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## Journal of Family Research

*In diesem Heft:*

**Schwerpunktthema: Timing and spacing of births: Effects for parents and children**

- The impact of the timing of first births and spacing of second births on women's careers
- The effects of the first birth timing on women's wages
- Timing of first birth and well-being in later life
- Effects of age at first birth on health of mothers aged 45 to 56
- How do the number of siblings, birth order, and birth spacing affect children's vocabulary competences

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# Inhalt

# Editorial

Liebe Leserinnen,
liebe Leser,

zum ersten Mal in diesem Jahr legen wir Ihnen ein Schwerpunktthemenheft vor. Es trägt den Titel *Timing and spacing of births: Effects for parents and children* und umfasst fünf Beiträge in englischer Sprache, die sich mit folgenden Fragen beschäftigen:
Welchen Einfluss hat das Timing der ersten Geburt und deren Abstand zur zweiten Geburt auf die Karriere von Frauen? (*Brehm/Buchholz*)
Welche Auswirkungen hat das Timing der Erstgeburt auf die Einkommen von Frauen? (*Putz/Engelhardt*)
Welche Zusammenhänge bestehen zwischen dem Timing der Erstgeburt und dem Wohlbefinden der Mütter im späteren Leben? (*Engelhardt/Schreyer*)
Welchen Einfluss hat das Alter zum Zeitpunkt der Erstgeburt auf die Gesundheit von Müttern im Alter von 45 bis 56 Jahren? (*Schlücker/Blumenfelder*)
Wie beeinflussen Geschwisterzahl, Geburtenreihenfolge und Geburtenabstände die Wortschatzkompetenzen von Grundschulkindern? (*Karwath/Relikowski/Schmitt*)
Heft 1/2015 wird reguläre Beiträge, überwiegend in deutscher Sprache, enthalten. Heft 2/2015 widmet sich dem Thema *Eltern, Kind, Schule – ein kompliziertes Verhältnis*, während im Heft 3/2015 *Kinderlosigkeit und Kinderreichtum in Deutschland* mit Daten des Mikrozensus 2012 analysiert werden.
Wir wünschen Ihnen eine anregende Lektüre!

Henriette Engelhardt-Wölfler
Geschäftsführende Herausgeberin
Editor-in-chief

Dear Readers,

For the first time in 2014, we present a special issue which is dedicated to the *Timing and spacing of births. Effects for parents and children.* It contains five contributions written in English that deal with the following questions:
What impact does the time of first births and the spacing of second births have on women's careers? (*Brehm/Buchholz*)
What effects does the timing of first birth have on women's wages? (*Putz/Engelhardt*)
What impact does the timing of first birth have on mothers' well-being in later life? (*Engelhardt/Schreyer*)
What effects does mothers' age have on health of mothers aged 45 to 56? (*Schlücker/Blumenfelder*)
How do the number of siblings, birth order, and birth spacing affect children's vocabulary competences? (*Karwath/Relikowski/Schmitt*)
The next issue will consist of regular contributions, predominantly written in German. The second and third issues in 2015 will deal with the often complicated relationship between parents, children and their schools (issue 2/2015) and with childlessness vs. families with a large number of children, being analysed with 2012 Microcensus data (issue 3/2015), respectively.

We hope that you enjoy reading this issue of our journal.

Kurt P. Bierschock
Redakteur
Managing editor

*Henriette Engelhardt*

# Introduction to the special issue on: *Timing and spacing of births: Effects for parents and children*

In Europe, age at birth has been increasing for decades. Research on the timing of first and subsequent births has focused primarily on the causes and less on the consequences of individual childbearing histories (Sobotka 2010; Balbo et al. 2013). Theoretical background, as in many studies on fertility, is the life course perspective (Elder et al. 2003). The central idea is that lives are influenced by an ever changing biographical and historical context. The trajectories in the various life domains – family, education, work, health, etc. – are linked and simultaneously influence each other. For instance, the family and fertility life cycle is interconnected with the employment and health life cycle. Thus, the occurrence and timing of events in one life domain may cause the occurrence and timing of events in other domains.

In life course research, timing effects are mostly captured by age and historical time. However, age as a social construction also differentiates the life course. "The social meanings of age can structure the life course through age expectations, and informal sanctions, social timetables, and generalized age grades" (Elder et al. 2003: 10). As the meaning of early and late parenthood compared to the 'proper' age of parenthood had considerably changed over time, the consequences should vary according to normative social timing (Mirowsky 2005; van Bavel/Nitsche 2013). Thus, when studying the effects of birth timing, one has to take care of the meaning of early and late timing which varies over time and regions and is different for women and men.

The consequences of the birth history on later life have received limited attention yet. In recent years though, a growing body of literature has been focusing on the educational, occupational and financial attainment, on social participation and social support, on physical health and psychological well-being of birth timing.

The focus of research in sociology and demography is on the consequences on fertility history on well-being in later life (e.g, Spence 2008; Umberson et al. 2010; Myrskylä/ Margolis 2014). Various studies in economics are interested on the wage penalty for motherhood and in the optimal timing of births, whereby the output is defined either in terms of career paths or in terms of wages (e.g., Gustafsson 2001; Miller 2011). Social epidemiologists are concerned with health consequences of early and late motherhood (e.g.,

Mirowky 2005; Henretta 2007; Grundy/Kravdal 2009). In many studies on the various outcomes of fertility histories, systematic analyses of differences in early and late timing are missing.

The life course perspective also directs attention to the Elder's concept of "linked lives", which points to the fact that individual life courses are interdependent (Elder 1994). Thus, the life courses of spouses, of parents and children, and of parents and grandparents, are coupled and mutually influence each other. In this perspective, the timing and spacing of births could not only affect the life course of mothers but also different life domains of fathers, children, and grandparents. It has been shown that the transition to fatherhood affects working life (Wetzels 1999) and well-being of men (Pollmann-Schult 2014). The transition to grandparenthood seems to be associated with early retirement (van Bavel/De Winter 2014). Moreover, early grandparenthood has shown to be negatively associated with health and well-being (Burton/Bengtson 1985).

As early as a hundred years ago, Alexander Graham Bell (1918) suggested that the lifespan of children varies with mothers' age at birth. While this relationship has been investigated in many studies (for an overview see Myrskylä/Fenelon 2012), the consequences of timing and spacing of births on other life domains, e.g. educational achievement of children, to my knowledge has been not studied yet.

This volume adds to the literature by focusing on selected outcomes on mothers and their offspring. The first two papers discuss effects of first birth timing on the labor market success of mothers. The following two deal with the effects of first birth timing on physical health and well-being in later life. The fifth paper studies the effect of birth order and birth spacing on children's competencies. Given the limited space in this volume, there is unfortunately no paper on the effects of reproductive histories on the life courses of fathers and grandparents.

The first paper by *Uta Brehm* and *Sandra Buchholz* deals with the question: "Is there a wrong time for a right decision? The impact of the timing of first births and the spacing of second births on women's careers". It investigates if and how women's career trajectories are influenced by the way women embed their prevalently two births into their employment biographies. Using data from the National Educational Panel Study for West German mothers of two children, the study finds that the occupational prestige at age 45 is severely impaired by the period after women's first birth. While this is not affected by a specific timing, higher educated women tend to time their first births least detrimentally. With regard to spacing, empirical evidence suggests that higher educated women can succeed in continuing their prestige accumulation by spacing their births very tightly. Lower and medium educated women's prestige is not considerably impaired by spacing, unless they return to part-time work soon after first birth.

*Tobias Putz* and *Henriette Engelhardt* consider in their contribution "The effects of the first birth timing on women's wages". While the wage effects of a birth, the so-called "motherhood wage gap", have already been analyzed in detail, studies exploring the timing of this life event still tend to be rare and are completely missing for Germany. Based on longitudinal data of the German Socio-Economic Panel, fixed-effects panel estimates indicate that the negative wage effects of a first birth up to age 45 can primarily be observed for those women, who bear their first child relatively late. Furthermore, the negative wage effects related to late motherhood can especially be observed for low-educated

and medium-educated women as well as for women who were married at first birth. Moreover, it seems that only young mothers experience an increase in their wages as time since the first birth elapses. At last, yet for late mothers only, the negative effects of childbirth increase with the length of the work interruption around first birth. Overall, in contrast to the existing literature, these results indicate negative wage effects of a delayed first birth. Thus, in accordance with the well-established "motherhood wage gap", these results can be considered as indication for a "late motherhood wage gap".

The following two contributions investigate the effect of birth timing on well-being. *Henriette Engelhardt* and *Jessica Schreyer* consider "Timing of first birth and satisfaction in later life". A large body of literature has documented a negative association between early childbearing and well-being in later life. The effects of late parenthood are mixed due to different social and physiological mechanisms as well as selection processes for the timing of first birth. This article extends the literature by employing propensity score matching to estimate effects of birth timing net of observed selectivity. A sensitivity analysis using Rosenbaum bounds provides hints on remaining unobserved selectivity. The analysis of data from the German Socio-Economic Panel shows that the timing of first birth has no effect on well-being in later life both for women and men. In case of the naïve estimator, the negative effects of early births and positive effects of late births for women are due to selection processes.

*Friederike Schlücker* and Raphaela *Blumenfelder* look at „Effects of age at first birth on health of mothers aged 45 to 56", controlling for early life conditions which affect both timing of first birth and health in later life. Compared to mothers who gave birth at middle age, they find a significantly higher risk of illness among young first-time mothers using data from the Survey of Health, Ageing and Retirement in Europe. This effect largely remains after controlling for selection effects which determine age at first birth. The results indicate that the negative effect of young age at first birth remains even after controlling for health-related resources throughout the life course. The results identify mechanisms of cumulative social inequality when disadvantaged women become mothers at younger age and thereby further increase their risk of disease.

The final contribution by *Claudia Karwath*, *Ilona Relikowski* and *Monja Schmitt*, "Sibling structure and educational achievement: How do the number of siblings, birth order, and birth spacing affect children's vocabulary competencies?", focuses on the childbearing effects on children. Empirical evidence suggests that sibling structure influences children's educational outcomes: While the negative effect of the number of siblings is quite consistent, there are mixed findings for birth order and birth spacing. Using longitudinal data from the BiKS 8-14 (Educational processes, competence development and selection decisions in preschool- and school age) study at the end of elementary school and focusing on children's vocabulary competencies, the results indicate a negative effect for increasing number of siblings, particularly when children originate from families with a lower educational background. Regarding birth order, the paper shows differential effects by parents' education, as only children from less educated families suffer from being a later-born child. Moreover, a longer spacing between a child and its older sibling is positively related to vocabulary competencies.

