates are derived controlling for Child Characteristics, Parents & Family and Regional Controls as described in Table 2.A.4. Results are derived by NTSLS. Standard errors in parentheses are clustered at the county level. */ **/ ***: Significance at the 10%-/ 5%-/ 1%- level.
Source: KiGGS Version 4 & Federal Statistical Office.

Appendix 2.D MTE Distribution

Within the instrumental variable framework Heckman and Vytlacil (2007) describe the participation decision as $D^* = \gamma Z + \delta X - u_D$ and $D = \mathbf{1}[D^* \leq 0]$, with u_D referring to unobservable factors, such as (negative) preferences or (weaker) need for participation, or costs of participation. This could also reflect differences in fees, as long as these fees differ within a state for parents with the same characteristics. u_D is also referred to as the propensity not to be treated. The condition for participation would then be $P(Z) > u_D$. Children with larger u_D are less likely to use *Early Care ceteris paribus*. Individuals who participate at a higher propensity score, given X, must face a relatively higher unobservable costs of participation, than those participating at lower propensity score values.

The MTE is given by:

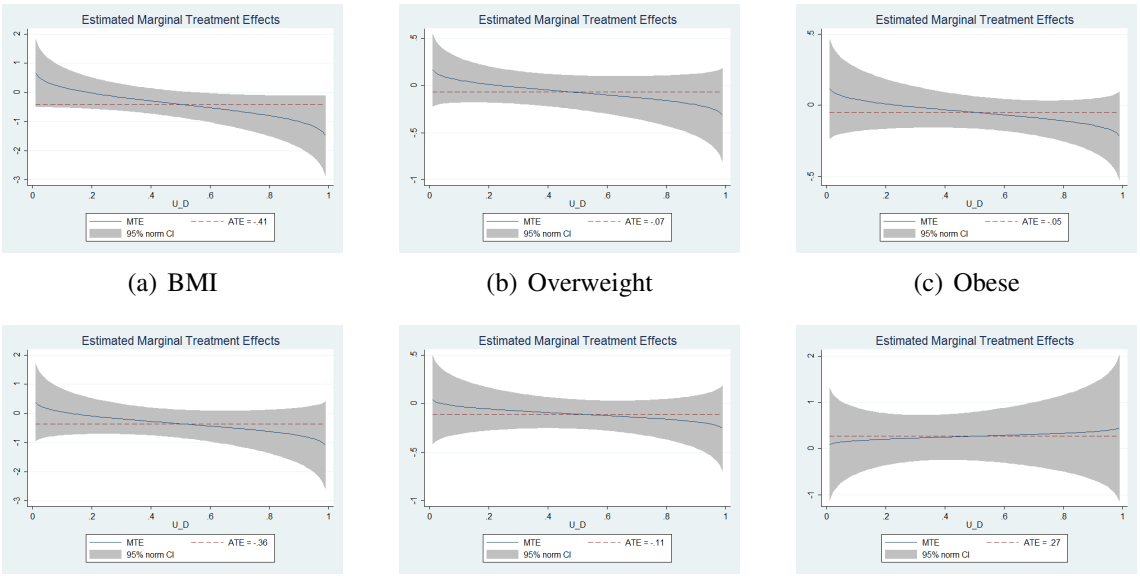
$$MTE(x,p) = EY_1 - Y_0 | X = x, P(Z) = u_D = \frac{dEY|X = x, P(Z) = p}{dp} \tag{2.4}$$

For the implementation the following equation has to be estimated

$$EY|X = x, P(Z) = p = \alpha_0 + X\beta_0 + (\alpha_1 - \alpha_0)p + X(\beta_1 - \beta_0)p + K(p) \tag{2.5}$$

where 0 indicates parameters of the equation for the non-treated outcome and 1 indicates parameters of the treated outcome. Here we use the parametric version to estimate the control function $K(p)$, assuming normally distributed error terms. The effects are calculated using the user written command *margte* in Stata (see Brave and Walstrum, 2014). An exact description of the estimation can be found in Heckman et al. (2006b) and Brave and Walstrum (2014). Normality is a strong assumption, but non-parametric methods are hard to justify in relatively small samples. The aim of the calculation is simply to investigate whether there is some evidence for treatment effect heterogeneity related to unobservable factors.

Figure 2.D.1: Distribution of Marginal Treatment Effects (MTE)



(a) BMI (b) Overweight (c) Obese

(d) Body Fat (e) BF 90 (f) Jump

Notes: Distributions are derived using the parametric normal approximation to the control function. Estimated controlling for the set of variables defined in 'Child Characteristics', 'Parents & Family' and 'Regional Controls' as described in Table 2.A.4.
Source: KiGGS Version 4 & Federal Statistical Office.

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CHAPTER 3

The Effects of Family-Friendly Firm Policies on Parental Well-Being and Working Time

3.1 Introduction

Labor force participation of women with children has been increasing steadily over the past years in most industrialized countries (OECD, 2013). This development goes hand in hand with the challenge of reconciling work and family. Individuals in most countries report problems with work-life balance (e.g. Kotowska, 2010; Lenain et al., 2014) and achieving the double goal of family and career is shown to be related to lower well-being than only realizing one of these goals (Bertrand, 2013).[1] Unfavorable working and childcare conditions force parents, particularly mothers, to reduce working hours, change to less demanding jobs, or to exit the labor market in order to meet their children's needs. However, these discontinuous work histories are disadvantageous for their labor market and financial prospects (Beblo and Wolf, 2002; BMFSFJ, 2006; Boll, 2012). Nowadays in Germany, as well as in other countries, a growing number of employers responds to their employees' changing requirements by offering family-friendly firm policies as fringe benefits, aiming either to retain or to attract parents as qualified employees.[2]

So far the success of family-friendly firm policies (FFPs) in influencing parental working decisions and easing the work-family conflict has not extensively been examined. There only exists limited, and almost no causal, evidence on how FFPs, such as childcare services and flexible working times or places, are perceived by employees and whether they actually support the reconciliation of work and family life. The present paper helps to fill this gap by analyzing the effects of two specific FFPs. These FFPs have a strong potential to decrease the burden for families with young children. Firstly, we consider the possibility to rely on easly accessible professional childcare while working. Secondly, we explore the effects of work schedules that are designed to provide the possibility to arrange working time flexibly and so to fulfill both work and family requirements.

The main contribution of the analysis is the estimation of causal effects stemming from the introduction of these FFPs on parental well-being. Well-being is captured by a broad set of satisfaction measures that allows an investigation into whether work as well as family related areas benefit from the provision of FFPs. These measures are satisfaction with life, job, family, and childcare, and the perception of time pressure. Further, it is addressed whether there is an accompanying effect on working behavior by analyzing the impact of FFPs on the time spent on work-related activities on weekdays as well as on agreed and actual working hours per week. The focus is set on mothers but in addition comparable estimates are provided for fathers.

[1] See also OECD (2007, Chapter 2) on problems of reconciling work and family in OECD countries.

[2] Germany faces a shortages of skilled workers in several industries. This problem may not be solvable by solely relying on immigration (Bauer and Kunze, 2004). Policies that enable mothers to participate in the labor market would release required skill reserves (Smeeding, 2014).

The escalation of the introduction of FFPs in German firms since the mid-2000s allows us to identify causal effects of these policies based on the change over time. The analysis relies on a representative German panel dataset (*"Families in Germany", FiD*) that focuses on families with young children and captures parents with diverse living and occupational backgrounds. In addition to a vast amount of information on objective and subjective characteristics of parents and children, this dataset contains information on the existence of FFPs at the parent's workplace. The panel structures allows the investigation to deal with unobserved heterogeneity by comparing differences over time and by conditioning on lagged dependent variables. After identifying the factors influencing the introduction of FFPs, this information is exploited in a matching approach to create an appropriate comparison group for the treated parents.

In line with the existing evidence, we find that socioeconomic background, occupation, and firm size are major determinants of whether a parent is offered the FFP. The estimation reveals reasonable and robust positive effects of childcare support on maternal satisfaction with childcare as well as on life and job satisfaction. Especially mothers with medium or lower education devote more time to work if childcare support is offered. Flexible working schedules only increase job satisfaction for mothers, but do not affect family-relevant areas. After controlling for other occupational changes, there are no robust effects of either childcare support or flexible working schedules found for fathers.

Germany is an interesting case to study family-friendly workplaces. Support for families provided by the German state is quite generous in international comparison.[3] However, by setting disincentives to employment, particularly for mothers, these public policies deteriorate the position of females in the labor market (Datta Gupta et al., 2008; Bertrand et al., 2010) and interlock valuable productivity potential (Smeeding, 2014). In the 2000s the German government changed the focus of its family polices to support concepts that facilitate the reconcilability of labor market participation and parenthood (see BMFSFJ, 2006). Major changes include the introduction of a new parental leave policy, an increase in publicly subsidized daycare provision for children before the age of three, and a stronger emphasis on the role of employers in reducing the work-family conflict for their employees. In autumn 2006 the Federal Ministry for Family Affairs, Senior Citizens, Women and Youth introduced the programs *Erfolgsfaktor Familie* (Success Factor Family) and *Familienbewusste Arbeitszeiten* (Family-conscious Working Hours) that provide support for employers in becoming more family-friendly. In addition, the program *Betriebliche Kinderbetreuung* (On-site Childcare) promotes the creation of daycare slots within a firm by paying €400 for each newly created full-time slot. By raising public

[3] Since the 1980s parental leave schemes with relatively high compensation rates and long leave periods allow parents to take a considerable amount of time off (see Spieß, 2011).

attention and financial support, these programs seem to successfully stimulate positive attitudes towards family-friendliness in firms.[4]

However, evidence on the effects of such policies is still scarce. While childcare provision is generally found to have a positive impact on female employment and well-being (e.g. Spieß, 2011; Schober and Schmitt, 2013), there is limited evidence on the effects of daycare provided by firms. Apart from part-time work, which is also shown to be positively related to job satisfaction for mothers, but without having much of an effect on life satisfaction (e.g. Booth and Van Ours, 2008), the effects of flexible working schedules are also not well analyzed. Particularly, economic studies identifying causal effects of FFPs for parents in representative settings are missing (see Section 3.2). Hence this study contributes by addressing several of these aspects.

The remainder is structured as follows. Section 3.2 gives an overview of the existing literature. Section 3.3 describes the dataset, sample selection, and the definitions of the outcomes and the treatments. Section 3.4 elaborates on the identification strategy and Section 3.5 provides the empirical results and the sensitivity analyses. Section 3.6 concludes with a discussion of the main findings.

3.2 Related Literature

Three strands of literature are relevant for the present analysis. The first strand investigates the factors facilitating the introduction of FFPs. These findings are incorporated in our identification strategy. Family-friendly firms are found to be larger, have a higher share of female workers and skilled workers; in a similar vain, employees receiving FFPs have higher occupational positions and qualifications (see Konrad and Mangel, 2000; Sharpe et al., 2002; Gray and Tudball, 2003; Budd and Mumford, 2006; Heywood et al., 2007; Bloom et al., 2011). Furthermore, at the firm level, FFPs are positively associated with the number of vacant positions (Fakih, 2014) and performance (Heywood et al., 2005).[5] At the individual level, tenure (Gray and Tudball, 2003; Fakih, 2014) and having young children (Sharpe et al., 2002; Heywood et al., 2007) are also positively related to FFP offers. Gerlach and Schneider (2012) confirm a positive relationship of firm size and also region (East/West) with family-friendliness in Germany.

The second strand of literature explores the relationship between FFPs and different aspects of well-being. Ezra and Deckman (1996) and Saltzstein et al. (2001) analyze the relationship of FFPs and satisfaction. Their sample includes a very specific group of

[4] An increasing number of firms began to participate in the *Success Factor Family* network since 2007 (see Figure 3.A.1). By becoming a member they show interest in family-friendliness and most of them also agreed to a general statement about supporting family-friendliness in their firm.

[5] Some studies argue that productivity was affected by FFPs, but it is questionable whether these studies can claim causality (see Konrad and Mangel, 2000; Bloom et al., 2011).

government employees in the US and they have no setup to identify causal effects. Ezra and Deckman (1996) reveal a positive correlation of on-site care and flexible schedules with childcare satisfaction for mothers. Similar to the present study there is no effect of on-site childcare for fathers. Saltzstein et al. (2001) estimate a positive association between job satisfaction and childcare support for mothers and single fathers. There is no such positive relationship for flex-time or part-time schedules.[6]

There are some studies that can more plausibly claim causality of the estimated effects. Possenriede and Plantenga (2014) and Artz (2010) estimate the effects of FFPs using fixed effect strategies. However, their studies are limited in making statements about work-life conflict, as they only investigate the effect on job satisfaction and neglect other aspects of parental well-being. Based on a Dutch Labor Supply Panel, Possenriede and Plantenga (2014) show that flexible work schedules are positively related to job satisfaction for both women and men, independent of whether they have children.[7] Similarly, based on the US-American NLSY data, Artz (2010) reveals a strong positive effect of flexible working schedules and a smaller positive effect of childcare support on job satisfaction. The effect for childcare only exists for parents, while in line with Possenriede and Plantenga (2014) flexible working schedules affect job satisfaction of employees with and without children. Kelly et al. (2014) provide causal evidence on the effect of family-friendly workplaces on well-being based on a randomized control intervention. Their treatment differs from our definition of FFPs, since it relates to a change in the work practice (e.g. training supervisors in demonstrating support for employees' private lives). These work practice interventions modestly reduce work-life conflict and improve family time adequacy.

The third related research area focuses on employees' behavior. This literature provides evidence for stronger commitment, e.g. a lower absenteeism rate, higher worker loyalty, and positive work attitudes if family-friendly firm policies are offered (see OECD, 2007; Butts et al., 2013). Still, most of these estimates do not clearly imply causality. Baughman et al. (2003) try to capture causal effects by arguing that the estimates are less prone to bias if more time has passed since the introduction of the FFP. Analyzing a large set of policies, they find lower turnover rates and lower wages in firms, which offer childcare referrals and sick leave.[8] There is no direct evidence for working time.

[6]Fiksenbaum (2014) also find a reduction of work-life conflict if family-friendly benefits are available . Work-life conflict is shown to be related to well-being, but also to physical health and productivity (see e.g Duxbury and Higgins, 2003).

[7]Possenriede and Plantenga (2014) further find that particularly part-time work raises "working-time fit" for mothers, but does not raise job satisfaction for mothers or fathers.

[8]There is some more evidence on the effect on wages. Heywood et al. (2007) identify negative earnings differentials for flexible working schedules, but not for childcare support and working at home. They argue that childcare and working at home dedicate attention to work and hence pay for themselves. On the contrary (Fakih, 2014) finds a negative impact of childcare support on wages in Canada. As for many individuals wages are determined by collective agreements in Germany, FFPs could only have an impact on

3.3 Data

The analysis is based on the "Families in Germany" dataset (*Familien in Deutschland, FiD*). This is a unique dataset on households with children in Germany. It was collected from 2010 through 2013. The dataset is exceptional in two ways: First, the largest part of the data consists of a "cohort-sample" of families with children born between 2007 and 2010. Second, the dataset includes detailed questions about the employer's FFP offers. Questions about family-friendliness at the workplace are designed in the style of the questions in the IAB Establishment Panel, the leading German survey on firms.[9] FiD is a study related to the German Socio-Economic Panel Study (SOEP). Therefore, it adheres to the high standards set by the SOEP.[10] In total more than 4500 households were sampled. All participating households filled out a household questionnaire, including information on all children in the household. Each household member of age 17 or older filled out a personal questionnaire that includes a set of questions about their working behavior and workplace characteristics. In addition, the dataset includes information on life course events, labor market history and general work- and family related attitudes. Consequently, the FiD data is very well suited to analyze the effect of family friendliness on parents with young children. To our knowledge, there are very few international and no other German panel surveys of this size on families with children in pre- and primary-school age that include questions on family-friendly firm policies.

The present study focuses on households with two parents and at most four children.[11] Biological and social parents are not distinguished. The sample only includes employed parents, as only these parents can be offered FFPs.[12] Effect are estimated for families with a youngest child aged zero to eight years. By proceeding this way, families are captured for which reconciling work and childcare is most challenging, as children in this age bracket have to be cared for all day. Given the specific design of FiD with its focus on families with young children, a large share of the FiD data can be used for the present analysis. Most observations in our sample are made for families with a youngest child aged two to five. There are fewer observations for younger children because few mothers are employed with children under two years. Observations are excluded if there is a

hourly wages in the long-run. The present study focuses on the short-run perspective.

[9]Even though the two datasets cannot directly be linked, the similarities in the questions facilitate the comparison between the results of the FiD analysis and findings in the IAB Establishment Panel. The IAB Establishment Panel is used in an accompanying paper by the authors.

[10]From 2014 on, the FiD-samples are integrated into the main SOEP for the data collection. For further details see Schröder et al. (2013).

[11]Single parents are excluded, as they are likely to react to FFP with different magnitudes. Despite oversampling, the group of *employed* single parents in the FiD data is too small for a separate analysis. There are few parents with more children. Therefore this group is difficult to balance.

[12]The partner is allowed to work zero hours.

newborn child in the household because these families experience a major change which is unrelated to the workplace. Since most mothers do not work if they have a newborn child this adjustment mainly affects the sample size in the analysis of fathers.[13]

To make sure that the actual parent is captured and to rule out that unusual parents drive our results, mothers have to be, at most, 45 years older than their youngest child. In the case of fathers it is a less restrictive, they should not be more than 55 years older than the youngest child in the household. As common in the literature teenage parents, who make less than 0.5 percent of our sample, are excluded.[14]

3.3.1 Outcomes

The aim is to provide a broad picture of parental subjective well-being.[15] It is captured by satisfaction in several work and family related areas:

- Life satisfaction: Satisfaction with *your life*.
- Job satisfaction: Satisfaction with *your work/job*.
- Family satisfaction: Satisfaction with *your family life*.
- Childcare satisfaction: Satisfaction with *the existing childcare options/possibilities*.
- Time Pressure: Experiencing *time pressure*.

Time pressure is measured on a five point scale with higher values indicating more time pressure experienced in the last for weeks. All other satisfaction items are measured on a 11-point Likert scale from 0 (absolutely unsatisfied) to 10 (absolutely satisfied).

Objective behavioral changes in working time are measured as:

- Time for Job: Hours devoted to work per *average weekday* (including travel, preparations, second job, overtime...).
- Agreed Hours: *Agreed* working hours per week (main job).
- Actual Hours: *Actual* working hours per week (main job).

For the working time measures only 'reasonable' information is included, thus observations of zero hours are excluded.

[13] By proceeding this way, we do not exclude any treated observation for *Childcare Support* and only six treated observations for *Flex Schedule* in the analysis of mothers. For fathers it is eight treated observations for *Childcare Support* and 72 treated observations for *Flex Schedule*.

[14] These are defined by being less than 20 years older than the youngest child.

[15] A measure of experienced utility.

3.3.2 Treatments

Identification is given by individuals for whom the status of being offered the respective FFP at their workplace changes in the observation period. This status is identified by the answer to the following question:[16]

"In some firms family-friendly policies are supported. How is it at your workplace: Are the following support policies offered by your employer?"

Childcare Support

- Tick either box: "Workplace childcare facilities (e.g. daycare (in-house kindergarten, crèche, day nursery), homework supervision in the company, slot in non-in-house daycare center)."
- Or tick box: "Sponsoring childcare."

Flex Schedule

- Tick box: "Flexible organization of working hours (e.g. part-time, working time account (flex time), save working time to a long-term account)."

In addition to the availability of *Childcare Support* it is observed whether parents actually use the provided support. This information is exploited to disentangle the effect of the usage of this FFP from the effect of the provision, as provision as well as usage are found to yield benefits for work attitudes (see Butts et al., 2013).[17]

It is assumed that the individual has no direct impact on whether it is offered the FFP by the firm. Parents who could clearly influence the introduction, i.e. self-employed, are excluded from the analysis (see Section 3.4.3) and managers only represent a very small fraction of the remaining sample. Furthermore, the main effects are not driven by this group, but by parents with lower education (see Section 3.5.2.3). Selection into firms is also not the driving force as results remain stable when parents who switch employers are excluded (see Section 3.5.3.3). Other correlations of parental characteristics and whether a FFP is offered are addressed in the estimation strategy (see Section 3.4).

While both FFPs have the potential to raise satisfaction levels by easing the reconciliation between paid work and family, the expectations for the change in working time are not unambiguous. *Childcare Support* can be assumed to enable parents, particularly mothers if they are the main caretakers, to increase the time they devote to the job. However, a flexible scheduling of working time does not have to be accompanied by a higher

[16]The answer "I do not know" is coded as "no provision" because the individual can not be affected by provision. Only one percent of all individuals do not know whether an FFP is provided by the employer.

[17]Provision could also capture the possibility to make use of the FFP in the future if necessary and accompanying changes in the work environment and attitudes towards parents. See Section 3.5.3.1.

amount of working time. *Flex Schedule*, as defined in the survey question, also includes part-time work, therefore the opposite could actually be the case.

3.4 Estimation Approach

If working in a firm that introduces the treatment FFP was assigned randomly, simple comparison of mean outcomes between treatment and control group could be interpreted as the average treatment effect. However, existing evidence suggests that firms with family-friendly working environments and the employees who work in these firms systematically differ from those without such policies. This is also true for our sample (see Section 3.5.1). Consequently, without any adjustments, the group of individuals in firms without FFP does not provide a valid counterfactual comparison group for the group with FFP.

The problem of unobserved heterogeneity is countered by combining two established identification approaches. To capture unobservable individual factors, the *FiD* panel dataset is exploited by applying difference-in-differences (DiD) and lagged dependent variable (LDV) specifications. Identification in the DiD model is based on the common trend assumption. In the LDV model unconfoundness given lagged outcomes is assumed. Combining these models with matching on a set of individual characteristics $\mathbf{X^M}$ overcomes problems of observed heterogeneity by creating a valid control group and relaxes the common trend assumption by assuming that it holds conditional on $\mathbf{X^M}$, but not necessarily unconditionally.

The general idea behind these estimators is to compare individuals who received the FFP from one period to the other with nearly identical individuals who did not receive the FFP and to analyze how well-being and working time changed between these two groups. Heckman et al. (1999, chapter 8) characterize three sources of selection bias in evaluation studies. With matching we target the first and the second source: The lack of common support and differences in explanatory variables. The DiD and LDV specifications address the third source, the differences in unobservable characteristics.

It is essential to note that compared to the cross-section matching estimator, the identification assumptions are weaker in the present panel setting. In the DiD model, causality does not hinge on the assumption that there are no unobserved factors connecting the *level* of the outcome to the treatment, but relies on the weaker assumption that the treatment status does not predict the *change* in the outcome conditionally on the set of observable characteristics. In the case of the LDV model, it is assumed that, conditional on $\mathbf{X^M}$ *and* the lagged outcome variable, confounding unobservable factors are irrelevant (Lechner, 2011). It can be argued that controlling for lagged outcomes also captures part of the

time-invariant as well as relevant time-variant confounding factors. Hence the DiD- and LDV-matching estimators have the advantage of eliminating unobserved differences between treated and non-treated individuals which cross-section matching estimators fail to eliminate (see Smith and Todd, 2005; Lechner, 2011)[18]

We are interested in whether the offer of a specific FFP has any effect for parents compared to the situation in which they were not offered the FFP. Therefore, the control group consists of individuals who do not receive the FFP offer in any of two consecutive observation periods (post-treatment and pre-treatment period in the following). Consequently, the treatment group consists of individuals who receive the FFP offer in the post-treatment period, but were not offered the FFP in the pre-treatment period. Individuals are excluded if they lose access to the FFP from one period to the other.

In a robustness check, individuals who receive the FFP in the post-treatment as well as in the pre-treatment period are added to the control group. These individuals do not have a status change, because they always receive the treatment. For the main specification it is assumed that parents who do not have the FFP in the beginning are most comparable. It could also be argued that the group of parents who already received the FFP is more similar to those who start to receive the offer at some point in the observation period. The results are robust to this variation of the control group (see Table 3.D.1 and Table 3.D.2). We prefer our main specification for two reasons. Firstly because the estimated effect has a clear-cut interpretation. Secondly, if the FFP has a long-term effect, the group of 'always-treated' is not an appropriate comparison.

Three periods of change are observed in the data: 2010 to 2011, 2011 to 2012 and 2012 to 2013. However, in 2011 only individuals who changed their employer were asked about family-friendly policies. For parents who did not change their employer in 2011, only changes from 2010 to 2012 and 2012 to 2013 can be identified. Hence, if t refers to the post-treatment period, for most observations the pre-treatment period refers to $(t-1)$. For observations in 2012 which belong to individuals who did not change their job in 2011, the pre-treatment period refers to 2010, hence $(t-2)$. This applies to treated as well as to untreated individuals. A control is added for different time spans between two observation points.

The analysis proceeds in three steps. First, the propensity score is estimated. Second, matching is performed based on the propensity score. Third, a weighted regression is computed to estimate the average treatment effect on the treated.

[18]Famous implementations of similar DiD-matching estimators are Heckman et al. (1997) and Smith and Todd (2005).

3.4.1 Propensity Score Matching

The main analysis is conducted based on a sample that is weighted using matching weights. Since direct matching on a large set of covariates is difficult, the analysis proceeds with propensity score matching (PSM).[19] PSM is a semi-parametric approach that allows for arbitrary heterogeneity related to the control variables. Conventional parametric regression methods can be sensitive to minor changes in the specification because of their heavy reliance on extrapolation. Therefore the matching estimator is particularly beneficial if the covariate distributions differ substantially between treatment and control group (Imbens, 2014). Ho et al. (2007) argue that matching should be used as a data preprocessor for subsequent analysis to reduce the bias and to increase efficiency.