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*Uta Brehm & Sandra Buchholz*

# Is there a wrong time for a right decision?

## The impact of the timing of first births and the spacing of second births on women's careers[1]

## Gibt es einen falschen Zeitpunkt für eine richtige Entscheidung?

## Der Einfluss des Timings der Erstgeburt und des Spacings der Zweitgeburt auf die Karrieren von Frauen

**Abstract**:
The issue of how to reconcile family and work is particularly relevant in the light of West Germany's institutional and normative framework which has been facilitating mothers of young children to withdraw from the labor market for some years. Though the topic has already been subject to academic debate, the questions remain if and how women's careers are influenced by the way women embed their prevalently two births into their employment biographies as well as if educational groups differ in these effects.

So far, research has mainly focused on the first birth's timing: aspirations to establish firmly on the labor market suggest a postponement of the first birth to some degree. The effect is less obvious for the spacing between first and second births: to avoid a detrimental career discontinuity, women can either choose a short spacing, blocking their periods of unpaid caregiving tightly for a quick and definite occupational return, or space their births widely, intermitting their parental leaves with periods of employment.

Using NEPS data for West German mothers of two, the study finds that compared to career entry, the occupational prestige at age 45 is severely impaired by the period after women's first birth. While this is not affected by a specific timing, higher educated women tend to time their first

**Zusammenfassung**:
Die Frage nach einer erfolgreichen Vereinbarkeit von Familie und Beruf stellt sich insbesondere in Westdeutschland, wo der institutionelle und normative Rahmen Mütter ermutigt, mehrere Jahre für die Betreuung ihrer Kleinkinder zuhause zu bleiben. Trotz umfassender Forschung zum Thema blieben bisher die Fragen offen, inwiefern weibliche Karrieren durch die zeitliche Einbettung der überwiegend zwei Geburten in die Erwerbsbiografien beeinflusst werden und ob sich Bildungsgruppen darin unterscheiden.

Bisher konzentrierte sich die Forschung dahingehend vor allem auf das Timing der Erstgeburt: Um sich fest am Arbeitsmarkt zu etablieren scheint eine gewisse Verzögerung der Erstgeburt hilfreich. Bezüglich des Spacings zwischen Erst- und Zweitgeburt liegen hingegen zwei Strategien nahe: Entweder bekommen Frauen ihre Kinder kurz nacheinander um danach endgültig an den Arbeitsmarkt zurückzukehren, oder sie nutzen einen langen Abstand zwischen den Kindern für eine berufliche Episode.

Mithilfe eines NEPS-Samples zweifacher Mütter kann die Studie aufzeigen, dass ihr berufliches Prestige zwischen Karriereeinstieg und dem Alter 45 insbesondere von der Episode nach der ersten Geburt beeinträchtigt wird. Obwohl dies nicht durch ein bestimmtes Timing bedingt ist, er-

1 This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort 6 – Adults (Adult Education and Lifelong Learning), doi:10.5157/NEPS:SC6:3.0.1. The NEPS data collection is part of the Framework Program for the Promotion of Empirical Educational Research, funded by the German Federal Ministry of Education and Research and supported by the Federal States.

births least detrimentally. With regard to the spacing, evidence suggests that only higher educated women can achieve to continue their prestige accumulation, namely by spacing their births very tightly. Lower and intermediately educated women's prestige, in contrast, cannot be impaired considerably by their spacing behavior, unless they decide to return to part-time employment soon after their first birth.

***Key words***: timing, spacing, occupational prestige, female career

weist sich das Timing höher gebildeter Frauen als am wenigsten nachteilig. Für das Spacing zeigt sich, dass nur höher gebildete Frauen nach ihren Betreuungsphasen noch Prestige anhäufen können, so sie denn ihre Kinder im kurzen Abstand zueinander bekommen. Die Prestigeentwicklung von Frauen mit geringerer Bildung hingegen wird nicht wesentlich durch das Spacing vermindert, außer sie entscheiden sich kurz nach der Geburt des ersten Kindes für die Rückkehr in einen Teilzeiterwerb.

***Schlagworte***: Timing, Spacing, Berufsprestige, weibliche Karriere

## 1. Introduction

It is well-known that a trade-off between work and family is characteristic for women in Germany (Buchholz/Grunow 2006; Grunow 2006; Pfau-Effinger/Smidt 2011). Women's mid-career phase is not as clearly defined as it is for men (Mayer 1991; Lauterbach 1994). This especially applies for West Germany with its long-standing conservative welfare regime (Esping-Andersen 1990) and its rather traditional gender culture (Pfau-Effinger 1996; Falk/Schaeper 2001) which results in a very gender-specific division of labor within families (Schulz/Blossfeld 2006; Grunow et al. 2007). Typical examples for the strong support of a rather traditional gender contract in West Germany include relatively generous maternity leave regulations, tax legislations favoring the male breadwinner or the 1.5 earner model instead of the dual earner model for families, comparatively low early childcare coverage rates, a still mostly half-day oriented kindergarten and schooling system, and strong support for rather traditional gender values.[2] As a consequence, women's careers in West Germany tend to be marked by employment interruptions as well as by high rates of part-time employment after family formation. Even today, the reconciliation of paid labor and childcare is mostly left to mothers.

A vast body of literature and empirical studies have already addressed the issue of how women in West Germany combine family and work and the effect of family obligations on women's labor market behavior and their employment careers (e.g. Engelbrech 1997; Grunow et al. 2006; Matysiak/Steinmetz 2006; Brose 2008; Aisenbrey et al. 2009; Gangl/ Ziefle 2009). It has been shown that the birth of the first child is the major incision into women's working lives and even occupationally established women draw back quite 'naturally' from the labor market to dedicate themselves to childcare for some years after having made the transition to motherhood (e.g. Blossfeld/Huinink 1991; Reichle 1996; Timm 2006). However, one particular issue that has been underrepresented or even missing altogether in the academic debate is if and how women's careers are influenced by the

2 Although there has been a clear modernization of both the gender culture and welfare state arrangements over the past decades in Germany, changes across time and/or birth cohorts are beyond the scope of this article. Similarly, we will not discuss existing differences between East Germany and West Germany.

way women embed their birth decisions into their life courses. Precisely, the notion addresses the impact of the *timing* of the first birth after labor market entry as well as the *spacing* of childbirths, which, in turn, is the time women allow to elapse after the birth of their first child until having their second child. Since these decisions go along with a specific occupational and childcare behavior, they can be expected to have a major influence on the ways women pursue and succeed in their career. Hence, the central aim of our study is to fill this research gap. Specifically, our analyses aim at answering the following research questions:

– How do mothers' careers develop before and after family formation?
– In what way does women's birth behavior, i.e. their timing of the first births and spacing of the second births, affect women's subsequent careers?

For both of these research questions, we will pay special attention to the question of educational differences. It is well known that women's educational level strongly influences their family planning, especially with regard to timing the birth of their first child (Timm 2006; Kreyenfeld 2007; Brehm 2013). However, the aim of our empirical analyses is to understand if women's timing of the first births and their spacing of the second in their employment careers differently impact their career development. For example, are higher educated women able to reduce their risks of career setbacks with the aid of steeper career developments before their family formation, a later timing of first births, and different spacing of second births?

Our empirical analyses are based on data from the adult cohort of the National Educational Panel Study (NEPS). The NEPS cohort supplies detailed and high-quality longitudinal information on individual life courses for various birth cohorts. Although this dataset also offers information on persons born in East Germany, we only use information of West German women since the East German women in our data have been shaped by a very different gender culture (e.g. Pfau-Effinger 1996; Grunow/Müller 2012). Even 25 years after the fall of the Iron Curtain, the situation of women in East and West Germany is still very different. Modelling intra-German differences as well as the complexity of change after reunification would go beyond the scope of our empirical study. Additionally, we restrict our analyses not only to West German but also to mothers of two because two children are still prevalent in Germany – in both normative and empirical terms (Goldstein/Kreyenfeld 2010). Hence, we will be able to study the impacts exerted by features of both the incisive family formation and the similarly relevant family extension in its predominant pattern in Germany. To measure women's career development, we will use information on their occupational prestige as described by the Standard International Occupational Prestige Scale (SIOPS) (for more information, see research design and methods below). The aim of this specific operationalization is to avoid biases resulting from different sectors and job mobility which may emerge from, e.g., monetary measures.

In our article, we proceed as follows. First, we present the framework of our empirical analyses by first outlining the West German context, previous research findings as well as general theoretical considerations. Based on this discussion, we then elaborate our research design, our data and our methodological approach. In the next step, we present the results of empirical analyses of our study and, thereafter, conclude by summarizing and discussing our findings.

## 2. Theoretical considerations and empirical implications

### Institutional context and previous research results

In order to understand the relationship between childcare and female employment in West Germany, one has to be aware of the specific family policies that have been influencing women's lives. Generally, following the Christian concept of a conservative welfare state (Esping-Andersen 1990), West Germany has been relying on the principle of subsidiarity in family policy issues. In line with that, the family, including children, is regarded to be one unit that arranges its matters itself. In order to support this self-regulation, the state subsidizes marriages – assuming that this provides the precondition to having children – by enabling a married couple's joint taxation. This instrument facilitates a financial benefit from high income differences between spouses and therefore promotes intra-familial division of labor into housework on the one hand and a gainful employment on the other. Particularly if there are children involved, the state traditionally leaves the care-intensive upbringing of the (young) offspring to the family. Although today public childcare can be provided for almost 20% of children under the age of three (Institut für Arbeit und Qualifikation 2014), this fairly high rate results from very recent developments that mark a partial change in policy paradigms (e.g. Bujard 2013). For many decades up until the early 2010s, in contrast, the rate of small children that could be cared for institutionally was at 3% at the most (Matysiak/Steinmetz 2006; Aisenbrey et al. 2009) – a legal claim to public childcare places was only admitted to at least three year olds and only since the mid-1990s. Also, even at times when a vast majority of older children attended kindergartens, most institutions' opening hours required for one parent to care for the offspring from the early afternoon onwards – just as, subsequently, by far most schools have been doing, too (ibid.). Normatively, and for a long time even legally[3], the resulting division of employment vs. household and reproductive tasks has been gender-specific: not parenthood taken as a whole, but specifically motherhood has been assumed to be a demanding responsibility that requires much time and devotion to the offspring. As a result, the majority of families have been living in a family model of a male breadwinner and a female carer that works in a part-time job at most. Female employment has been a given, but only given that there are no children that need to be cared for (Falk/Schaeper 2001; Rosenfeld et al. 2004; Brose 2008).

To protect women against a double burden while facilitating a secured time and room for childcare, West Germany started to introduce labor market policies that ascertain a partly paid parental (and in the beginning even exclusively maternal) leave along with a guarantee to be able to return to their old jobs after less than one year in the late 1970s. In the subsequent decades, these regulations were extended to three years of granted leave with compensatory payments being granted for up to two years. Only rather recent policies of the late 2000s reversed this development by restricting higher compensatory payments to little more than a year and by explicitly incentivizing the other parent to go on leave as well. Hence, though formally orienting towards women's return to the labor mar-

3 Up until 1977, the Civil Code ruled in § 1356 BGB (1) that a woman was in the first place responsible for housekeeping, any employment was secondary and only permitted if the first could be guaranteed.

ket after periods of unpaid caregiving, these policies facilitated long and even increasing occupational breaks of mothers.

Economically, women's thereby fostered familial responsibilities have been assumed to occur at the expense of occupational commitment and productivity (Becker 1960, 1981) while a discontinuous employment could even result in a depreciation of mothers' human capital (Becker 1985). While this may not be the case for all women, the productivity-abating relation is often also anticipated by employers, at worst resulting in statistical discrimination (Phelps 1972; Arrow 1973). Indeed, research has shown that these policies can work against mothers in the labor market. For West Germany, Gangl and Ziefle (2009) provide evidence for women's weakened position in the labor market due to the higher costs for the employer which they indirectly pass on to mothers, putting all women as potential mothers into an adverse bargaining position (see also Hirschle 2011; Ochsenfeld 2012).

On the whole, the described institutional framework along with mothers' associated bargaining position on the labor market reflects empirically in a low employment rate of mothers with young children in Germany (Matysiak/Steinmetz 2006; Aisenbrey et al. 2009; Berninger 2009; Frodermann et al. 2013). Although studies indicate a gradual rejection of that pattern in younger cohorts, fostered by the increasing importance of part-time jobs (Grunow et al. 2006; Frodermann et al. 2013), historically, extensions of parental leave regulations have been countered quickly by mothers' extension of their time in unpaid childcare (Grunow et al. 2011). Within the legal framework of job security, mothers are entitled to re-enter their previous position upon their (part-time) return. Nonetheless, they often choose a job that leads to downwards mobility for the sake of flexibility, the compatibility of family and career, and proximity to home (Engelbrech 1997; Gangl/Ziefle 2009; Hirschle 2011). But even after re-entering the previous job, the employment interruption is likely to result in a considerably lower income, particularly in the long run (Ziefle 2004). This is only partly due to the loss in experience; a large share of the total penalty in terms of wage and career cannot be explained by women's actual labor market behavior (Gangl/Ziefle 2009; Ochsenfeld 2012).

One particularly relevant aspect regarding mothers' careers is their educational level. The higher women's education, the higher the opportunity costs associated with childcare and with the difficulties in combining family and career: highly educated women stand to either lose or gain a lot. As a result, it has been found that one fourth of women with a high schooling degree remain childless whereas this applies to only one eighth of women with a low degree (Aisenbrey et al. 2009; see also Bauer/Jacob 2010). Nonetheless, those highly educated women who decide in favor of children have considerably higher rates of returning to the labor market after childbirth – they even disproportionally refrain from taking parental leave altogether (Matysiak/Steinmetz 2006; Hanel/Riphahn 2011; Drasch 2011; Grunow et al. 2011). Beyond that, they are more likely to return into full-time positions (Matysiak/Steinmetz 2006). These quicker returns as well as their higher education itself facilitate higher chances of upward occupational mobility, even as mothers (Aisenbrey et al. 2009).

But what do these deliberations imply to the present study's focal points? How does mothers' career develop in the long term, particularly depending on the period prior to family formation and with special regard to women's educational level? Theoretical and empirical considerations (e.g. Gangl/Ziefle 2009; Aisenbrey et al. 2009; Hirschle 2011; Ochsenfeld 2012) point to a rather minor, possibly even negative career development once women are mothers. Hence, we generally can expect their career developments to be

primarily dependent on the period prior to family formation and women's achievements during that time. A higher education, however, seems to enable mothers to further climb up the career ladder – due to both their human capital and their birth-related behavior.

The highlighted empirical results convey an impression of the pervasive incision motherhood poses to women's careers. However, they do not allow us to understand the impact exerted by the various specific ways in which women arrange and embed their births into the course of their careers. Hence, it is exactly this issue which our empirical study on West German women will address. Specifically, we aim at understanding the following: how does women's *timing* of the first birth after labor market entry[4] affect their subsequent careers? How does the *spacing* of the family expansion, meaning the time that elapses until women have their second births, impact women's possibilities to secure their career after family formation? How do activities between first and second child birth affect women's career chances? And finally, do the effects of timing and spacing vary by educational level? In other words: Is a specific timing and spacing of births more important for some women's career development than for that of others? However, before assessing these questions empirically, we will first approach them theoretically.

## Timing the first birth

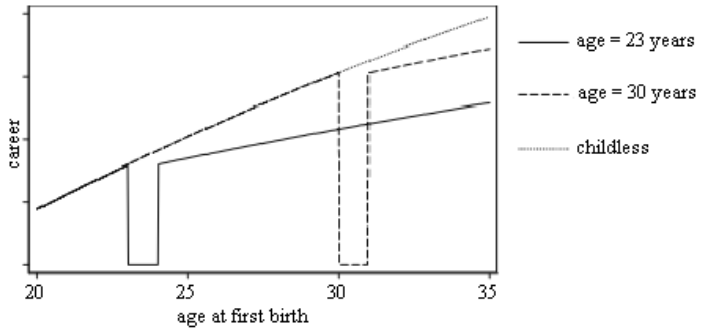
When it comes to the optimal timing of a first birth in the course of a career, there are several opposing theoretical considerations that contribute to a woman's decision. According to a dynamic model of fertility (Gustafsson 2001), the utility of an early birth concerns the precious time as a family: the earlier the child is born the more time will be left to a parent to enjoy with the child or even grandchildren. Most career-related considerations, however, contrast this aspect. As a later timing allows for a longer time of human capital accumulation, childbirth entails a smaller chance of an incisive depreciation, even during longer breaks. Furthermore, as a career can be assumed to develop positively yet diminishingly when approaching its zenith, the expectable subsequent profit becomes smaller, decreasing women's returns and thus their motifs to further invest into human capital: thus a late birth is more beneficial than one earlier in life (see also Miller 2011; Figure 1). In terms of the most profitable timing for a woman's career, it seems that the farthest possible postponement of the first birth decreases its costs. This can be assumed to be particularly true for West Germany. Since family policies regarding parental leaves and public childcare facilitate long breaks of unpaid caregiving and thereby bring occupational aspirations to an almost certain halt, family formation is a very costly decision. A postponement of the first birth would hence enable women to entirely focus on their career for several years and stabilize their occupational position before withdrawing from the labor market for the child's upbringing (Blossfeld/Huinink 1991).

Empirically, however, this clear-cut suggestion does not necessarily encounter evidence, neither internationally nor in West Germany. Some studies do indeed yield results that support a late timing's profitability, emphasizing late mothers' higher labor market in-

4 In many studies, the timing is measured following a life-course perspective, depicting the time since a woman's birth. With regard to this study's subject, however, we choose a more career-oriented approach.

volvement and income because of the higher respective achievements before birth (Troske/Voicu 2009; Miller 2011). However, other findings suggest that late mothers experience disproportional wage penalties, reinforced by either the shorter time to compensate for the loss in the long term (Putz/Engelhardt in this volume) or by the associated shorter spacing that affects the career negatively due to a longer consecutive leave (Karimi 2014b).

*Figure 1*: effect of first birth on career, depending on timing




*Note:* figure abstracted and adjusted from Miller (2011).

All in all, the theoretical implications and the empirical results do not convey a clear picture of the timing's impact on female careers. Instead, they seem to point to an inversely u-shaped effect: at the beginning, the effect of the birth postponement is increasingly positive, yet this relation turns at some point and changes into the opposite. To test if this supposition holds true, we will assess the relationship between women's timing and their careers empirically.

While these considerations address the timing's overall impact, we can assume educational differences in the timing's effect on the career. Concerning these, however, no precise indication for assumptions could be extracted from previous work. What has been established is a longer postponement of births of higher educated women, partly because of their greater range of (occupational) opportunities (e.g. Weber 2004; Timm 2006; Bauer/Jacob 2010), partly because of their higher aspirations regarding the child's education and wellbeing for which they aspire to meet the perceived material requirements (Gustafsson 2001). This already indicates that higher educated women plan their births more thoughtfully, thoroughly weighing both their high opportunity costs and their chances to combine work and family (Beets 2011), especially in the light of insufficient institutional opportunities to sustain their previous pursuit of career. As a result, we can expect higher educated women's timing to have a more positive effect on their career than what applies to less educated women – possibly even independent from the actual timing.

## Spacing the second birth

As has already been implied, the spacing between the first and the second birth is similarly relevant for a mother's career. A major influencing factor in this regard is mothers'

time allocated to childcare, be it in two consecutive parental leaves or in a subsequence of breaks that are intermitted by episodes of employment.

Theoretically, a long spacing is assumed to allow for a better balanced use of opportunities and alternatives to childcare, enabling occupational continuity and smoothing consumption by shortening the time women spend away from the labor market (Newman 1983; Troske/Voicu 2009). Nonetheless, the cost effectiveness of children is assumed to increase strongly by a second child (Newman 1983): while the transition to the first child is a major incision into a woman's career, the second child is supposed to be not much of an additional hindrance as many arrangements have already been made.

Presumably, the Swedish government has been following this thought when it decided to pay a speed premium to first-time mothers in order to support a quick second birth before reentering the labor market. Nonetheless, Karimi (2014a) was able to show with a Swedish sample, that a longer spacing is more and increasingly beneficial for women's income as it enables them to return to the labor market between births – which results in a higher and profitable attachment to the labor market (see also Miller/Xiao 1999; Troske/Voicu 2009). West Germany's institutional framework, however, has been setting considerable constraints to such a quick return to the labor market after the first birth. The structural and financial incentives to go on parental leave for up to three years on the one hand and the lack in (all-day) public childcare for young children on the other hand made women withdraw from the labor market for several years after their first birth. To successfully return to the labor market before giving birth to their second child, mothers would have to space their two children very widely, bringing many years of age difference between the siblings. Firstly, such a long spacing and a labor market return in the meantime can be presumed to reduce the cost effectiveness usually associated with a second child. Secondly, it can be supposed that not only one but two occupational breaks of several years would impair a woman's career substantially. As a result, it seems reasonable for West German women to space their births shortly in order to return rather quick and definitely after only one occupational break, merged for both children.