The conditional probability to participate in the treatment (the propensity score), i.e. the probability to be offered the FFP, is estimated based on a probit model.[20] The set of variables $\mathbf{X}^M$ included in the estimation of the propensity score contains only variables that are either time invariant, measured before the treatment took place or are otherwise not affected by the treatment. Weights are derived based on the estimated propensity scores and are placed on the observations for the non-treated when computing the treatment effect.

Given the set of variables $\mathbf{X}^M$, it is assumed that the conditional independence assumption holds:

$$E_{P(\mathbf{X}^M)|D=1}[\Delta Y^{NT}|P(\mathbf{X}^M),D=1] = E_{P(\mathbf{X}^M)|D=1}[\Delta Y^{NT}|P(\mathbf{X}^M),D=0]. \tag{3.1}$$

$D=1$ indicates that an individual received the treatment FFP. $\Delta Y^{NT} = Y^{NT,post} - Y^{NT,pre}$ indicates the change in the outcome in absence of the treatment (T =*treated*, NT =*non-treated*). $P(\mathbf{X}^M)$ refers to the propensity score. The estimates should be interpreted as the average treatment effect on the treated (ATT) because the observations for the non-treated individuals are weighted such that they provide an appropriate comparison group for the treated individuals. This estimate is given by:

$$\begin{aligned}\beta_{ATT} = E[\Delta Y^T - \Delta Y^{NT}|D=1,P(\mathbf{X^M})] &= E[\Delta Y^T|D=1) - E[\Delta Y^{NT}|D=1,P(\mathbf{X^M})] \\ &= \frac{1}{n_T}\sum_{i\in G_T}\left[\Delta Y_i^T - \sum_{j\in G_{NT}}\omega(i,j)\Delta Y_j^{NT}\right]\end{aligned} \tag{3.2}$$

where n_T is the number of cases in the treatment group G_T. The observation for an individual i in the treatment group is matched to a counterfactual observation that is created using a weighted average of observations j in the control group G_{NT}. The weights ω are

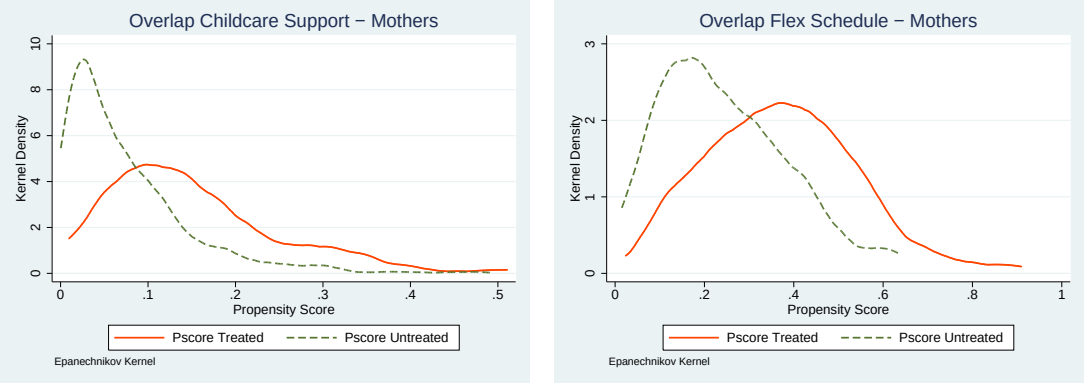
[19] This phenomenon is also known as the 'curse of dimensionality' (Rosenbaum and Rubin, 1983).

[20] The results are robust to using a logit model.

constructed using the well-established procedure of kernel matching.[21] Unlike pair-wise matching, kernel matching does not only rely on the one nearest neighbor for the match, but uses kernel-weighted averages over multiple observations in the comparison group.[22] The main results are based on an epanechnikov kernel with a bandwidth of 0.06 as chosen by Heckman et al. (1997).[23] In line with Smith and Todd (2005), our results are robust to slight variations in the bandwidth.

A further requirement in the matching procedure is common support, given that the estimated treatment effects are only defined in the region of common support.[24] Implementing the common support condition ensures that any combination of characteristics observed in the treatment group can also be found in the control group. Figure 3.4.1 for mothers and Figure 3.E.1 for fathers depict a kernel density estimate of the propensity scores for the treatment and the control group. The graphs are based on the main specification including the controls described in Section 3.4.3. The estimates show that there exists a large region in which observations with the same propensity score are observed in the treatment and the control groups, this is referred to as overlap region.

Figure 3.4.1: Overlap of Propensity Scores for Treated and Non-Treated - Mothers



(a) Overlap *Childcare Support* (b) Overlap *Flex Schedule*

In the main analysis, overlap is imposed by dropping treated observations whose propensity score is higher than the maximum value or lower than the minimum value in the control group. This mainly affects the analysis of *Flex Schedule* (see Figure 3.4.1).

[21] In case of kernel matching the weights take on the following form: $\omega(i,j) = \frac{K\left[\frac{P_i - P_j}{b}\right]}{\sum_j K\left[\frac{P_i - P_j}{b}\right]}$ where b refers to the bandwidth and $K[.]$ to the kernel function.

[22] Asymptotically, all matching procedures produce the same results because they reduce to exact matching in infinite samples (Caliendo and Kopeinig, 2008).

[23] The bandwidth is the smoothing parameter, its choice is analogous to the choice of the number of neighbors. A smaller bandwidth implies higher variance and lower bias.

[24] Theoretically, in case of the ATT it is sufficient to assume $P(D = 1|\mathbf{X}^M) < 1$.

In some regions the propensity score density is rather low, even if there exist observations in the treatment and the control group. This is not uncommon (see Caliendo and Kopeinig, 2008). Sensitivity of the results is tested using 'trimming'. With trimming two percent of the treated observations at which the propensity score density in the control group is lowest are dropped. The results are robust to this adjustment.[25]

In order to compare the covariate distribution across the matched groups and to test whether the groups are adequately balanced, the two-sample t-test proposed by Rosenbaum and Rubin (1985) is conducted. In addition, the quality of the matching is verified by analyzing the standardized percentage bias. This standardized percentage bias is defined as the difference of the sample means in the treated and non-treated subsamples as a percentage of the square root of the average of the sample variance in the treated and in the non-treated group (see Rosenbaum and Rubin, 1985).[26]

The robustness of our results to the weighting procedure is tested by applying a different approach to calculate the weights, called entropy balancing (Hainmueller, 2012). This optimization procedure derives weights such that the reweighted treatment and control group satisfy a pre-specified balancing condition. In our case this condition is the sample mean. Consequently, by imposing equality of the means in the treatment and control group, the essential criterion that is usually applied to judge the success of matching is automatically fulfilled.[27] The results are robust to this change in the weighting procedure (see Table 3.C.1 and Table 3.C.2).

3.4.2 Specification of the Regression Model

The model estimated based on the weighted sample can be formalized as follows:

$$\underbrace{\Delta Y_{i,t}}_{Y_{i,t}^{post}-Y_{i,t}^{pre}} = \alpha + \beta \Delta FFP_{i,t} + \gamma \mathbf{X}_{i,t} + \eta_t + \varepsilon_{i,t} \qquad t = 2011, 2012, 2013 \qquad (3.3)$$

where the change in well-being or working time within a person is explained by changes in the treatment $FFP_{i,t}$ between the post-treatment period t and the pre-treatment period. If only individuals with $FFP_{i,t}^{pre} = 0$ are compared it follows that $\Delta FFP_{i,t} = FFP_{i,t}^{post}$. The coefficient β measures the treatment effect. Year fixed effects η_t are included, because changes in the treatment status are observed over a period of three years.

In the present panel setting, this DiD approach corresponds to the first differences fixed effects model (Wooldridge, 2010, section 10.6.3).[28] This leads to unbiased estimates

[25] Results are available on request.

[26] The matching weights and the test statistics are derived using the user written package psmatch2 in Stata (see Leuven and Sianesi, 2014).

[27] See Marcus (2013) for an implementation of this procedure.

[28] It is controlled for individual not group fixed effects, which increases precision.

if the introduction of FFP is a function of time-invariant characteristics. This assumption may not be reasonable for all outcomes. Therefore, an LDV specification is estimated in addition, assuming unconfoundedness given lagged outcomes (Imbens and Wooldridge, 2009). In this approach it is assumed that the omitted variable bias does not arise from a time-invariant individual specific factor, but from pre-treatment trends. Hence, $Y_{i,t}^{pre}$ would be correlated with the error term (Imbens and Wooldridge, 2009).[29] In repeated cross-section analyses, DiD is often the only option, but in panel data more information is available and can be exploited in the LDV approach (Imbens and Wooldridge, 2009).

The difference in the specification between the DiD and the LDV model is that the LDV model includes $Y_{i,t}^{pre}$ as a control variable and $Y_{i,t}^{pre}$ is also included in the estimation of the propensity score. However, as described, identification is based on different assumptions (e.g. Lechner, 2011). The LDV model can be formalized as:[30]

$$\Delta Y_{i,t} = \alpha + \beta \Delta FFP_{i,t} + \gamma \mathbf{X}_{i,t} + \delta Y_{i,t}^{pre} + \eta_t + \varepsilon_{i,t} \qquad t = 2011, 2012, 2013 \quad (3.4)$$

Under reasonable assumptions, the two approaches have a nice property (see Guryan, 2001; Angrist and Pischke, 2008): If the treatment is positively selected on lagged outcomes, the DiD or fixed effects model produces negatively biased estimates. If the treatment is positively selected on fixed characteristics, the LDV estimator, that controls for lagged outcomes, produces positively biased estimates of the treatment effect. It is the other way around for negative selection on fixed effects or lagged outcomes. Hence the two estimates may be seen as bounds for the true estimate.[31]

In the simple DiD and LDV specifications, presented in this paper, the vector of variables $\mathbf{X}_{i,t}$ is empty and the treatment and control group are also not matched based on $\mathbf{X}_{i,t}^{M}$. In the main specification it is matched on and linearly controlled for $\mathbf{X}_{i,t}^{M}$. This combination of matching with regression adjustment is shown to reduce problems of misspecification and to improve precision of the estimates (Stuart, 2010; Kreif et al., 2013).[32]

An extended specification includes $\Delta \mathbf{X}_{i,t} = \mathbf{X}_{i,t}^{post} - \mathbf{X}_{i,t}^{pre}$ for a subset of $\mathbf{X}_{i,t}^{M}$ as linear controls to ensure that the results are not driven by changes that took place at the same time as the introduction of the FFP. If the FFP was introduced at the same time, as for

[29] If, for example, FFPs are introduced in firms with a good work environment, such that even in absence of the treatment employees are highly satisfied, the DiD may underestimate the true treatment effect because starting from a high level, there may only be a small increase in satisfaction possible in this group.

[30] Sometimes the following expression is used instead, which leads to the same β estimator: $Y_{i,t}^{post} = \alpha + \beta \Delta FFP_{i,t} + \gamma \mathbf{X}_{i,t} + (\delta + 1) Y_{i,t}^{pre} + \eta_t + \varepsilon_{i,t}$. Consequently, β can be interpreted as the value added by the treatment to a given level of the outcome under consideration.

[31] It is not reasonable to combine both approaches because in this case much stronger assumptions and dynamic panel data models are necessary (see e.g. Angrist and Pischke, 2008).

[32] The hybrid procedure of combining regression adjustment with reweighting methods is also referred to as 'double-robust' (Bang and Robins, 2005). This approach leads to consistent estimates if either the propensity score, i.e. the estimation leading to the weights, or the outcome equation is correctly specified.

example, a promotion, the positive effect of the promotion would mistakenly be attributed to the FFP.[33] However, we are careful not to include characteristics that were themselves affected by the change in the FFP under consideration (Angrist and Pischke, 2008).

3.4.3 Balancing Observable Characteristics

To ensure a good balancing of the treated and the control group, two adjustments are made. Firstly, it is controlled for major factors that are correlated with the introduction of the FFP and the *change* in well-being or working time. Three groups of variables are included: i) family, individual, and partner characteristics; ii) workplace characteristics; and iii) regional characteristics (see Table 3.B.1 for details). Secondly, the sample is adjusted by excluding some observations with zero probability of receiving the treatment from the control group.