Nonetheless, the scarce national and international evidence points at the profitability of a long spacing that is intermitted by episodes of employment, particularly when these are pursued full-time. Especially in light of an easier access to part-time jobs in the German context, a full-time employment between births indicates a considerably higher occupational commitment (Frodermann et al. 2013; Hipp/Stuth 2013). Thereby it facilitates the continuity of tasks and experience and protects better against dequalification, downward mobility and, hence, income loss (Vogel 2009). Assumedly, this also mirrors for prestige measures in the data: mothers' chances to maintain or even raise their prestige after having children can be expected to be highest for those who space their births widely in order to return to the labor market – particularly if they show high occupational commitment by working full-time.

When relocating the focus from the spacing's overall impact of women's careers to educational differences, however, evidence is again rather scanty. In terms of the spacing itself, children are assumed to benefit from a longer spacing (Newman 1983) as it decreases siblings' direct competition for parental resources and therefore leaves more time to allocate to each child's individual fostering. This can be expected to be in accordance with the wishes of highly educated women in particular. Nonetheless, higher educated women have been found to space their births more shortly. One major reason given for this behavior is a pro-

cess of self-selection: in light of their high opportunity costs, highly educated first-time mothers prove a relatively high family orientation that also leads to a quick family expansion (Kreyenfeld 2002; Bernhard/Kurz 2007; Brose 2008). Again, however, it remains as yet unclear what these results imply for the spacing's impact on differently educated women's careers. In line with the previous argument regarding the timing, we assume a particularly high reflective faculty in higher educated women who consider the compatibility of family and career as well as opportunity costs more thoughtfully (Beets 2011). As a result, a longer spacing in order to enable beneficial occupational continuity would be an especially attractive and valuable instrument for them, particularly since higher educated women have been found to reenter the labor market more quickly after their first birth, to be more likely to return into full-time employment, or to waive their entitlement to parental leave altogether (Matysiak/Steinmetz 2006; Hanel/Riphahn 2011; Drasch 2011; Grunow et al. 2011). However, their spacing has been found to be rather short. This behavior could arise from a rationality that strives for a relatively short occupational interruption for both children in quick succession – in order to return to the labor market quickly, definitely and successfully. As both assumptions appear valid, they have to be collocated in our analysis.

To follow up the posed research questions and elaborated hypotheses, we approach the topic empirically. In order to do so, the following section introduces the underlying analytic design, the chosen data as well as the methods to elaborate on the issue.

## 2. Research design, data and methods

### Research design

The aim of our empirical analyses is to understand if and how West German women's careers are influenced by their birth behavior, specifically the timing of the first birth and the spacing of the second one. To model women's career development across time, we observe mothers of two at different time points in their careers. We assess their occupational prestige, described by the Standard International Occupational Prestige Scale SIOPS (Treiman 1975), at labor market entry, one year before their first birth, and finally at the age of 45. We decided for the age of 45 as our observation's last point in time for several reasons: firstly, additional analyses with our sample have shown that if women have not returned to employment until this age, they barely return thereafter. Hence, our analyses are able to capture those mothers who intend to combine family and work. Secondly, research has shown that the age of 45 usually marks the high point in individuals' careers. Up to that age, the most and most important steps on the career ladder have been taken and the approaching retirement yields the danger that additional investments may not pay off anymore (Schippers 2011). Thirdly, women's fertility usually comes to a standstill at about the age of 45. Therefore, most women have completed their family formation and expansion by that point.

To approach our research issue empirically, we address them step by step, starting off with the overall development of women's prestige before family formation and across the course of their career. First, descriptive methods of analysis help us to reveal the career developments overall and by educational groups. With the aid of linear regression, we then follow up the relationships and underlying mechanisms across the course of women's career in

more detail. Following up the impact of women's specific birth behavior on their career in a second step, we extend the elaborated models by women's timing of first births and spacing of second births and their associated activities in between. To address the question of education-specific effects, we introduce interaction terms between education and birth behavior. However, as particularly the last step can be expected to raise the complexity of the model's propositions beyond easy comprehensibility, we will, at last, simulate the findings' specific implications to the development of women's long-term careers, based on the obtained results. Since the youngest women hint best at more recent developments that may have taken place and hence carry a particular contentual weight, we will pay special regard to the youngest birth cohort in most of our analyses. Firstly, we do so by adducing them as reference in our multivariate estimations. Secondly, we adjust our simulations to the youngest cohort by drawing from the results estimated before as well as applying the cohort's specific prestige measures (see section 4). This approach is supported by the sample's composition: most women were born during the most recent observable years as can be examined in Table 2.

## Data

Our empirical analysis is based on data from the German National Educational Panel Study (NEPS) (Blossfeld et al. 2011). Adapting a precursive study in 2007/08, the survey has been collecting detailed retrospective data at every person's first interview and panel data on a yearly basis since 2009/10. The relevant adult sample with cohorts between 1944 and 1986 consists of altogether 11 932 people who have been surveyed in computer-assisted telephone (CATI) and personal interviews (CAPI) by the latest considered panel wave in 2011/12.

Though the NEPS data also offers information for persons born in East Germany, we restrict our analyses to West German women because the employment behavior of East and West German women is even today hardly comparable. The East German gender culture is far more modern (e.g. Pfau-Effinger 1996), also childcare patterns vary strongly. Modeling such complex intra-German differences as well as the complexity of change after reunification would go beyond the scope of our empirical study. Because of the specific research interest of our study, which is to analyze the effect of family formation and expansion on women's careers, and because two children are normatively and empirically still the prevalent family model, we additionally restrict our sample to mothers of two and biological motherhood only.

To assess these women's career development, we observe women at three time points of their career, precisely at career entry, one year before the birth of their first child and finally at the age of 45[5]. This means we exclude women that were unemployed or inactive, e.g. as housekeepers, at any of these time points. We are aware that, based on this sample definition, we are not able to picture the lives of *all* women and mothers. However, as our specific research interest is in studying the effects of family formation and expansion on women's career developments, we have to restrict our analyses 'by definition'

5 As the prerequisite for the women in our sample is to have already reached the age of 45 at the last interview, we restrict our sample to the women born between 1944 and 1966. We will use the dummies for cohorts in our models mainly as control variables and will not interpret these effects as the focus of our study is not on cohort changes.

to women who indeed combined family *and* employment. We also exclude women that had their first child prior to their career entry, which is a rare event[6]. Additionally, we exclude those very occasional cases with an implausible short spacing between the two births of less than nine months as well as mothers of multiples. Based on these definitions, our sample comprises 570 women with two (biological) children which represent approximately 70%[7] of the women with two children in our dataset.

## Method

In order to get an impression of women's career developments and their influencing factors, we apply both descriptive and multivariate methods. First, after a very basic descriptive analysis of the sample's mean prestige developments, we aim to describe the interrelation of women's career steps before and after family formation, overall and across educational groups. To do so, we cluster our women along their prestige differences between the beginning of their career and the first cut-off one year before the first birth as well as between the latter and their prestige at age 45.

In a second step, we aim at examining women's career development as a function of the timing of their first births, the spacing of their second births, the related activities, and their education. Specifically, we do so by calculating a robust stepwise OLS on the difference between their occupational prestige at career entry and their prestige at the age of 45. In choosing this method, we take advantage of the opportunity to model the effects induced by the full employment and family biography up to the relevant age. As most of the independent variables describe the length of women's time in either a familial (childless, with only one child) or an activity state (e.g., employment, unemployment, unpaid caregiving before birth timing or during birth spacing), they can enter the model as continuous variables.

Thirdly, we aim to illustrate ideal type careers and prestige developments by performing simulations. To do so, we apply the estimated regression effects to meaningful combinations regarding birth behavior, associated activities and women's educational level. The pursuit of these simulations is to visualize the results' implications to women's careers and the impact of embedded family- and work-related decisions.

The occupational prestige is obtained from NEPS's computation of SIOPS-08, the current edition of the Standard International Occupational Prestige Scale (cf. Treiman 1975). The scale integrates public prestige evaluations on an international average, guided by ISCO-08's[8] occupational unit groups. Though the score actually ranges from 0 to 100, jobs realistically cluster between 20 and 80. Paying tribute to this non-ratio scale, we center the prestige at career entry at the sample's mean value. The further transfer of the SIOPS measure to the central career variables as well as the operationalization of the other relevant factors are summarized in Table 1.

6 Approximately four percent have their first child prior to their first job.

7 The share of women does not vary considerably by cohort and only slightly by educational level with a higher percentage of intermediately educated women.

8 International Standard Classification of Occupation by the International Labour Organization (ILO)

*Table 1*: operationalization of relevant variables to women's career development

| | |
|---|---|
| prestige at career entry | SIOPS of most prestigious job at labor market entry, centered around the sample's mean |
| prestige development before the first birth | difference between most prestigious jobs' SIOPS at labor market entry and one year before the timing of the first birth [if the first birth is timed less than one year after career entry, we consider the first job's SIOPS] |
| prestige development across the career | difference between most prestigious jobs' SIOPS at labor market entry and at the age of 45 |
| educational level | general and academic school leaving degrees:<br>no or lower secondary degree *(Haupt-/Volksschulabschluss)*<br>middle secondary degree *(Mittlere Reife)*<br>upper secondary degree *(Abitur)*<br>tertiary degree *(Fachhochschul-/Universitätsabschluss)* |
| control: cohorts | aggregated birth cohorts:<br>1944 to 1949<br>1950 to 1954<br>1955 to 1959<br>1960 to 1966 |
| timing | elapsed time between labor market entry and the first birth |
| spacing | elapsed time between the first birth and the second birth |
| activities before the first birth/during spacing: | duration variables calculated from monthly event data between labor market entry and the first birth or between the first birth and the second birth |
| employment | episodes of one or more occupations, net of interruptions due to parental leaves yet including occupations that are taken up during parental leave |
| full-time employment | employment episode with working hours that add up to the equivalent to one employment with reportedly more than part-time or full-time employment |
| part-time[9] employment | employment episodes with working hours that add up to the equivalent to one employment with reportedly less than part-time or part-time employment |
| other/flexible employment | episodes of employments in which at least one job is reported to have flexible hours or all jobs are reported to need no time effort at all |
| unpaid caregiving | episodes of parental leave or housekeeping |
| unemployment | episodes of unemployment |
| education | episodes of education in school, university or vocational training |
| other | episodes of miscellaneous activities |

To provide an overview of the variables' numerical composition, Table 2 conveys detailed descriptive statistics. As can be seen, the sample's employment pattern is characterized by high levels of full-time employment before the first births: only a minority participated in other activities, e.g. housekeeping, often only for a few months. The employment pattern between the births of the first and the second child is influenced by the selectivity of our sample which, in turn, results from our examination of women who combine family and employment. Hence, these women participate disproportionally in (full-time) employment.

9 Regarding the working hours, the NEPS dataset only contains information at the beginning as well as at the end of an employment. While this only tells us *if* women changed their working hours but does not offer any indication as to *when* they did it, we assume this to happen in the wake of a birth and the normative responsibilities related to it.