Family composition is captured by the individual's, the partner's and the children's age as well as by the number of children. Individuals are also balanced according to their socioeconomic status by controlling for pre-treatment information on education, household income, net hourly wage, whether the individual possesses a high occupational position, tenure, the individual's unemployment record (unemployment experience), and full-time-work experience. In order to capture further restrictions, pre-treatment information on the partner's education, whether the partner participated in the labor market, whether the partner possesses a high occupational position and his or her unemployment experience are added. Parents with five or more years of unemployment are excluded because there is no observation in the treated group with such a high unemployment record.[34]

To measure the attitudes of the parents, the specification includes whether the mother agrees that women should have a stronger focus on children than on their careers and whether the father agrees that men and women should contribute equally to housework and family responsibilities. This should, for example, capture whether substituting parental care with daycare is perceived as positive or negative.

The availability of FFPs may depend on the employee's occupational function. A researcher might, for example, be allowed to work more flexibly than a janitor. The main specification is based on the ISCO88 codes, that capture occupational differences, but also industrial aspects.[35] The results are robust to controlling for industry based on the NACE coding instead.[36] In addition, working in the civil service sector is included and it is controlled for firm size and whether other FFPs are offered in the pre-treatment period.

[33] This is similar to the classic first differences or fixed effects setting, where all left- and right-hand variables are included as first difference or deviation from the mean.

[34] We lose less than 4 percent of the sample.

[35] E.g., machine operators are more likely to work in the automobile sector than in the media sector.

[36] Results are available on request.

Hence the treatment and the control group are balanced by the overall family-friendliness of the firms.

To further ease balancing, industries and occupations without changes in the considered FFP over the observation period are excluded. These are the agricultural and mining sectors (about 2 percent of the sample) and individuals working as soldiers (less than 0.5 percent) or individuals in training (about 1 percent) in the pre-treatment period.

Parents who are self-employed are also excluded.[37] The argumentation behind this restriction is that the introduction of FFPs in the owned firm is most likely to be endogenous and impacted by the parent's needs and preferences.

Binary controls for city size capture differences arising from living in a city rather than in the countryside (e.g. commuting longer distances) and indicators for East and West Germany capture general differences in the availability of publicly subsidized daycare and the parent's attitudes towards maternal employment and daycare usage.[38]

Changes occurring simultaneously with the introduction of the FFP are captured in the extended model by controlling for changes in hourly wages, in the occupational position, in the occupational function (ISCO88), in the overall family-friendliness measure and for whether there was a change of the employer.

3.5 Empirical Results

In this section the estimated effects of *Childcare Support* and *Flex Time* are discussed with a focus on mothers. Mothers often face more challenges reconciling work and family life because children are still mainly a mother's duty in many families (see e.g. Wall and Arnold, 2007). However, we provide and discuss comparable estimates for fathers.

3.5.1 Mean Differences and Balancing

The mean values of the control variables for mothers are examined separately for the treated and the control groups for *Childcare Support* and *Flex Schedule*, respectively (see Table 3.E.1 and Table 3.E.2).[39] Column three in these tables displays the mean differences between the treated and the control group in the unmatched (raw) sample. As expected, given the existing evidence, the characteristics of the treatment and control groups differ significantly in the raw sample.

There are three groups of factors that are clearly related to the introduction of a FFP and are similar for *Childcare Support* and *Flex Schedule*. Firstly, in line with previous

[37] The partner is allowed to be self-employed.

[38] The results are robust to including information on the availability of subsidized daycare for children under three years at the county level. Results are available on request.

[39] Corresponding results for fathers are shown in Table 3.E.3 and Table 3.E.4.

research, there are differences in socioeconomics status, hinting to higher socioeconomic status in the group of the treated. This is indicated by differences in household income, the individual's education and wages, and the partner's unemployment record, education and position. In the case of *Flex Schedule*, the partner's characteristics play a stronger role than for *Childcare Support*. Secondly, we can confirm that tenure plays a role for receiving FFPs. Finally, larger firms offer FFP more frequently.

There are also occupational differences. Regarding *Childcare Support*, mothers who are professionals or work in the civil service sector receive this FFP more often, the opposite is true for service and sales workers. Firms that were more family-friendly in the past are more likely to offer *Childcare Support*. The offer of *Flex Schedule* is slightly more frequent among managers. Parents in elementary occupations are less often offered FFPs.

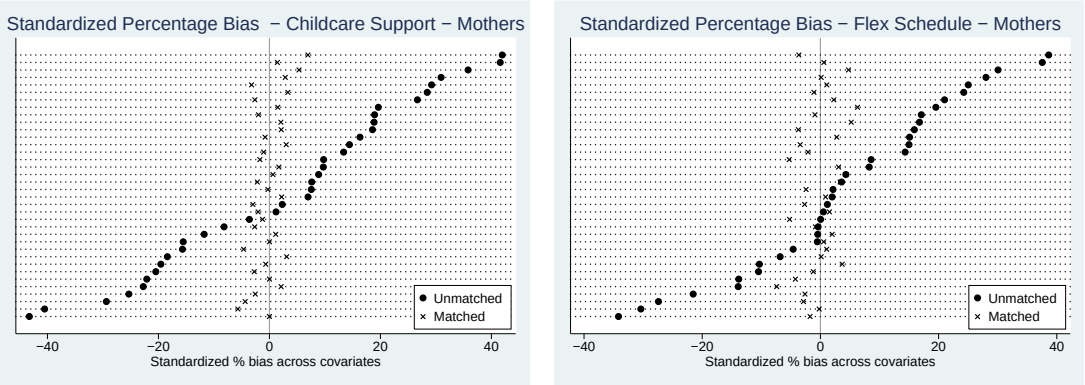
For fathers, similar factors determine whether FFP is offered and most differences are even more pronounced (see Table 3.E.3 and Table 3.E.4). Most described differences are also found in the multivariate probit estimation of the propensity score, but the patterns are weaker, as some of these variables capture similar aspects (not shown).

The last row in Table 3.E.1 reveals that 71 mothers are observed in the treatment group for *Childcare Support*. The number of non-treated observations to draw from is large, which allows us to construct appropriate counterfactual observations for the treated. In the case of *Flex Schedule*, the treatment group is larger with 131 mothers (see Table 3.E.2). For fathers, the treatment group consists of 90 observations for *Childcare Support* and 147 for *Flex Schedule*. The control group in the case of *Childcare Support* is larger than for *Flex Schedule* as more individuals are already offered *Flex Schedule* in the beginning, i.e. to them applies $FFP^{pre} \neq 0$.

Columns four in Table 3.E.1 and Table 3.E.2 display the difference in the means between treated and control groups in the matched sample. Based on the two-sample t-test, there exist no significant differences in the covariates between the two groups after matching on the propensity score, anymore (compare columns three and four of Table 3.E.1 and Table 3.E.2).

The last column in these tables displays the distribution of the standardized percentage bias in the matched sample. To abbreviate the documentation, the means of the standardized percentage bias before and after matching are calculated (last row of Table 3.E.1 and Table 3.E.2). For mothers, the overall bias before matching is 19.6 for *Childcare Support* and 14.5 for *Flex Schedule*. A significant reduction can be achieved for both groups so that the average standardized percentage bias after matching is 2.3 in the case of *Childcare Support* and 2.6 for *Flex Schedule*. This enormous reduction shows that the matching procedure is able to balance the characteristics in the treatment group and the matched comparison group. Table 3.E.1 and Table 3.E.2 further reveal that in the matched

Figure 3.5.1: Standardized Percentage Bias before and after Matching - Mothers



(a) Balancing *Childcare Support* (b) Balancing *Flex Schedule*

sample the standardized percentage bias for all variables is far below ten percent and in nearly all cases around the five percent level. The gain in balance becomes even more apparent in the graphical representation in Figure 3.5.1, which depicts the standardized percentage bias in the matched and the raw sample. The differences in the unmatched samples diverge much further from zero than in the matched sample.

A similar reduction in the differences between treatment and control groups is reached for fathers (see Table 3.E.3 and Table 3.E.4). It is particularly important that factors related to the socioeconomic background are well balanced because these variables are highly suspected to be correlated with well-being and working time.

A large part of the differences will be captured by the DiD and LDV setting and as matching is combined with regression adjustment, the variance is further reduced in the main analysis. As mentioned, estimates based on entropy balancing reveal that the results are very similar when a weighting procedure is applied that explicitly equalizes the means in the treatment and the control group (see Table 3.C.1 and Table 3.C.2).

3.5.2 Results for Well-Being and Working Time

3.5.2.1 Main Effects of Childcare Support

Table 3.5.1 shows the results for the effect of *Childcare Support* for mothers. The estimated effects reveal that the provision of *Childcare Support* strongly raises satisfaction with the childcare by 0.46 to 0.72 points depending on the estimator. The LDV estimation leads to smaller effects than the DiD estimation, but the effects are still very pronounced. The LDV model takes into account that the treatment group experienced a lower level of care satisfaction in the pre-treatment period (see Table 3.F.1). Our estimations reveal for all outcomes that the higher the level of the outcome in the pre-treatment period, the smaller is the change in the outcome on average. Conditioning on the pre-treatment level

of the outcome hence reduces the treatment effect in the case of care satisfaction. The overall positive effect on care satisfaction is a plausible result and indicates that public daycare provision does not sufficiently meet the demand of working women - this could be in terms of quantity, quality or flexibility.

Table 3.5.1: Effects of *Childcare Support* - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD								
Δ Childcare Support	0.28**	0.24	0.10	0.65**	−0.09	0.54**	0.05	0.52
	(0.14)	(0.23)	(0.15)	(0.30)	(0.13)	(0.24)	(0.84)	(0.95)
Observations	993	965	993	800	993	938	993	986
LDV								
Δ Childcare Support	0.26**	0.46***	0.09	0.49**	−0.07	0.67***	0.59	1.10
	(0.12)	(0.17)	(0.13)	(0.19)	(0.10)	(0.22)	(0.78)	(0.88)
Observations	993	965	993	800	993	938	993	986
DiD plus Matching								
Δ Childcare Support	0.27**	0.17	0.03	0.79***	−0.03	0.59***	0.01	0.47
	(0.11)	(0.22)	(0.14)	(0.28)	(0.12)	(0.22)	(0.67)	(0.77)
Observations	877	859	877	718	877	831	878	872
LDV plus Matching								
Δ Childcare Support	0.19*	0.37**	0.02	0.46**	−0.02	0.54***	−0.05	0.39
	(0.10)	(0.16)	(0.12)	(0.19)	(0.09)	(0.19)	(0.60)	(0.69)
Observations	877	859	877	718	877	831	878	872
DiD plus Matching plus Changes								
Δ Childcare Support	0.50***	0.36*	0.10	0.72***	−0.10	0.50**	−0.19	0.18
	(0.11)	(0.18)	(0.13)	(0.27)	(0.14)	(0.21)	(0.61)	(0.74)
Observations	877	859	877	718	877	831	878	872
LDV plus Matching plus Changes								
Δ Childcare Support	0.36***	0.56***	0.07	0.53***	−0.11	0.45**	−0.29	0.20
	(0.10)	(0.15)	(0.11)	(0.20)	(0.11)	(0.19)	(0.55)	(0.66)
Observations	877	859	877	718	877	831	878	872

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). The number of observations varies, because after matching not all observations are in the support.
Source: FiDv4.0.

All specifications show that *Childcare Support* offered by the mother's employer positively affects her life satisfaction. Particularly the LDV specification also reveals a positive effect on job satisfaction. The DiD estimates for job satisfaction are weaker but lead to the same qualitative conclusion. In contrast to care satisfaction, is the introduction of

Childcare Support more frequent among individuals experiencing a relatively high level of job satisfaction in the pre-treatment period, implying that the job was already rather enjoyable before the treatment took place (see Table 3.F.1). This explains that the LDV estimate exceeds the DiD estimate. There is no clear effect on time pressure.

Overall our findings suggest that mothers benefit in work, life and family relevant areas when their employer provides childcare support. This suggests a reduction of work-family conflicts. These positive effects are in line with previous research showing that on-site care is related to higher childcare satisfaction (Ezra and Deckman, 1996) and job satisfaction (Saltzstein et al., 2001; Artz, 2010).

There could be two underlying effects: A general increase in the availability of affordable high-quality daycare and the additional benefits of on-site childcare, e.g. by being more adaptable to parental working hours or being of higher quality than daycare by other providers. Thus to reveal the extent of the second mechanism, future research may aim at analyzing the effect of on-site childcare in countries with an extensive supply of public daycare, e.g. the Scandinavian countries. In countries such as Germany and the US the childcare market is restrictive, in terms of prices in the US and because of limited availability in Germany. Hence, both mechanisms may play a role in these settings.

Further estimates show that the increase in well-being is accompanied by an increase in working time. Column six in Table 3.5.1 reveals that on average there is a significant effect of 0.45 to 0.67 additional hours spent on work related activities per weekday. There is also a positive, but much smaller, tendency for actual weekly working hours. The effect for time devoted to the job might be stronger as individuals have to assess the time in hours per day. This is a relatively rough measure. However, it could also indicate that more time is devoted to work mainly during the week or outside official working hours, which is not entirely captured by the other two measures. There is no significant increase in agreed working hours. Hence, if there is a change in working time it seems to be driven by supplementary work during the week, e.g. work at home, overtime or travels, but not the working time stipulated by the contract. The findings become clearer once analyzing effect heterogeneity with respect to education (see Section 3.5.2.3).