*Table 2*: descriptive statistics to relevant variables to women's career development

| **occupational prestige**[10] | **mean** | **std. dev.** |
|---|---|---|
| prestige at career entry | 44,8 | 10,5 |
| prestige one year before first birth | 46,1 | 10,0 |
| prestige at age 45 | 44,9 | 11,7 |

| **educational level** | **N** | **%** |
|---|---|---|
| no or lower secondary degree | 169 | 29,7% |
| middle secondary degree | 249 | 43,7% |
| upper secondary degree | 63 | 11,1% |
| tertiary degree | 89 | 15,6% |
| *total* | | *100%* |

| **control: cohorts** | **N** | **%** |
|---|---|---|
| 1944-49 | 96 | 16,8% |
| 1950-54 | 90 | 15,8% |
| 1955-59 | 148 | 26,0% |
| 1960-66 | 236 | 41,4% |
| *total* | | *100%* |

| **birth behavior** | **mean** | **std. dev.** |
|---|---|---|
| timing | 6,8 | 3,7 |
| spacing | 3,8 | 2,4 |

| **activities**[11] | **N** | **%** |
|---|---|---|
| before first birth: | | |
| employment | 570 | 100,0% |
| *of which:* | | |
| full-time | 532 | 93,3% |
| part-time | 52 | 9,1% |
| other/flexible | 49 | 8,6% |
| unpaid caregiving | 87 | 15,3% |
| unemployment | 58 | 10,2% |
| education | 68 | 11,9% |
| other | 39 | 6,8% |
| ***N=*** | | |

| | **N** | **%** |
|---|---|---|
| during spacing: | | |
| employment | 384 | 67,4% |
| *of which:* | | |
| full-time | 235 | 61,2% |
| part-time | 161 | 41,9% |
| other/flexible | 31 | 8,1% |
| unpaid caregiving | 436 | 76,5% |
| unemployment | 61 | 10,7% |
| education | 14 | 2,5% |
| other | 42 | 7,4% |
| | | ***570*** |

# 4. Results

## Women's career before and after the first birth's timing

Our first research question aims at systematically reconstructing West German women's career development across their career as well as in relation to their development prior to family formation. We expect the first birth to be a major incision into women's careers, resulting in an only slightly positive or even negative prestige development after family formation. Instead, we expect the period before family formation to play the major part in women's overall career development.

10 The prestige measures are reported in absolute values only, not as centered figures or as differences.

11 The percentages describe the shares of women who participated in specific activities during the observed periods. Since many women participate in different consecutive activities during these periods, the percentages sum up to well above 100%.

We approach this issue by starting off with a broad examination of women's careers. To do so, Table 3 provides a first impression of our sample's prestige at career entry (i.e. before the observed women have had two children), their development before family formation (that is, one year before the birth of the first child) and the prestige they attain by the age of 45 in relation to their prestige at entry. The table reveals the mean values of both the absolute prestige at career entry and the developmental career measures. Additionally, it symbolizes the shares of women's prestige developments before the first births as well as across their career. Positive progresses are indicated by upward arrows, career descents are reported next to downward arrows, and the shares in which comparing the prestige scores of the respective two points in time do not yield any differences are shown above horizontal arrows[12].

*Table 3*: women's occupational prestige and prestige development

| occupational prestige SIOPS | mean | shares in positive and negative prestige development | | no development |
|---|---|---|---|---|
| prestige at career entry | 44.8 | | | |
| prestige development before the first birth | 1.3 | 15.3% ↗ | 9.8% ↘ | 74.9% → |
| prestige development across the career | .1 | 29.0% ↗ | 29.0% ↘ | 41.9% → |
| *N*= | | | | *570* |

*Note:* prestige at career entry reported in absolute values, not centered.

On average, the sampled women first enter into a job with a prestige score of almost 45. Such a prestige is, for example, assigned to nursing associate professionals, retail managers, and car mechanics. Upon their first births' timing, only about 25% of our women show any prestige development compared to their prestige at career entry. Of those that do, however, the majority – that is 15.3% in absolute values – report a positive career progression. Additional yet unreported analyses yield that these 'high flyers' gain an average of 13.9 prestige points, lifting them into prestige scores that are assigned to, e.g., dispensing opticians, therapeutic equipment technicians and ship engineers. The 9.8% of women that report prestige impairment before their first births, in contrast, lose a mean of 8.6 points, resulting in a prestige that is similar to that of hotel managers, library clerks and blacksmiths. The higher share of positive prestige developments raises the overall mean to a prestige enhancement of 1.3.

At the peak of mothers' career at age 45, the results yield that the share of women that do not show any career development has decreased remarkably to 41.9%. Hence, the share of women that report prestige changes rises considerably after family formation, suggesting that the occupational episode after transiting to motherhood is, on average, much more important to mothers' careers than expected. In line with our assumptions, though, the period after family formation is much more characterized by negative prestige developments, reflected by the fact that the prestige developments before family formation – which are positive on average – cannot hold their ground. The shares and developmental magnitudes of

12 The premise of comparing prestige scores at two points in time involves the risk of underestimating developments that again reverse in the course of time.

those with positive and negative prestige developments across their careers balance each other (each amounting to 29%). Unreported analyses show that both groups develop by between eleven and twelve prestige points on average. Comparing these results to the developments before family formation suggests that, on average, most prestige enhancements women achieve before having their first child disappear after their transition to motherhood.

In addition to this overall picture, Table 4 approaches our research question concerning educational differences in women's career development. Our assumption was that a higher education smoothens the career development before and after family formation by enabling higher educated women to even climb up the career ladder once they are mothers. A comparison between the mean prestige developments of the period before the first birth to those across the long-term career does yield some support to that assumption: the values become increasingly positive in both periods the higher women's education is and the average loss of the attained prestige after family formation is only slightly smaller for higher educated women.

The total values in the two aforementioned tables are, however, not able to convey an impression of if and how this subsequent balancing is related to the development prior to family formation in the individual cases. To follow up this question, Figure 2 provides a first overview of the developments' interrelations. To do so, it illustrates – again with the aid of upward, downward and horizontal arrows – women's shares of prestige developments before family formation and, proceeding from these, their further development after their first births. Although these shares do give an impression of the proportional relevance of respective developments, they do not convey the developments' exact magnitudes.

*Table 4*: women's occupational prestige and prestige development by educational group[13]

| occupational prestige SIOPS | means | | | |
|---|---|---|---|---|
| | no or lower secondary education | middle secondary education | upper secondary education | tertiary education |
| prestige at career entry | 40.5 | 43.8 | 45.8 | 55.2 |
| prestige development before the first birth | .0 | 1.5 | 1.8 | 2.7 |
| prestige development across the career | -1.3 | .3 | 1.1 | 1.6 |
| ***N=*** | | | | ***570*** |

*Note:* prestige at career entry reported in absolute values, not centered.

As already could be seen in Table 3, Figure 2 again yields that the vast majority of women show no prestige development at all before family formation, and most of the remaining part report positive career developments. Yet, these paths already taken are not necessarily reflected in the occupational period after the first births. During this period, all three groups – those with positive, negative and null development – report primarily stability. Beyond that, however, it seems that the more positive the development was before transiting to motherhood, the higher are the risks of losing prestige afterwards: among those women that gained

13 For the youngest cohort, the women we refer to most in our analyses, prestige measures are slightly different. Particularly, this applies to the prestige at career entry: for women with no or lower secondary education, it averages to 36.61 (e.g. library clerks, market salespersons), for those with intermediate education to 44.2 (e.g. nursing associate professionals, keyboard operators), for those with upper secondary education to 46.28 (e.g. midwifery professionals, insurance representatives), and for tertiary educated women to 53.54 (e.g. social work professionals, archivists).

(15.3%) or did not report any development before family formation (74.9%), more women forfeit occupational prestige afterwards (6.0% resp. 20.4%) than (further) accumulating it (2.8% resp. 15.1%). Of those that lost prestige between career entry and first birth, instead, the figures prove the contrary (1.6% vs. 3.7%). Hence, it does not indicate that the achievements before the first birth guarantee a further climbing up on the career ladder or even an ensured prestigious position, but it seems that the transition to motherhood introduces new insecurities and possibly penalties. This also reflects in the, in sum, higher share of women that report negative prestige developments after the first births (27.9%[14]) than positive ones (21.6%[15]) – quite the opposite picture compared to the developmental distribution before.

In addition to this overall picture, Figure 2 follows up the educational differences in Table 4 that yielded some support to the assumption of a less severe impact of the first birth on higher educated women's career. The figure shows that there are major differences between educational groups. During the period before family formation, higher educated women succeed distinctly more often in terms of prestige – even though educational groups do not vary considerably in their timing of first births: for all groups approximately seven years[16] pass after career entry. Altogether, a positive career emerges for 20.6% to 22.5% of women with upper secondary or tertiary education prior to their first birth – compared to a respective figure of only 10.7% for low educated women. Additionally, a higher education helps to at least maintain these achievements, even during motherhood: though the chances of further accumulating prestige is universally low across educational groups – only between 1.8% and 4.8% of women manage to gain consistently across their career – the shares of women that forfeit their before acquired prestige after their first births (between 5.9% and 6.4%) does not grow proportionally with the share of women who are successful before their first births (between 10.7% and 22.5%). Hence, higher education seems to facilitate both a prestige gain before family formation and the ability to secure this achievement beyond the transition to motherhood.

Besides that, particularly women with tertiary education seem to be by far least likely to show no prestige development before family formation at all: in contrast to the other educational groups – in which between 74.0% and 79.1% report a null development – only 65.2% of tertiary educated women display prestige stability. Apparently, for highly educated women, the episode before family formation is very rich in occupational opportunities and thus mobility. Those that did not seize these opportunities, however, seem to have considerably lower chances of making up for the omission after becoming mothers: only very few women (4.5%) manage to gain prestige after their first births even though they did not report any development before.

Subsequent to the highly educated women's eventful episodes before their first births, however, these women show the highest share of prestige-neutral career developments: in sum, 65.2%[17] of women with tertiary education do not report any (further) development after transiting to motherhood, in contrast to 53.4% and 55.6%[18], respectively, of women

14 6.0% + 20.4% + 1.6%

15 2.8% + 15.1% + 3.7%

16 Additional yet unreported analyses yield that the youngest cohort's timing ranges between 6.74 (upper secondary education) and 7.18 years (middle secondary education).