Childcare Support leaves well-being and working time of fathers mainly unchanged. The basic models suggest that the provision of *Childcare Support* raises job satisfaction for fathers. However, this result is not robust. When controlling for other changes taking place at the same time, this effect disappears (see Table 3.G.1). The effect of *Childcare Support* seems to be confounded with other changes, such as an increase in wages or a change to a more satisfying occupational position. More research is needed to determine whether this policy is not suitable to reduce work-family conflict for fathers or whether such a conflict does not exists for the majority of fathers because childcare is still mainly

a mother's duty.[40]

3.5.2.2 Main Effects of Flex Schedule

In contrast to *Childcare Support*, *Flex Schedule* does not seem to affect work-life balance, but has only an effect on work related satisfaction. The estimates show a robust increase of job satisfaction by 0.41 to 0.54 points (see Table 3.5.2). However, there is no spillover to life satisfaction and also no accompanying change in satisfaction with family or childcare. There even seems to be a slight increase in perceived time pressure, but this effect is not statistically significant in all specifications. Controlling for the fact that the group of treated has experienced less time pressure before the treatment (see Table 3.F.2) reduces the effect.

There is no significant change in working time. It appears as if mothers slightly reduce their working hours. This may be due to *Flex Schedule* also including the possibility to reduce working hours to part-time.

Even fewer effects of *Flex Schedule* are related to a father's well-being. However, fathers significantly reduce their actual working time, which indicates that *Flex Schedule* is a means for fathers to give up working long hours. At the same time there is a tendency of a reduction in family satisfaction (see Table 3.G.2). This could be explained by *Flex Schedule* coming with requirements by the firm, for example, permanent disposability or working on weekends, that reduce time available for the family. There is also evidence that it is not widely accepted if fathers use part-time or flex-time (see Coltrane et al., 2013; Williams et al., 2013), hence it is possible that fathers only work flexibly if there are challenges faced by the family.

Our findings indicate that *Flex Schedule* should not be seen as a clear-cut family benefit. This is in line with previous research. Saltzstein et al. (2001) find, for example, that a positive relationship of flexible schedules with job satisfaction only exists in dual-earner households without children. Similarly Possenriede and Plantenga (2014) argue that flexible work schedules appeal more generally to employees and are not a policy explicitly targeted at parents. Work flexibility, at least in the way it is currently implemented, may not be far-reaching enough. Problems concerning childcare or family emergencies may not be solvable this way.

3.5.2.3 Heterogeneous Effects by Education

It can be assumed that the effects of FFPs are not homogeneous, because parents are to a different degree constrained in their allocation of time. Highly educated parents can be

[40]The finding that 40 percent of mothers but less than 20 percent of fathers use *Childcare Support* supports this hypothesis.

Table 3.5.2: Effects of *Flex Schedule* - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD								
Δ Flex Schedule	−0.07	0.54**	−0.03	0.12	0.17*	−0.04	−0.36	−0.15
	(0.14)	(0.22)	(0.13)	(0.25)	(0.09)	(0.21)	(0.74)	(0.77)
Observations	471	453	471	395	471	435	471	466
LDV								
Δ Flex Schedule	−0.04	0.54***	−0.12	0.03	0.10	−0.04	−0.34	−0.16
	(0.12)	(0.18)	(0.12)	(0.21)	(0.08)	(0.19)	(0.68)	(0.71)
Observations	471	453	471	395	471	435	471	466
DiD plus Matching								
Δ Flex Schedule	−0.13	0.42*	−0.01	−0.12	0.16*	0.01	−0.77	−0.55
	(0.17)	(0.22)	(0.13)	(0.28)	(0.09)	(0.22)	(0.76)	(0.74)
Observations	463	443	463	371	463	423	463	459
LDV plus Matching								
Δ Flex Schedule	0.09	0.51***	−0.08	0.02	0.04	−0.17	−0.69	−0.85
	(0.14)	(0.19)	(0.12)	(0.21)	(0.07)	(0.19)	(0.66)	(0.67)
Observations	463	443	463	371	463	423	463	459
DiD plus Matching plus Changes								
Δ Flex Schedule	−0.13	0.41**	−0.06	−0.34	0.18	−0.18	−0.84	−0.43
	(0.18)	(0.20)	(0.14)	(0.30)	(0.11)	(0.24)	(0.73)	(0.79)
Observations	463	443	463	371	463	423	463	459
LDV plus Matching plus Changes								
Δ Flex Schedule	−0.04	0.49***	−0.11	−0.16	0.13	−0.26	−0.94	−0.68
	(0.13)	(0.18)	(0.12)	(0.24)	(0.08)	(0.23)	(0.69)	(0.75)
Observations	463	443	463	371	463	423	463	459

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). The number of observations vary, because after matching not all observations are in the support.
Source: FiDv4.0.

assumed to be less restricted than lower educated parents in choosing a convenient work environment and childcare arrangement, as they are, for example, more able to purchase private childcare or domestic help.

Effect heterogeneity with respect to education is analyzed based on interaction terms due to a relatively small sample size. For a clearer representation the two higher and two lower education groups are combined. Hence, there is only one interaction effect, separating the treatment effect for those with high education or high vocational training from

those with lower education (vocational training and low education).[41] This exercise provides valuable insights on effect heterogeneity by qualitatively analyzing the interaction effect.

Table 3.5.3: Effects of *Childcare Support* by Maternal Education - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Childcare Support	0.83***	0.42	0.09	0.54	−0.12	0.88***	1.03	2.30**
	(0.14)	(0.26)	(0.15)	(0.36)	(0.18)	(0.29)	(0.83)	(0.95)
Δ Childcare Support *	−0.80***	−0.15	0.01	0.40	0.06	−0.90**	−2.95**	−5.12***
High Educ./High Voc.	(0.21)	(0.40)	(0.26)	(0.62)	(0.23)	(0.40)	(1.29)	(1.44)
Observations	877	859	877	718	877	831	878	872
LDV plus Matching plus Changes								
Δ Childcare Support	0.62***	0.62***	0.06	0.34	−0.15	0.85***	0.87	2.23**
	(0.11)	(0.19)	(0.14)	(0.28)	(0.14)	(0.26)	(0.80)	(0.90)
Δ Childcare Support *	−0.65***	−0.23	0.01	0.23	0.10	−0.90**	−2.78**	−4.83***
High Educ./High Voc.	(0.20)	(0.31)	(0.24)	(0.40)	(0.18)	(0.35)	(1.19)	(1.28)
Observations	877	859	877	718	877	831	878	872

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3).
Source: FiDv4.0.

Our findings support the hypothesis of heterogeneous effects. The results presented in Table 3.5.3 show that even though all mothers value *Childcare Support*, revealed by higher levels of care satisfaction in both groups, mid-level and lowly educated mothers benefit more than highly educated mothers in terms of life satisfaction. There is a similar tendency for job satisfaction. In addition, there is an increase in working time, which is also not prevalent for highly educated mothers. In this analysis, the change in actual working hours clearly supports the conclusions based on the measure of hours devoted to work related activities on an average weekday. There is a similar, but smaller effect for agreed working time.

Hence, for mothers with medium and lower education the restriction on childcare availability may actually be relaxed by the introduction of *Childcare Support*. Highly educated mothers may value that childcare is offered, but their life may be less influenced by external restrictions on childcare anyway and the kind of childcare offered by *Childcare Support* may not be able to further relax their situation.

[41] Implicitly it is assumed that there is no difference in the effect in the combined groups. Separating the groups leads to the same qualitative conclusions. The main effects are driven by the group with vocational training, as the group with low education is rather small.

In the case of *Flex Schedule*, differences by education are not clear (see Table 3.5.4). The effect on job satisfaction exists for all groups. There seem to be stronger reductions in working time in the group of mothers with a high education background.

Table 3.5.4: Effects of *Flex Schedule* by Maternal Education - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Flex Schedule	−0.06	0.37	0.04	0.01	0.10	−0.11	−0.36	0.38
	(0.20)	(0.24)	(0.17)	(0.32)	(0.13)	(0.29)	(0.91)	(1.01)
Δ Flex Schedule *	−0.19	0.12	−0.35	−1.14	0.23	−0.22	−1.54	−2.64
High Educ./High Voc.	(0.43)	(0.41)	(0.27)	(0.71)	(0.22)	(0.51)	(1.70)	(1.62)
Observations	463	443	463	371	463	423	463	459
LDV plus Matching plus Changes								
Δ Flex Schedule	−0.00	0.50**	−0.06	0.01	0.08	−0.20	−0.52	0.23
	(0.17)	(0.22)	(0.16)	(0.29)	(0.09)	(0.27)	(0.85)	(0.93)
Δ Flex Schedule *	0.23	−0.10	−0.30	−0.57	0.11	−0.31	−0.90	−3.03*
High Educ./High Voc.	(0.26)	(0.38)	(0.24)	(0.52)	(0.17)	(0.45)	(1.60)	(1.60)
Observations	463	443	463	371	463	423	463	459

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3).
Source: FiDv4.0.

3.5.3 Sensitivity of the Treatment Effects

3.5.3.1 Actual Usage of Childcare Support

Butts et al. (2013) claim that the effect of provision of FFPs is at least as large as the effect of actual usage. It seems possible that part of the effect is driven by the offer because as long as the offer is continuing it increases future possibilities to reconcile work and family. In addition, the work environment may change, particularly the understanding for the specific challenges faced by parents. However, it would be surprising if the individuals who make use of the FFP would not benefit the most.

FiD only provides information on the usage of *Childcare Support*, while the usage of *Flex Schedule* is not observed. Therefore the hypothesis that provision has a separate effect can only be tested for *Childcare Support*. About 40 percent of mothers with *Childcare Support* available make directly use of it.[42]

Usage has the stronger effect, particularly on life satisfaction and satisfaction with childcare (see Table 3.5.5). However, there are also positive, though smaller and weaker,

[42]These are 27 observations for mothers.

effects of the pure availability on life and job satisfaction as well as as a positive tendency in care satisfaction. The offer with and the offer without usage seem to raise working time.

The FiD data does not provide direct information on whether the parent intends to use *Childcare Support* in the future, which might explain the effects of the provision. However, for the waves 2011 and 2012 it is possible to state that the same number of mothers begins to use *Childcare Support* until the next interview, as mothers use *Childcare Support* directly in the wave in which the offer is made the first time.

Table 3.5.5: Effects of *Childcare Support* - Provision and Usage - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Offer & No use	0.37***	0.30	0.03	0.19	−0.16	0.62**	−1.03	−0.05
Care Support	(0.14)	(0.25)	(0.16)	(0.27)	(0.15)	(0.29)	(0.73)	(0.90)
Δ Offer & Use Care	0.69***	0.44	0.20	1.64***	0.00	0.32	1.04	0.52
Support	(0.14)	(0.35)	(0.19)	(0.52)	(0.20)	(0.31)	(0.78)	(1.10)
Observations	877	859	877	718	877	831	878	872
LDV plus Matching plus Changes								
Δ Offer & No use	0.23*	0.58***	0.02	0.20	−0.17	0.58**	−0.95	−0.01
Care Support	(0.14)	(0.19)	(0.15)	(0.23)	(0.11)	(0.25)	(0.67)	(0.84)
Δ Offer & Use Care	0.54***	0.54**	0.14	1.10***	−0.02	0.27	0.67	0.52
Support	(0.12)	(0.23)	(0.16)	(0.28)	(0.16)	(0.27)	(0.73)	(0.96)
Observations	877	859	877	718	877	831	878	872

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3).
Source: FiDv4.0.

3.5.3.2 Balancing by all Pre-treatment Outcomes

It is a reasonable extension to balance the treatment and control group not only with respect to the pre-treatment value of the outcome under consideration, but to require balancing with respect to all eight outcomes that were assumed to be essential to assess the effect of the treatment. Including pre-treatment outcomes in the set of control variables reveals an even clearer and more significant pattern (see Table 3.5.6). In the case of *Childcare Support*, these estimates even imply a reduction of time pressure.[43]

[43]The sample size is slightly reduced, because for some observations the pre-treatment information particularly on care satisfaction is missing, while it is available for the other measures.

The effect of *Flex Schedule* on job satisfaction becomes also more pronounced. However, there are still no accompanying changes in satisfaction in other areas or in working time.