17 12.4% + 46.1% + 6.7%

18 6.0% + 44.2% + 3.2% resp. 9.5% + 44.4% + 1.6%

with middle or upper secondary education. Low educated women, however, constitute a distinct exception in this respect: there is no registered prestige change after the first births for as little as 36.7%[19]. Apparently, the risks and chances to their prestige seem to be largest after family formation – while the risks seem to prevail. In line with our supposition, this suggests that lower educated women are penalized the most for their motherhood, not only in terms of their expectable prestige but seemingly also with regard to the reliability of their jobs. The highly educated, in contrast, appear to attain a long-term occupational security before their first births which they can rely upon as mothers.

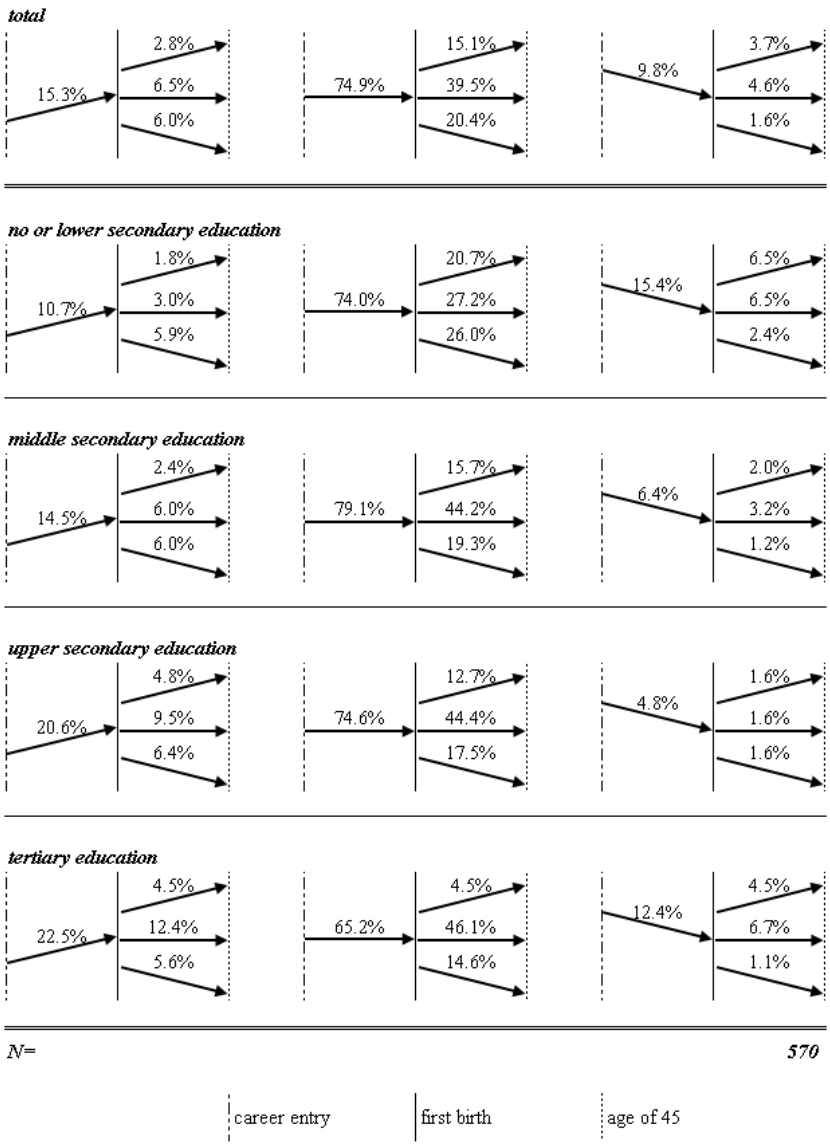
These descriptive results provide a first interesting insight into prestige developments, particularly with regard to the differences across educational groups. To get an even deeper understanding of West German women's career developments before and after their first births, we assess the impactful factors multivariately by regressing prestige, education and controlling measures to the prestige development between career entry and the career's high point at age 45 in Table 3.

In a first step, we further concentrate on how mothers' careers develop overall, particularly in relation to their career before family formation. With regard to the shares of women whose prestige develops positively, descriptive analyses have shown that the overall proportion of women that report prestige developments rise considerably after family formation. Also, while the shares of positive developments outnumber those of negative ones during the period before the first births, the opposite is true for the period afterwards. However, no specific pattern shows behind these developments: the results did not convey specific paths taken before the first births of which women keep track afterwards. To examine the magnitudes of developments beyond their shares, Model 1 estimates the impact of both the mean-centered prestige at career entry and its subsequent development until just before a woman's first birth.

Assuming a zero development for the latter, which has proven to reflect the career of almost 75% of women, shows that the higher the occupational prestige is at career entry, the smaller is mothers' career enhancement by age 45. At first sight, this seems natural as the prestige score is constrained by lower and upper bounds which offer limited opportunities to occupational ascents and descents. However, the constant suggests that already entering the career at a prestige score of the average 44.8 leads on to a slight loss across the career. Of every additional prestige point that women secure at career entry, one quarter will be lost by the age 45. A positive career prior to the first birth, instead, raises the lifelong career gain by .62 per prestige point. This means that of the prestige women manage to gain before forming a family, more than one third will be lost after they have become mothers of two. Hence, gaining prestige before the first birth does not guarantee its preservation into motherhood – neither does it indicate an ongoing prestige gain. Also, glancing at the model's power to explain the variance, it becomes apparent that those two variables account for as much as 32% of women's variance in their career at age 45 – an indeed sizeable impact. It supports the high relevance of the period before the first child for women's long-term career – yet still, a considerably greater role seems to be left to other factors, possibly the period after family formation.

19 3.0% + 27.2% + 6.5%

*Figure 2*: development of occupational prestige before and after timing in total and by educational level




The second part of our research question regarding women's career development before and after the first birth concerns education-specific differences. Preliminary analyses have suggested that the relevance of the occupational period before family formation varies by educational group: greater shares of highly educated women gain during that period and manage to secure their achievements beyond their transition to motherhood – while at the same time lower educated women seem to be confronted with an increased insecurity re-

sulting from their first birth. To get a deeper understanding of the processes, in Models 2 to 4 we pay special attention to the already evinced educational differences.

In a first step, we consider the further prestige development across educational groups, controlled for cohort effects (Model 2). For the time after family formation, no or a lower secondary education reduces the expectable prestige gain after family formation in comparison to intermediately educated women – despite the high amount of changes. Mothers' upper secondary education, in contrast, does not raise the expectable prestige gain above that of the reference category, even though descriptive analyses yielded high chances of prestige enhancement before the first births. Instead, only a tertiary degree pays off across the career as a mother – presumably, this is primarily because they manage to maintain the prestige they have attained before first births better than other educational groups. Nonetheless, the educational pay-off is enormous and further adds to the higher prestige of women with tertiary education at career entry: in the youngest cohort, it exceeds intermediately educated women's entry prestige by a mean of more than nine points.

Beyond these differences, however, education-specific impacts of attainments before family formation are rather complex in nature. Precisely, in Model 3 there is some marginally significant[20] support to the result that women with tertiary education benefit more from prestige gained between career entry and their first births: they seem to be able to maintain an additional one fifth of every gained prestige point – given that the prestige at career entry and the gained prestige before the first birth are similar to that of intermediately educated women. As this is hardly the case, however, Model 4 proves that there is even more to this picture: an education-specific interaction of prestige at career entry and prestige development prior to timing suggests a slightly smaller gain from the latter for both women with no or lower secondary and tertiary education. While the magnitude seems rather small at first sight, applying the very different means of the youngest cohort's prestige measures for the concerning educational groups (see section 3) sheds light upon the interaction's relevance. Starting from their considerably lower average prestige at career entry, mothers with no or lower secondary education are influenced considerably more by the prestige they gain or forfeit between career entry and their first birth: every additional prestige point predicts two thirds of a prestige point at the age of 45. While this means they are considerably more prone to continue losing prestige as mothers if they have taken that path before their transition to motherhood, it also implies that they would profit remarkably from the prestige they manage to attain during that period. Mothers with tertiary education, in contrast, start off at a considerably higher prestige level at career entry and have been shown to have a period before their transition to motherhood that is considerably more eventful, presumably because of a greater variety of opportunities. After transiting to motherhood, however, the prestige gained or forfeited during that time has fairly little influence on their long-term prestige development; it seems that their career is stabilized.

These results emphasize the insecurity lower educated women face on the labor market once they have become mothers: they are influenced heavily from their attainments or omissions before family formation. The higher women's education and hence the higher their prestige and additional attainment before family formation is, the smaller is this influence, suggesting an increasingly stabilized career once these women are mothers.

20 $p = .11$

The depicted analyses aimed at systematically reconstructing West German women's career development in relation to the period before the first birth. Secondly, they intended to answer the question of education-specific differences in these developments. The results have shown that the period after family formation is indeed fairly detrimental to women's prestige; the on average positive attainments before the transition to motherhood do not ensure stability. This seems to be particularly true for women with no or lower secondary education: the data suggests that they face the highest amount of insecurity as mothers. Although they show, on average, very little prestige development before family formation, their attainments as well as omissions influence their long-term career considerably. Highly educated women, in contrast, often profit from an episode of many occupational opportunities between career entry and their first birth: they on average manage to attain prestige additionally to their high prestige at career entry. After their transition to motherhood, these attainments seem to offer long-term occupational security.

But how do these careers depend on women's birth behavior concerning their first births' timing as well as their second births' spacing? What role do the activities play, especially during the spacing? And in what way are the elaborated educational differences due to education-specific timing and spacing decisions? In the next step, we follow up these questions by multivariately controlling for their impact on women's careers.

*Table 5*: impact of previous prestige measures and education on prestige at age 45

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | b | b | b | b |
| prestige at career entry | -.25** | -.40** | -.41** | -.40** |
| prestige development before the first birth | .62** | .49** | .37** | .47** |
| control: cohort groups (Ref: 1960-66) | | | | |
| 1944-49 | | 3.13** | 3.28** | 3.32** |
| 1950-54 | | 2.22* | 2.16+ | 2.32* |
| 1955-59 | | 1.39 | 1.49 | 1.39 |
| educational level (Ref: middle secondary education) | | | | |
| no or lower secondary education | | -2.96** | -3.18** | -3.10** |
| upper secondary education | | 1.70 | 1.44 | 1.52 |
| tertiary education | | 5.09** | 4.72** | 4.50** |
| interaction effects | | | | |
| prestige at career entry* | | | | |
| no or lower secondary education | | | .17 | |
| upper secondary education | | | .17 | |
| tertiary education | | | .21 | |
| prestige at career entry* | | | | |
| prestige development before the first birth* | | | | |
| no or lower secondary education | | | | -.02* |
| upper secondary education | | | | -.01 |
| tertiary education | | | | -.01** |
| constant | -.68+ | -1.86** | -1.71* | -1.85** |
| N | 570 | 570 | 570 | 570 |
| $R^2$ | .321 | .362 | .366 | .367 |

*Note:* + p<.10, * p<.05, ** p<.01

## The general and education-specific effect of timing and spacing on women's careers

Since the pending research question is very complex in nature, we divide the analysis of the effect of women's birth behavior and the underlying education-specific effects into three separate, yet interwoven parts. Firstly, we focus on the effect of women's timing and spacing on their career and the underlying effect of the associated activities they participate in. In a second step, we set our focus on education-specific differences between the effects of women's timing and spacing decisions on their careers. At last, we abstractly simulate ideal type courses of female careers by applying the results established before in order to clarify and illustrate the interaction of timing, spacing and the related activities on the one hand and the educational effects on the other hand.