Table 3.5.6: Effects of FFPs - Including all Pre-treatment Outcomes - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
LDV plus Matching (incl. all pre-treatment outcomes plus Changes								
Δ Childcare Support	0.32***	0.66***	0.10	0.53***	−0.28***	0.46**	−0.30	0.17
	(0.10)	(0.15)	(0.12)	(0.19)	(0.10)	(0.21)	(0.60)	(0.76)
Observations	771	769	771	700	771	736	771	770
LDV plus Matching (incl. all pre-treatment outcomes) plus Changes								
Δ Flex Schedule	0.11	0.70***	−0.14	−0.17	−0.02	−0.37	0.04	0.10
	(0.13)	(0.18)	(0.13)	(0.23)	(0.08)	(0.25)	(0.60)	(0.72)
Observations	395	391	395	369	395	364	395	395

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). *Source:* FiDv4.0.

3.5.3.3 Excluding 'Job-Changers'

It is assessed whether our findings are only driven by individuals who changed their employer during the observation period because they aimed for family-friendliness at their workplace. In the main specification it is assumed that if parents switch the employer, this is not primarily because of the FFP. This is not implausible given that many factors affect the choice of the workplace.

Still, if these "job-changing" individuals were rather unhappy with their previous situation, the effects on well-being might be overestimated. Even though, the specification which controls for the lagged dependent outcomes should partly capture this effect, a separate analysis for individuals who did not switch the employer (non-job-changers) is performed. The majority of treated mothers belongs to the non-job-changers. More precisely 50 treated mothers for *Childcare Support* and 91 treated mothers for *Flex Schedule*, did not change their job before the FFP was offered.

The estimates given in Table 3.5.7 suggest that the effects on well-being and time pressure are even larger when *Childcare Support* comes 'at a surprise', i.e. without changing the workplace. Only the increase in working hours is less pronounced. Rather, we observe a shift to devoting more time to work on weekdays. Additional estimates, not presented here, support this claim by suggesting that mothers who receive *Childcare Support* are less likely to work on weekends.

Table 3.5.7: Effects of *Childcare Support* - Non-Job-Changing Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Childcare Support	0.53***	0.46**	0.12	0.71***	−0.19	0.70***	−1.04**	−0.11
	(0.15)	(0.20)	(0.16)	(0.26)	(0.14)	(0.24)	(0.48)	(0.77)
Observations	600	590	598	495	600	566	598	595
LDV plus Matching plus Changes								
Δ Childcare Support	0.30**	0.58***	0.05	0.47**	−0.29**	0.57***	−0.92**	0.01
	(0.12)	(0.17)	(0.12)	(0.20)	(0.12)	(0.22)	(0.45)	(0.75)
Observations	600	590	598	495	600	566	598	595

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). *Source:* FiDv4.0.

Table 3.5.8: Effects of *Flex Schedule* - Non-Job-Changing Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Flex Schedule	−0.25	0.63**	−0.05	−0.02	0.08	−0.54**	−1.12	−1.17
	(0.25)	(0.26)	(0.21)	(0.37)	(0.15)	(0.26)	(0.71)	(0.81)
Observations	287	288	287	246	294	264	288	285
LDV plus Matching plus Changes								
Δ Flex Schedule	0.00	0.70***	−0.06	0.04	−0.07	−0.46*	−1.02	−1.18
	(0.16)	(0.24)	(0.18)	(0.26)	(0.10)	(0.25)	(0.69)	(0.78)
Observations	287	288	287	246	294	264	288	285

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). *Source:* FiDv4.0.

The estimates for *Flex Schedule* in the group of non-job-changers also confirm its positive effect on job satisfaction. The point estimate is of a similar size. However, if mothers do not switch employers, the opportunity to work flexibly seems to come along with a reduction in total working time by half an hour per day or more than one hour a week (see Table 3.5.8).

3.6 Conclusions

Family-friendly firm policies are implemented to ease the work-family conflict for working parents. Evidence on whether and which policies actually meet this goal is rare. We estimate the effect of two specific family-friendly policies on the well-being and working time of mothers and fathers. The two policies are childcare support provided by the firm and flexible working schedules. These policies seem particularly likely to reduce problems for parents to reconcile work and family life. Flexible working schedules might allow parents to better adapt to their offspring's often unforeseeable and constantly changing needs. On-site childcare and other childcare support by firms may be a valuable asset particularly in countries, such as Germany, where publicly subsidized daycare does not always sufficiently meet parental needs.

The empirical setting exploits the fact that since the mid-2000s an increasing share of employers respond to their employees' needs by offering a family-friendly work environment. These changes over time allow us to identify causal effects of the two family-friendly policies based on difference-in-differences and lagged dependent variable strategies in a panel dataset on families with young children in Germany (FiD). The panel models are combined with matching to decrease potential bias arising from factors correlated with the offer of the policies and the change in the considered outcomes.

In a first step we explore the individual, family, and job characteristics that are positively related to the introduction of a family-friendly firm policy at the parent's workplace. In line with the previous evidence we find that parents with high socioeconomic status and position, as well as longer tenure, are more likely to report that a family-friendly firm policy is established. Related to firm characteristics, firm size makes the most obvious difference.

The main analysis reveals that childcare support strongly increases maternal satisfaction with childcare and raises her life satisfaction and job satisfaction. Especially mid-level and lower educated mothers increase their working hours when childcare support is offered. These effects are driven by the direct usage of childcare, but it appears that the mere possibility to make use of the childcare support also yields benefits. Flexible working schedules only affect mothers' job satisfaction, but there are no accompanying effects for work behavior and family related satisfaction.

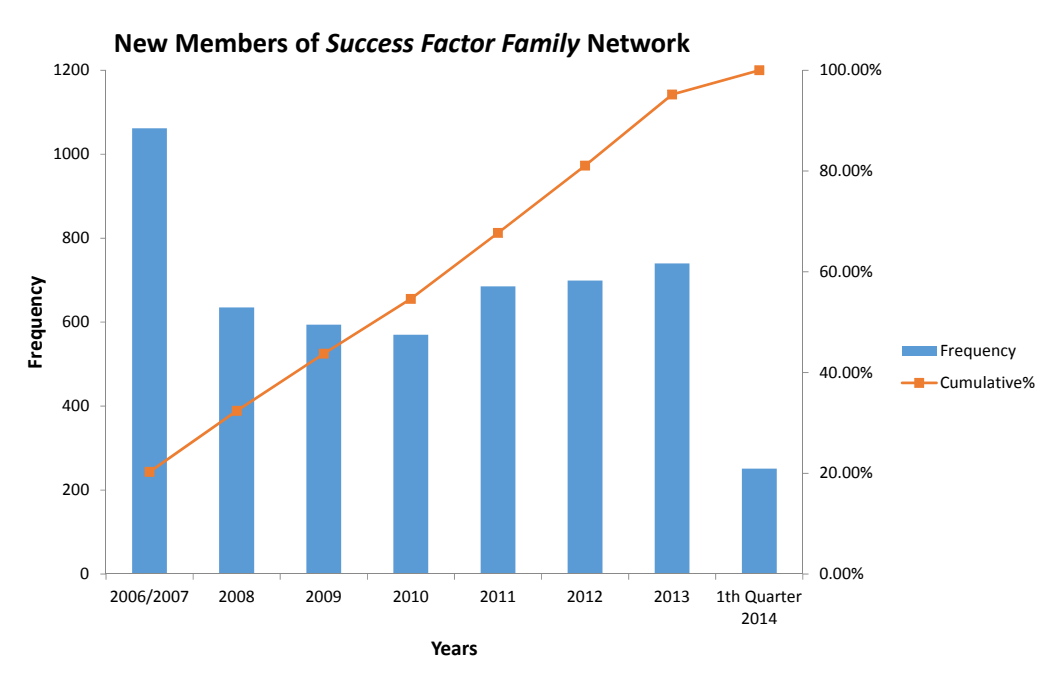
Results for fathers can be summarized in short: There are hardly any effects of family-friendly firm policies. Particularly the father's satisfaction shows no clear reaction to either childcare support or flexible working schedules. This is in accordance with findings suggesting that it is less accepted if fathers make use of these policies (see e.g. Coltrane et al., 2013; Williams et al., 2013) and furthermore with the evidence indicating that organizing family life is still mainly a mother's duty (see e.g. Wall and Arnold, 2007).

The findings in this paper suggest that the subsidy that is currently paid to firms by the German government for setting up childcare slots at the workplace may actually reach the goal of helping mothers to reconcile work and family life. Childcare support also seems to be effective in increasing maternal working hours, but only for mothers with a medium or low level of education.

Flexible working schedules, on the other hand, do not have a clear impact on the work-life balance. In the current form, a flexible organization of working hours does not increase mothers' or fathers' satisfaction in family related areas, though at least it raises maternal job satisfaction. Further research is needed to find out whether there are some aspects covered by our measure of working time flexibility, such as part-time work or a working hours account that could indeed reduce the work-family conflict, while others hinder reconcilability. Additionally, we need to investigate whether there are other factors that accompany flexible working schedules, for example permanent disposability by phone or email, that counteract a positive effect of this policy.

Appendix 3.A *Success Factor Family* Network

Figure 3.A.1: New Members of *Success Factor Family* Network



Note: Number of new members per year and cumulative members in percent. Own calculations.
Source: Data provided by *Deutscher Industrie- und Handelskammertag (DIHK)*.

Appendix 3.B Description of Control Variables

Table 3.B.1: Description of Conditioning Variables

Variable	Scale	Description
Family Characteristics		
Age Youngest Child	Continuous	Age of the youngest child in years.
Youngest Child Age < 3	Binary	Youngest child is younger than three years.
No School Aged Child	Binary	Youngest child is not yet in school.
2 Children 3-4 Children	Binary	Number of children under 17 years (in household). References Group: One child.
Household Income (p)	Continuous	Household income in €1000.
Parental Characteristics (Individual and Partner)		
Age^{+}	Continuous	Age in years.
Family Attitude $^{+}$	Binary	Women: Strongly agree/agree that mothers should care more for children than career. Men: Strongly agree/agree that men and women should care equally for family and household.
Low Education (p) (ISCED 1/2) High Vocational (p) (ISCED 5) High Education (p) (ISCED 5A/6) $^{+}$	Binary	Highest Educational degree (ISCED 1997 Coding). References Group: Vocational Training (ISCED 3/4).
High Job Position (p)$^{+}$	Binary	(High) qualified professional or managerial worker or high-level/executive civil servant.
Hourly Wage (p)	Continuous	Hourly wage in €.
Tenure (p)	Continuous	Tenure in years.
Unempl. Exp.(p)$^{+}$	Continuous	Unemployment experience in years.
Full-Time. Exp.(p)$^{+}$	Continuous	Full-time work experience in years.
Partner not working (p)	Binary	Partner did not participate in the labor market.
Workplace Characteristics		
Large Firm Small Firm	Binary	Number of employees in firm. Large: > 100 Employees, Small: $\leq$ 20 Employees References Group: 20-100 employees.
Family-Friendly (p)	Binary	Firm offers two FFP out of "Contact during parental leave", "Any other childcare support" or "Support in Emergencies".
Civil Service	Binary	Work in civil service sector.
Manager Professionals Technicians & Assoc. Professionals Service & Sales Worker Craft & Trades Worker Plan & Machine Operator Elementary Occupations	Binary	Occupation (ISCO88 summarized). Reference Group: Clerical Support Worker,
Regional Characteristics		
Small City/Rural	Binary	Urbanization. Indicating living small city or rural areas (<20000 inhabitants).
West Germany	Binary	Living in West Germany.
Years Change-Period	Values 1/2	Indicates whether one or two years lie between post-treatment and pre-treatment period.

Note: $^{+}$ Variables included for individuals themselves and partner.
Note: (p): Measured in pre-treatment period.

Appendix 3.C Weighting by Entropy Balancing

Table 3.C.1: Entropy Balancing *Childcare Support* - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Flex Schedule	−0.23	0.42*	−0.09	−0.26	0.19	−0.23	−0.70	−0.48
	(0.17)	(0.21)	(0.15)	(0.31)	(0.11)	(0.23)	(0.65)	(0.73)
Observations	993	965	993	800	993	938	993	986
LDV plus Matching plus Changes								
Δ Flex Schedule	−0.08	0.54***	−0.16	−0.11	0.09	−0.30	−0.67	−0.51
	(0.13)	(0.19)	(0.13)	(0.27)	(0.09)	(0.22)	(0.63)	(0.71)
Observations	993	965	993	800	993	938	993	986

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). *Source:* FiDv4.0.

Table 3.C.2: Entropy Balancing *Flex Schedule* - Mothers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Flex Schedule	−0.21	0.40*	−0.08	−0.24	0.19*	−0.25	−0.73	−0.47
	(0.17)	(0.21)	(0.15)	(0.31)	(0.11)	(0.23)	(0.66)	(0.73)
Observations	471	453	471	395	471	435	471	466
LDV plus Matching plus Changes								
Δ Flex Schedule	−0.07	0.52***	−0.15	−0.11	0.09	−0.32	−0.73	−0.54
	(0.13)	(0.19)	(0.13)	(0.27)	(0.09)	(0.22)	(0.64)	(0.70)
Observations	471	453	471	395	471	435	471	466

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). *Source:* FiDv4.0.