### Timing, spacing, and the activities in-between

In the following, we focus on the effect of women's birth behavior and the activities related to it on their career. In Table 6, we gradually integrate variables that measure the timing – starting with career entry –, the spacing as well as the associated activities into the main model established before, keeping developments before the timing and general educational expectancies constant. We start off with assessing the – potentially non-linear – effect of the timing in Model 1 as well as the respective effect of the spacing in Model 2. We assumed an inversely u-shaped effect of the timing as well as a profitable prolongation of the spacing for women's careers. For neither of the two measures, however, there is any straightforward evidence for a duration-dependent effect. Apparently, above what women have achieved in terms of prestige, neither the timing of the first births nor the spacing of the second yield an effect on a mother's career. For the timing, it seems reasonable that this effect falls short of revealing underlying educational differences for which we test in a subsequent step. Women's activities before the transition to motherhood, in contrast, predominantly encompass their employment: only rather few women spend some (short) time outside the labor market at all (cf. section 3). Hence, the data does not seem to leave room for activity-specific differences of the timing's impact. For the spacing, however – considering the West German institutional and normative framework which facilitates several years of unpaid caregiving – we assume an underlying effect of women's activities between births.

To follow up the assumption regarding the activities during birth spacing and to review our argumentation of an activity-unspecific timing, we test for effects of women's activities in Models 3 to 7. Model 3 shows that, as expected, women's employment prior to family formation does not alter the timing's effect on their career. As by far most women spend their time before family formation in employment, this is not surprising. With regard to the spacing, it seemed theoretically reasonable to space births widely in order to intermit the associated episodes of unpaid caregiving with periods of employment. However, since the West German framework encourages mothers to stay at home for several years, the positive effect of a wide spacing could be blighted by this arrangement. To examine this ambiguity, Models 4 and 5 first assess the effects of the general activities during spacing, without controlling for the duration of women's participation in these activities. We contrast mothers that spend their time between births with unpaid caregiving to those that choose to pursue an employment. As Model 4 suggests, there is no significant effect of generally participat-

ing in either of those activities. Regarding the respective group of activities by the spacing's duration, however, Model 5 adds valuably to that picture. It reveals that a very small spacing – the conditional main effects[21] are estimated for the solely analytical spacing of zero years – proves to be much less detrimental if it is spent with unpaid caregiving exclusively. This effect is declining steeply, however, lowering the expectable prestige at 45 by at least one and a third points every year women spend outside the labor market without giving birth to a second child. For some years, participating in an employment between births seems to be even more harmful to a career. It is only after two and a half years that the strong interaction effect of employment and spacing suggests that the penalizing impact of a prolonged spacing can be suspended – although not reversed – by re-entering the labor market. If women space their births beyond that duration, an employment can help to keep the second child penalty to a minimum at about minus three to four prestige points at age 45. The results suggest that the effect of the spacing is indeed dependent upon women's activities between births: contrary to our assumption, a short spacing in unpaid caregiving seems to be the most profitable arrangement. Spacing births widely and intermitting them with an employment, however, appears to secure some of women's prestige if they decide for a spacing that is longer than two to three years.

To get a deeper understanding of the processes, particularly with regard to women's occupational commitment in full- or part-time employments between births, we assess the more specific duration effects of these activities in Models 6 and 7. As Model 6 shows, there is no significant effect for the duration of any activity during the birth spacing in general: the effect of working full-time or part-time for, e.g., one year between births is not the same during a short and a long spacing. It is, again, only the specific employment in relation to the spacing's duration that proves influential (Model 7). Despite the significant interaction effects for the births' spacing and women's employment variables themselves[22], there are two other aspects that command attention upon integrating the terms. Firstly, the spacing's squared effect gains considerably in strength and is not far from the defined limit of significance anymore[23]. This suggests that the observed effects lose in intensity across time. Secondly, the conditional main effect of a full-time employment's duration does not vary significantly from the main spacing effect that reflects periods of unpaid caregiving. In combination with a fairly weak positive interaction effect, this suggests that during a spacing's first years it is rather indifferent whether women return to the labor market full-time or if they stay at home to care for the child. Apparently, a full-time employment only proves beneficial after several years of postponing the second child. The respective main effect of a part-time employment's duration, in contrast, falls considerably, outlining a remarkable negative effect of working at short hours. This effect is particularly strong if women return part-time soon after the first births. Then, according to the comparatively weak interaction effect, these detriments balance only after several years.

21 The conditional main effect of an employment during spacing is close to significance at $p = .12$.

22 The interaction effect of spacing and full-time employment is at $p = .101$.

23 $p = .13$

*Table 6*: impact of timing, spacing, and the related activities on prestige at age 45

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| | b | b | b | b | b | b | b |
| prestige at career entry | -.41** | -.42** | -.42** | -.42** | -.43** | -.41** | -.41** |
| prestige development before the first birth | .49** | .48** | .50** | .50** | .49** | .50** | .50** |
| control: cohort groups (Ref: 1960-66) | | | | | | | |
| 1944-49 | 3.16** | 3.22** | 3.46** | 3.51** | 3.48** | 3.43** | 3.28** |
| 1950-54 | 2.24* | 2.46* | 2.87* | 2.87* | 3.09** | 2.82* | 2.71* |
| 1955-59 | 1.41 | 1.51 | 1.59 | 1.54 | 1.54 | 1.48 | 1.40 |
| educational level (Ref: middle secondary education) | | | | | | | |
| no or lower secondary education | -2.95** | -2.90** | -3.00** | -2.97** | -2.68** | -2.91** | -2.92** |
| upper secondary education | 1.75 | 1.66 | 1.48 | 1.58 | 1.70 | 1.47 | 1.42 |
| tertiary education | 5.18** | 4.98** | 5.33** | 5.29** | 5.51** | 5.26** | 5.22** |
| timing | .26 | .18 | .13 | .14 | .19 | .22 | .23 |
| squared timing | -.02 | -.01 | -.01 | -.01 | -.01 | -.01 | -.01 |
| spacing | | -.44 | -.49 | -.58 | -1.33* | -.64 | -.14 |
| squared spacing | | .01 | .01 | .01 | -.02 | .01 | -.08 |
| duration of activities before the first birth (ref: employment) | | | | | | | |
| education | | | -.59 | -.56 | -.53 | -.65+ | -.64+ |
| unemployment | | | 3.94+ | 3.72 | 3.78 | 4.39+ | 4.22+ |
| unpaid caregiving | | | -1.06 | -1.02 | -.89 | -.94 | -.93 |
| other | | | -.49 | -.50 | -.63 | -.58 | -.63 |
| group of activities during spacing (ref: unpaid caregiving exclusively) | | | | | | | |
| employment | | | | .96 | -3.17 | | |
| other activities | | | | 1.85 | 1.96 | | |
| interaction effects | | | | | | | |
| employment*spacing | | | | | 1.33* | | |
| duration of activities during spacing (ref: unpaid caregiving) | | | | | | | |
| education | | | | | | 1.72 | 1.82 |
| unemployment | | | | | | -.35 | -.35 |
| other | | | | | | -.54 | -.65 |
| full-time employment | | | | | | .27 | -.26 |
| part-time employment | | | | | | .13 | -1.22+ |
| other/flexible employment | | | | | | .19 | .49 |
| interaction effects | | | | | | | |
| spacing* | | | | | | | |
| duration of full-time employment | | | | | | | .10 |
| duration of part-time employment | | | | | | | .21** |
| constant | -2.74+ | -.84 | -.90 | -1.35 | .84 | -.96 | -1.14 |
| N | 570 | 570 | 570 | 570 | 570 | 570 | 570 |
| $R^2$ | .362 | .368 | .378 | .380 | .387 | .382 | .388 |

*Note:* + p<.10, * p<.05, ** p<.01

Disconcertingly, these results imply that a (part-time) employment between births can be much less positive for a career than interrupting the participation in the labor market altogether. This relationship contrasts any assumptions that suggest a benefit from occupational commitment and continuity. Presumably, the particularly negative effect of a quick part-time return reflects a specific behavior and decision-making process that has already been

observed in previous research (Engelbrech 1997; Hirschle 2011): mothers that decide[24] to return part-time enter a specific track which they follow for a substantial time. Although this track often enables a high flexibility and compatibility of career and family, these benefits apparently come at enormous long-term costs. Not even a full-time return soon after the first birth seems to signal occupational commitment in an outstanding way. Possibly, both effects are a result of women's institutionally and normatively encouraged multi-year parental leave that is typical for the West German conservative regime: even those women that are highly occupationally oriented withdraw from the labor market for about three years and return strongly committed afterwards. Therefore, the signals a full-time employment soon after the first birth sends and the continuity it facilitates are not inherent to occupationally ambitious women. A committed return after a period of unpaid caregiving can have the same effect – which is why we cannot observe a remarkable difference in the data.

## Education-specific effects of timing and spacing

In order to follow up the question how timing and spacing effects vary by educational level, in Table 7 we enter interaction terms of educational level and the respective birth behavior into the model established before. Our assumptions suggest that higher educated women profit stronger from their timing and spacing behavior, because they take their decisions more thoughtfully due to their high opportunity costs and greater reflexivity.

In Model 1, we first assess education-specific effects of the first births' timing. Even though women with middle and upper secondary education have proven to be very similar in their influential factors for a career so far, it is only the latter that benefit substantially from postponing their family formation. The result suggests that these women, who have not fully exhausted their high educational potential in the tertiary sector, make up for this omission on the job. Hence, they seem to have some necessity to establish in the labor market before forming a family in order to make a career.

Beyond that, the integration of the interaction terms also yields that the tertiary education's formerly very positive main effect becomes insignificant conditionally. This result suggests that a timing right after career entry would nullify their high education's positive impact on their career. Apparently, their timing is of major relevance and contributes substantially to their occupational success. Although a precise indication of the educational group's specific timing cannot be derived from the results, highly educated women seem to manage to time their first births individually in a way that is occupationally very beneficial. This interpretation gives some hints to confirming our assumption of a more positive timing effect for highly educated women.