Appendix 3.D Including Always-Treated

Table 3.D.1: Effects of *Childcare Support* incl. Always-Treated - Mothers

	Well-Being					Working Behavior		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Childcare Support	0.48***	0.40**	0.10	0.67***	−0.14	0.46**	−0.03	0.53
	(0.11)	(0.17)	(0.13)	(0.25)	(0.13)	(0.20)	(0.58)	(0.72)
Observations	1011	989	1011	831	1011	964	1011	1005
LDV plus Matching plus Changes								
Δ Childcare Support	0.35***	0.56***	0.10	0.44**	−0.15	0.37**	−0.26	0.42
	(0.10)	(0.13)	(0.11)	(0.17)	(0.10)	(0.18)	(0.51)	(0.63)
Observations	1011	989	1011	831	1011	964	1011	1005

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). *Source:* FiDv4.0.

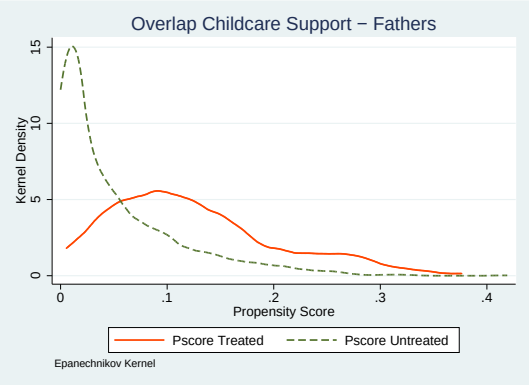
Table 3.D.2: Effects of *Flex Schedule* incl. Always-Treated - Mothers

	Well-Being					Working Time		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD plus Matching plus Changes								
Δ Flex Schedule	−0.03	0.40**	−0.13	0.03	0.22**	−0.10	−0.59	−0.17
	(0.14)	(0.19)	(0.11)	(0.22)	(0.09)	(0.17)	(0.55)	(0.59)
Observations	959	931	959	786	959	907	958	951
LDV plus Matching plus Changes								
Δ Flex Schedule	−0.08	0.39**	−0.19**	−0.04	0.13**	−0.08	−0.44	−0.07
	(0.11)	(0.15)	(0.09)	(0.20)	(0.06)	(0.16)	(0.50)	(0.54)
Observations	959	931	959	786	958	907	958	951

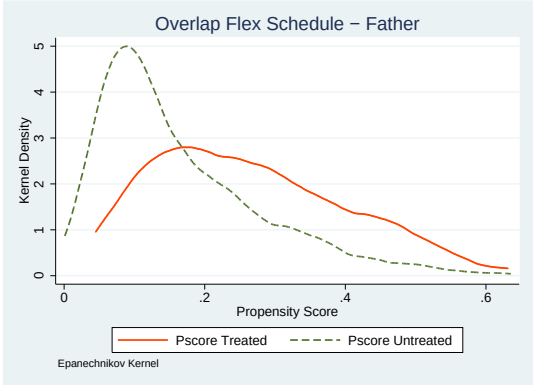
Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). *Source:* FiDv4.0.

Appendix 3.E Balancing

Figure 3.E.1: Overlap of Propensity Scores for Treated and Non-Treated -Fathers

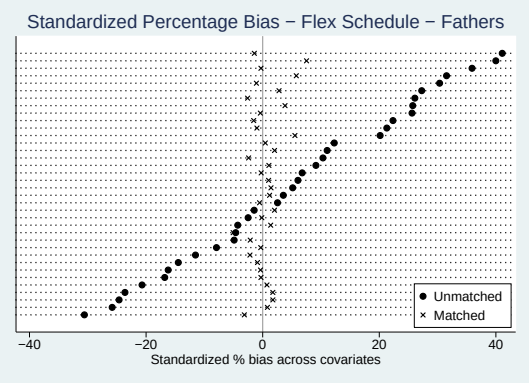


(a) Overlap *Childcare Support*

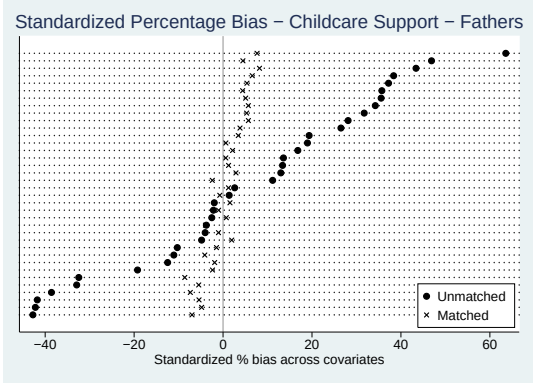


(b) Overlap *Flex Schedule*

Figure 3.E.2: Standardized Percentage Bias before and after Matching - Fathers



(a) Balancing *Childcare Support*



(b) Balancing *Flex Schedule*

Table 3.E.1: Balancing for *Childcare Support* - Mothers

	Unweighted Mean		Difference		% Std.
	Treated	Control	Raw	Matched	Bias
Family Characteristics					
Age Youngest Child	4.3	4.2	0.14	0.01	0.6
Youngest Child < Age 3	0.1	0.1	−0.07*	0.01	2.1
No School Aged Child	0.9	0.9	0.05	0.00	−0.8
2 Children	0.5	0.5	0.01	−0.01	−2.0
3-4 Children	0.2	0.3	−0.09	−0.01	−2.7
Household Income (p)	3.9	3.4	0.42**	−0.04	−2.6
Mother's Characteristics					
Own Age	37.4	37.0	0.38	−0.11	−2.2
Family Attitude	0.3	0.4	−0.09	0.00	−0.7
Low Education (p)	0.0	0.1	−0.06*	−0.01	−4.4
High Vocational (p)	0.1	0.0	0.02	0.00	−1.7
High Education (p)	0.4	0.3	0.13**	0.02	3.3
High Job Position (p)	0.3	0.2	0.08	−0.01	−2.0
Hourly Wage (p)	12.3	10.9	1.36*	0.11	1.5
Tenure (p)	7.5	5.7	1.87**	−0.21	−3.2
Unempl. Exp. (p)	2.5	3.4	−0.87	0.08	1.1
Full-Time Exp. (p)	6.3	5.9	0.37	−0.01	−0.3
Partner's Characteristics					
Partner's Age	40.9	40.1	0.84	0.18	3.0
Partner's Family Attitude	0.7	0.6	0.05	0.01	1.7
Partner's High Education (p)	0.3	0.3	0.01	−0.01	−3.0
Partner's High Position (p)	0.4	0.3	0.09	0.01	2.1
Partner's Unempl. Exp. (p)	3.6	4.1	−0.56	−0.19	−1.2
Partner not working (p)	0.0	0.0	−0.02	0.00	−2.7
Workplace Characteristics					
Large Firm	0.6	0.5	0.18***	0.03	5.3
Small Firm	0.2	0.4	−0.12**	−0.01	−2.6
Family-Friendly (p)	0.4	0.2	0.18***	0.03	6.9
Civil Service	0.4	0.2	0.19***	0.01	1.4
Manager	0.0	0.0	0.01	0.00	2.2
Professionals	0.3	0.2	0.13***	0.01	2.9
Technicians & Assoc. Professionals	0.4	0.3	0.06	0.00	−1.0
Service & Sales Worker	0.1	0.2	−0.14***	−0.02	−5.7
Craft & Trades Worker	0.0	0.0	−0.02	0.00	.
Plan & Machine Operator	0.0	0.0	−0.01	0.00	.
Elementary Occupations	0.0	0.1	−0.09**	0.00	.
Regional Characteristics					
West Germany	0.7	0.8	−0.08	0.01	3.1
Small City/Rural	0.1	0.2	−0.05	−0.02	−4.7
Years Change-Period	1.2	1.2	0.07	0.01	2.1
Observations[c]	71	922			
	71	810			
Mean Bias (raw,matched)			19.6	2.3	

Notes: Columns 1 and 2 display the mean values in the treated and non-treated group in the unmatched sample. Column 3 reports the difference between these two group-specific means and column 4 displays the corresponding difference in means in the matched sample. In column 5 the standardized percentage biased for the matched sample is displayed. Significance levels for the t-test in column 3 and 4 are reported as: */ **/ ***: Significance at the 10-/5-/1-percent level.
[a] Values in parentheses remain after matching and on support.
Source: FiDv4.0.

Table 3.E.2: Balancing for *Flex Schedule* - Mothers

	Unweighted Mean		Difference		% Std.
	Treated	Control	Raw	Matched	Bias
Family Characteristics					
Age Youngest Child	4.3	4.0	0.31*	0.10	6.3
Youngest Child < Age 3	0.1	0.2	−0.07**	−0.01	−2.6
No School Aged Child	0.9	0.9	−0.04	−0.01	−4.2
2 Children	0.5	0.5	0.00	−0.03	−5.2
3-4 Children	0.3	0.3	0.00	0.01	2.0
Household Income (p)	3.4	3.2	0.27**	0.03	2.3
Mother's Characteristics					
Own Age	37.6	36.1	1.51***	0.01	0.1
Family Attitude	0.4	0.4	−0.07	−0.04	−7.4
Low Education (p)	0.0	0.1	−0.08***	0.00	−0.2
High Vocational (p)	0.1	0.0	0.03	−0.01	−3.4
High Education (p)	0.2	0.2	0.02	0.02	4.3
High Job Position (p)	0.2	0.2	0.01	0.00	0.9
Hourly Wage (p)	10.8	9.9	0.91	0.17	2.8
Tenure (p)	6.7	4.4	2.25***	−0.21	−3.7
Unempl. Exp. (p)	2.8	3.8	−0.94	−0.11	−1.2
Full-Time Exp. (p)	6.2	5.4	0.81*	−0.04	−0.9
Partner's Characteristics					
Partner's Age	41.0	39.1	1.84***	0.29	4.8
Partner's Family Attitude	0.7	0.6	0.07	−0.01	−2.1
Partner's High Education (p)	0.3	0.2	0.11**	0.00	1.1
Partner's High Position (p)	0.3	0.2	0.11**	0.00	−1.1
Partner's Unempl. Exp. (p)	4.8	4.5	0.34	−0.39	−2.4
Partner not working (p)	0.0	0.0	−0.01	0.00	1.1
Workplace Characteristics					
Large Firm	0.5	0.4	0.18***	0.00	0.6
Small Firm	0.3	0.4	−0.13***	−0.01	−2.9
Family-Friendly (p)	0.1	0.1	0.04	−0.01	−3.7
Civil Service	0.3	0.2	0.00	0.01	1.5
Manager	0.0	0.0	0.03*	0.01	5.2
Professionals	0.2	0.2	0.00	0.00	0.5
Technicians & Assoc. Professionals	0.3	0.3	0.04	−0.02	−5.3
Service & Sales Worker	0.2	0.2	−0.04	0.02	3.7
Craft & Trades Worker	0.0	0.0	0.01	0.01	3.1
Plan & Machine Operator	0.0	0.0	−0.01	0.00	0.1
Elementary Occupations	0.1	0.2	−0.10***	−0.01	−1.7
Regional Characteristics					
Small City/Rural	0.2	0.2	0.01	0.01	3.3
West Germany	0.8	0.8	0.00	−0.01	−2.7
Years Change-Period	1.2	1.2	0.00	0.00	−0.8
Observations[a]	131	339			
	(127)	(339)			
Mean Bias (raw,matched)			14.5	2.6	

Notes: Columns 1 and 2 display the mean values in the treated and non-treated group in the unmatched sample. Column 3 reports the difference between these two group-specific means and column 4 displays the corresponding difference in means in the matched sample. In column 5 the standardized percentage biased for the matched sample is displayed. Significance levels for the t-test in column 3 and 4 are reported as: */ **/ ***: Significance at the 10-/5-/1-percent level.
[a] Values in parentheses remain after matching and on support.
Source: FiDv4.0.

Table 3.E.3: Balancing for *Childcare Support* - Fathers

	Unweighted Mean		Difference		% Std.
	Treated	Control	Raw	Matched	Bias
Family Characteristics					
Age Youngest Child	3.7	3.7	−0.02	0.01	0.7
Youngest Child < Age 3	0.3	0.3	0.04	−0.01	−2.4
No School Aged Child	0.9	0.9	0.01	0.00	1.2
2 Children	0.4	0.5	0.00	0.01	1.6
3-4 Children	0.3	0.3	−0.03	0.00	−1.0
Household Income (p)	3.6	3.1	0.46***	0.08	5.4
Father's Characteristics					
Own Age	39.6	38.8	0.75	0.07	1.2
Family Attitude	0.7	0.6	0.07	0.00	0.6
Low Education (p)	0.0	0.1	−0.08**	−0.02	−8.6
High Vocational (p)	0.2	0.1	0.10***	0.02	5.3
High Education (p)	0.4	0.2	0.17***	0.03	6.6
Household Inc. (p)	3.6	3.1	0.46***	0.08	5.4
High Job Position (p)	0.5	0.3	0.22***	0.02	4.5
Hourly Wage (p)	15.9	13.3	2.65***	0.31	4.4
Tenure (p)	9.3	8.1	1.26*	0.15	2.1
Unempl. Exp. (p)	2.1	3.5	−1.45	−0.18	−2.4
Full-Time Exp. (p)	12.2	12.9	−0.68	−0.27	−4.1
Partner's Characteristics					
Partner's Age	37.5	36.0	1.47**	0.30	5.7
Partner's Family Attitude	0.4	0.5	−0.05	−0.01	−1.5
Partner's High Education (p)	0.3	0.2	0.07*	0.00	0.6
Partner's High Position (p)	0.1	0.1	0.06**	0.01	3.4
Partner's Unempl. Exp. (p)	0.9	5.0	−4.16***	−0.80	−7.4
Partner not working (p)	0.3	0.5	−0.17***	−0.03	−5.5
Workplace Characteristics					
Large Firm	0.9	0.6	0.26***	0.03	7.7
Small Firm	0.1	0.2	−0.14***	−0.02	−4.8
Family-Friendly (p)	0.3	0.2	0.14***	0.02	5.7
Civil Service	0.3	0.1	0.18***	0.03	8.2
Manager	0.1	0.1	0.00	0.00	−0.7
Professionals	0.3	0.2	0.15***	0.02	5.1
Technicians & Assoc. Professionals	0.3	0.2	0.11***	0.02	3.8
Service & Sales Worker	0.0	0.1	−0.01	0.00	1.9
Craft & Trades Worker	0.1	0.2	−0.15***	−0.02	−5.4
Plan & Machine Operator	0.0	0.1	−0.11***	−0.02	−7.0
Elementary Occupations	0.1	0.1	0.00	0.00	−1.0
Regional Characteristics					
Small City/Rural	0.1	0.2	−0.04	−0.01	−1.9
West Germany	0.9	0.8	0.04	0.01	2.9
Years Change-Period	1.3	1.3	−0.01	−0.02	−4.0
Observations[a]	90	1,565			
	(90)	(1,565)			
Mean Bias (raw,matched)			23.2	3.8	

Notes: Columns 1 and 2 display the mean values in the treated and non-treated group in the unmatched sample. Column 3 reports the difference between these two group-specific means and column 4 displays the corresponding difference in means in the matched sample. In column 5 the standardized percentage biased for the matched sample is displayed. Significance levels for the t-test in column 3 and 4 are reported as: */ **/ ***: Significance at the 10-/5-/1-percent level.

[a] Values in parentheses remain after matching and on support.

Source: FiDv4.0.

Table 3.E.4: Balancing for *Flex Schedule* - Fathers

	Unweighted Mean		Difference		% Std.
	Treated	Control	Raw	Matched	Bias
Family Characteristics					
Age Youngest Child	3.6	3.7	−0.14	−0.01	−0.3
Youngest Child < Age 3	0.3	0.3	0.02	0.01	1.4
No School Aged Child	0.9	0.9	0.01	0.00	−0.5
2 Children	0.5	0.5	0.03	0.01	1.0
3-4 Children	0.3	0.3	−0.02	0.01	1.4
Household Income (p)	3.2	2.8	0.41***	0.00	−0.3
Father's Characteristics					
Own Age	39.5	38.3	1.19**	0.33	5.5
Family Attitude	0.6	0.6	−0.02	−0.02	−5.1
Low Education (p)	0.1	0.2	−0.08***	0.00	0.8
High Vocational (p)	0.1	0.0	0.06***	0.00	−1.5
High Education (p)	0.2	0.1	0.12***	0.02	5.8
High Job Position (p)	0.4	0.2	0.17***	0.03	7.5
Hourly Wage (p)	13.4	11.5	1.86***	−0.07	−1.1
Tenure (p)	8.3	7.4	0.82	0.03	0.4
Unempl. Exp. (p)	3.4	4.8	−1.45*	−0.03	−0.4
Full-Time Exp. (p)	13.1	13.2	−0.09	0.14	2.0
Partner's Characteristics					
Partner's Age	36.3	35.7	0.60	0.11	2.0
Partner's Family Attitude	0.4	0.5	−0.07*	0.00	−0.9
Partner's High Education (p)	0.2	0.1	0.11***	0.01	2.8
Partner's High Position (p)	0.1	0.0	0.02	−0.01	−2.4
Partner's Unempl. Exp. (p)	3.0	6.4	−3.44**	0.24	1.7
Partner not working (p)	0.4	0.5	−0.08**	0.00	−0.3
Workplace Characteristics					
Large Firm	0.7	0.5	0.20***	−0.01	−1.4
Small Firm	0.2	0.3	−0.10***	0.01	1.7
Family-Friendly (p)	0.1	0.1	0.08***	−0.01	−2.6
Civil Service	0.2	0.1	0.07***	0.00	−1.0
Manager	0.1	0.0	0.02	0.00	1.1
Professionals	0.2	0.1	0.09***	0.01	3.8
Technicians & Assoc. Professionals	0.2	0.1	0.10***	0.00	−0.4
Service & Sales Worker	0.0	0.1	−0.03	−0.01	−2.2
Craft & Trades Worker	0.2	0.3	−0.13***	−0.01	−3.1
Plan & Machine Operator	0.1	0.2	−0.07**	0.00	0.7
Elementary Occupations	0.1	0.1	−0.01	0.00	−0.2
Regional Characteristics					
Small City/Rural	0.2	0.2	0.03	0.00	−0.3
West Germany	0.9	0.9	0.01	0.00	1.2
Years Change-Period	1.3	1.4	−0.02	−0.01	−2.1
Observations[a]	174	778			
	(174)	(778)			
Mean Bias (raw,matched)			17.3	1.9	

Notes: Columns 1 and 2 display the mean values in the treated and non-treated group in the unmatched sample. Column 3 reports the difference between these two group-specific means and column 4 displays the corresponding difference in means in the matched sample. In column 5 the standardized percentage biased for the matched sample is displayed. Significance levels for the t-test in column 3 and 4 are reported as: */ **/ ***: Significance at the 10-/5-/1-percent level.
[a] Values in parentheses remain after matching and on support.
Source: FiDv4.0.

Appendix 3.F Pre-Treatment Outcomes

Table 3.F.1: Pre-treatment Outcomes - *Childcare Support*

	Mothers			Fathers		
	Treated	Control	Diff	Treated	Control	Diff
Life (pre)	7.9	8.0	−0.06	7.9	7.8	0.15
Work (pre)	7.9	7.6	0.35	7.4	7.5	−0.00
Family (pre)	8.6	8.7	−0.05	8.9	8.8	0.04
Care (pre)	7.5	7.8	−0.38	7.3	7.6	−0.27
Stress (pre)	3.5	3.5	0.02	3.3	3.2	0.12
Time Job (pre)	5.8	5.0	0.73**	9.8	9.5	0.22
Agreed Hours (pre)	23.4	20.6	2.83**	39.8	39.0	0.76
Actual Hours (pre)	26.0	22.7	3.29**	45.8	44.0	1.80*

Source: FiDv4.0.

Table 3.F.2: Pre-treatment Outcomes - *Flex Schedule*

	Mothers			Fathers		
	Treated	Control	Diff	Treated	Control	Diff
Life (pre)	7.8	7.7	0.04	7.9	7.6	0.20*
Work (pre)	7.5	7.5	−0.02	7.2	7.3	−0.10
Family (pre)	8.5	8.7	−0.21	8.9	8.8	0.10
Care (pre)	7.8	7.8	0.02	7.6	7.7	−0.10
Stress (pre)	3.3	3.4	−0.12	3.2	3.2	−0.02
Time Job (pre)	5.0	5.0	−0.00	9.6	9.6	−0.02
Agreed Hours (pre)	20.7	20.4	0.27	39.2	39.7	−0.48
Actual Hours (pre)	22.5	22.4	0.09	44.8	44.4	0.43

Source: FiDv4.0.

Appendix 3.G Treatment Effects for Fathers

Table 3.G.1: Effects of *Childcare Support* - Fathers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD								
Δ Childcare Support	−0.01	0.37*	−0.06	−0.08	−0.04	−0.02	−0.57	−0.19
	(0.14)	(0.19)	(0.12)	(0.27)	(0.12)	(0.15)	(0.53)	(0.76)
Observations	1655	1649	1654	1269	1654	1642	1653	1635
LDV								
Δ Childcare Support	0.08	0.41***	−0.04	−0.14	0.03	0.07	−0.19	0.50
	(0.12)	(0.15)	(0.11)	(0.21)	(0.10)	(0.13)	(0.46)	(0.67)
Observations	1655	1649	1654	1269	1654	1642	1653	1635
DiD plus Matching plus Changes								
Δ Childcare Support	−0.20	0.08	−0.09	−0.13	−0.02	−0.00	−0.74*	−0.49
	(0.15)	(0.17)	(0.11)	(0.28)	(0.11)	(0.14)	(0.44)	(0.66)
Observations	1655	1649	1654	124	1654	1642	1653	1635
LDV plus Matching plus Changes								
Δ Childcare Support	−0.13	0.04	−0.07	−0.05	0.06	0.14	−0.02	0.43
	(0.11)	(0.14)	(0.10)	(0.20)	(0.10)	(0.13)	(0.37)	(0.61)
Observations	1655	1649	1654	124	1654	1642	1653	1635

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). The number of observations vary, because after matching not all observations are in the support.
Source: FiDv4.0.

Table 3.G.2: Effects of *Flex Schedule* - Fathers

	Well-Being					**Working Time**		
	Δ *Satisfaction with...*				ΔTime	ΔTime	ΔAgreed	ΔActual
	Life	*Job*	*Family*	*Care*	*Pressure*	Job	Hours	Hours
DiD								
Δ Flex Schedule	0.05	0.16	−0.19	−0.14	0.05	−0.11	−0.09	−1.45***
	(0.10)	(0.17)	(0.13)	(0.20)	(0.09)	(0.13)	(0.40)	(0.55)
Observations	952	945	952	731	951	942	951	937
LDV								
Δ Flex Schedule	0.16*	0.12	−0.13	−0.17	0.04	−0.12	−0.37	−1.23**
	(0.09)	(0.14)	(0.11)	(0.16)	(0.07)	(0.13)	(0.38)	(0.51)
Observations	952	945	952	731	951	942	951	937
DiD plus Matching plus Changes								
Δ Flex Schedule	−0.06	0.04	−0.31**	−0.12	0.03	−0.24*	0.07	−1.30**
	(0.10)	(0.20)	(0.14)	(0.23)	(0.10)	(0.13)	(0.35)	(0.52)
Observations	952	944	952	731	951	941	951	937
LDV plus Matching plus Changes								
Δ Flex Schedule	−0.03	−0.03	−0.23**	−0.12	0.02	−0.25**	−0.35	−1.27***
	(0.09)	(0.16)	(0.12)	(0.17)	(0.08)	(0.12)	(0.33)	(0.48)
Observations	952	944	952	731	951	941	951	937

Note: Standard errors in parentheses are clustered at the individual level. */ **/ ***: Significance at the 10-/5-/1-percent level. All models include year-fixed effects. *Matching*: Matching on and regression adjustment for X^M (see Table 3.B.1). *Changes*: Regression adjustment for ΔX (see Section 3.4.3). The number of observations vary, because after matching not all observations are in the support.
Source: FiDv4.0.

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Abgrenzung

Kapitel 1: Die Idee zu diesem Kapitel habe ich alleine entwickelt und umgesetzt.

Kapitel 2: Die Daten, die in diesem Kapitel verwendet werden, sind sensibel, da eine Verknüpfung des KiGGS-Datensatzes mit regionalen Charakteristika vorgenommen wurde und somit der Anonymisierungsgrad nicht mehr so hoch ist. Ein Bearbeitung war daher nur in Kooperation mit dem Robert-Koch Institut (RKI) und vor Ort am RKI in Berlin möglich. Thomas Lampert ist verantwortlicher Vertragspartner des RKI. Die Idee, die Umsetzung und alle weiteren Inhalte des Papieres sind jedoch ausschließlich von mir zu verantworten.

Kapitel 3: Im Rahmen meines Aufenthaltes am Deutsches Institut für Wirtschaftsforschung (DIW) habe ich diesen Artikel mit Johanna Storck vom DIW geschrieben. Die Idee zu dem Papier hatte die ich bereits grundsätzlich an der Universität Konstanz entwickelt, die detaillierte Ausarbeitung der Umsetzung ist jedoch erst mit Johanna Storck entstanden. Wir haben beide zur Aufbereitung des Datensatzes beigetragen. Die Schätzungen wurden hauptsächlich von mir durchgeführt. Die erste Version des Artikels stammt aus meiner Hand. Gemeinsam haben wir die empirische Analyse und die Ausformulierung überarbeitet.