24 That decision could be driven by either a deliberate job change or by some involuntarily necessity due to not finding an access back into one's initial profession – which might urge women to bridge with minor or even marginal employments.

*Table 7*: impact of education-specific timing and spacing on prestige at age 45

| | 1<br>b | 2<br>b |
|---|---|---|
| prestige at career entry | -.41** | -.42** |
| prestige development before the first birth | .50** | .49** |
| control: cohort groups (Ref: 1960-66) | | |
| 1944-49 | 3.27** | 3.38** |
| 1950-54 | 2.71* | 2.62* |
| 1955-59 | 1.42 | 1.48 |
| educational level (Ref: middle secondary education) | | |
| no or lower secondary education | -4.32* | -2.58 |
| upper secondary education | -2.39 | 5.76* |
| tertiary education | 3.08 | 10.06** |
| timing | .04 | .25 |
| squared timing | -.01 | -.01 |
| spacing | -.22 | .27 |
| squared spacing | -.07 | -.10+ |
| duration of activities before the first birth (ref: employment) | | |
| education | -.75+ | -.73* |
| unemployment | 4.44+ | 4.24+ |
| unpaid caregiving | -.73 | -.88 |
| other | -.92 | -.47 |
| duration of activities during spacing (ref: unpaid caregiving) | | |
| education | 1.88 | 2.43 |
| unemployment | -.35 | -.38 |
| other | -.55 | -.63 |
| full-time employment | -.23 | -.26 |
| part-time employment | -1.27+ | -1.42* |
| other/flexible employment | .50 | .49 |
| interaction effects | | |
| spacing* | | |
| duration of full-time employment | .09 | .09 |
| duration of part-time employment | .22** | .27** |
| timing* | | |
| no or lower secondary education | .20 | |
| upper secondary education | .56+ | |
| tertiary education | .32 | |
| spacing* | | |
| no or lower secondary education | | -.12 |
| upper secondary education | | -1.23+ |
| tertiary education | | -1.50+ |
| constant | .35 | -2.48 |
| N | 570 | 570 |
| $R^2$ | .391 | .395 |

*Note:* + p<.10, * p<.05, ** p<.01

To follow up the assumption of educationally differing spacing-effects, we insert interaction effects of educational levels and their spacing in Model 2. As a result, the picture becomes even more interesting: pursuing the before complex impact of the spacing and its related activities exposed before, the educational level of women also plays a significant role. In fact, controlling for the interaction uncovers a much more positive conditional

main effect for all women. Particularly women with at least upper secondary education would profit enormously from a very short spacing, yet every year of postponing the second births proves more detrimental to the expectable prestige at age 45. Women with low education would be able to make up for some of their disadvantages they have compared to intermediately educated women by spacing their births more shortly. At first glance, this suggests that they forfeit some opportunities by spacing their births the way they do – although a spacing of zero years as represented in the data is, of course, impossible.

Drawing upon previous research helps to comprehend that picture. The spacing of highly educated women has been found to be considerably shorter than that of women with no or lower education (e.g. Kreyenfeld 2002). So far, this has been explained by a partner effect and self-selectivity: firstly, their short spacing is due to their higher material security that is provided by their homogamous partner and, secondly, to the higher family orientation they display when they decide in favor of motherhood despite their high opportunity costs. Our results, however, suggest an additional explanation: higher educated women space their two births more closely in order to better seize their occupational opportunities by returning to the labor market more quickly. Since the West German institutional and normative framework somewhat puts obstacles to returning to the labor market soon after the first birth, they instead opt to return as soon as possible after their period of childcare. To keep the resulting interruption of their employment short, they space their births more closely – though they still lose some chances to accumulate prestige through their spacing of about two to three years.

Birth spacing, the related activities and the underlying educational effects

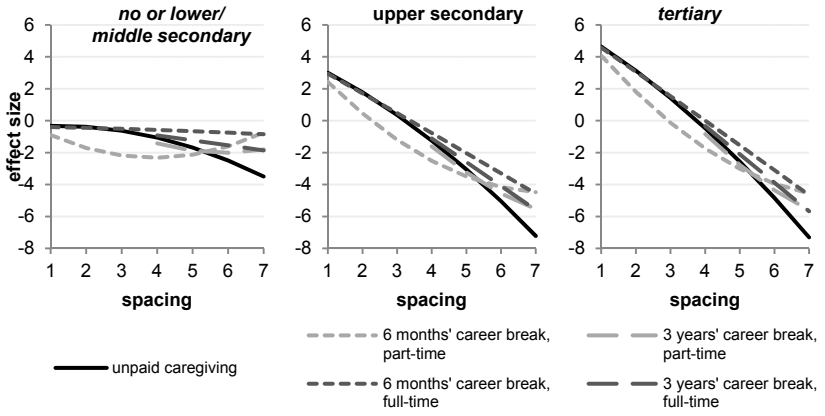
The profoundly examined results of Tables 6 and 7 in the previous sections have already yielded an in-depth impression of the impact exerted by women's particular birth behaviors, the associated activities as well as their educational level on their career development. This picture was shown to be particularly complex for women's spacing between the first and the second births: on the one hand, the spacing's effect was highly dependent upon women's activities between births. While reentering into a part-time employment soon after the first birth has generally turned out to be very detrimental to women's long-term career, participating in unpaid caregiving before having the second child within only a few years has been shown to be the occupationally most beneficial choice. On the other hand, education-specific results concerning the spacing of births have shown that there are indeed considerable differences between women of various educational groups: particularly highly educated women benefit substantially from a shorter spacing of births.

However, since it is very hard to understand how these different effects of women's activities during their spacing and their education coincide with one another, we aim to add some clarification to this complex picture in the following. Focusing on the youngest cohort, we simulate some of women's ideal type career developments by applying the results established before (Model 2 of Table 7) to abstract compositions of female education, birth behavior, and activities. Drawing upon these ideal type figures, at first we pay attention to the specific effects different spacing behaviors and activities have on women's prestige development between career entry and the age of 45. Secondly, we illustrate the impact these ideal type behaviors have, realistically, on women's prestige at the age of

45. To do so, we visualize the effects in relation to the average prestige measures of differently educated women before family formation, precisely their prestige at career entry and their prestige development before their first births. To provide these pictures of the youngest cohort's ideal type birth spacing behaviors and activities by education, we calculate the effects of different spacing durations, exemplarily applying a continuous episode of unpaid caregiving, an employment interruption of six months followed by part-time or full-time employment and a respective interruption of three years.

In Figure 3, we first illustrate the specific effects of the different spacing behaviors and acitivites by educational groups. Since controlling for an education-specific birth spacing (Model 2 of Table 7) has been accounting for differences between women with no or lower and middle secondary education, we summarize these educational groups and hence compare women with no or lower/middle secondary, upper secondary and tertiary education in Figure 3.

*Figure 3*: effect on career across different activities during spacing, by educational degree




*Note*: timing constant at seven years.

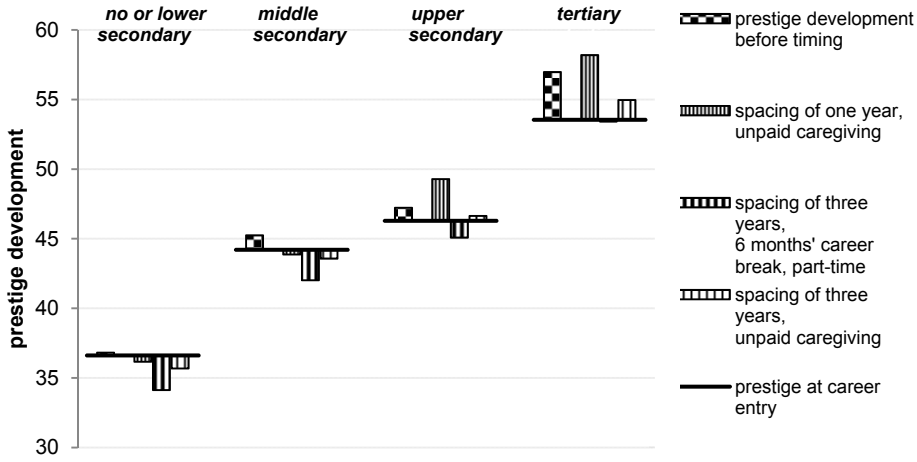
It becomes apparent that there are both major activity-specific and education-specific differences. At first regarding the latter, the graphs impressively demonstrate the enormous career impairments women with at least upper secondary education face with every additional year of postponing the second birth. The activity between births plays, in contrast, a comparatively subordinate part – the most important aspect in order to affect their career is the birth spacing's duration.

Beneath, however, there are still activity-specific differences that are particularly meaningful for mothers with no, lower and middle secondary education. The figure yields that the effects of episodes of unpaid caregiving and full-time employment do not vary considerably from one another during the first three years. It is only after that time that both slopes diverge increasingly and a full-time employment – particularly one that has been entered as soon as half a year after the first birth – proves to be noticeably less detrimental than unpaid caregiving. A part-time employment soon after birth, however, decreases the expectable prestige at age 45 immensely right from the start; the effect even intensifies during the first three to four years. It is only after as much as five years of birth spacing that the slopes

of unpaid caregiving and part-time employment intersect. This implies that the concerning part-time occupational period starts to become less detrimental for the career than having stayed at home for those five years plus of birth spacing. By that time, however, the effect is of rather theoretical nature as most women will have already given birth to a second child.

Although Figure 3 has already contributed greatly to comprehending the effect of differently educated women's birth spacing behavior and the associated activities, what remains is the central question concerning the all-encompassing impact of these behaviors on women's career developments. Figure 4 helps to clarify the picture by illustrating all educational groups' mean prestige base levels and achievements before timing as well as their long-term progression depending on birth spacing and activity behaviors, again drawing upon exemplary combinations of birth spacings and activities. Specifically, we single out birth spacing behaviors of one or three years, both spent exclusively with unpaid caregiving. For the birth spacing duration of three years, we additionally look into a return into part-time employment after half a year. The impact of any full-time employment, in contrast, has to be neglected as its effect does not differ from that of unpaid caregiving during the exemplarily observed birth spacings of up to three years (cf. Figure 3).

*Figure 4*: ideal type career development between career entry and age 45, by educational level and activity during a one and three year spacing




*Note*: timing constant at seven years.

Particularly for women with intermediate education who, on average, gained noticeably before family formation, Figure 4 shows that the occupational child penalty is strong and not effectively compensable: whatever spacing and activity they choose, the expectable prestige at age 45 falls below the average prestige at career entry. Only higher educated mothers of two seem to have chances of further accumulating prestige between career entry and the age of 45. However, gaining prestige beyond what they have attained during the most beneficial time before family formation appears to be only possible if they space their two children very shortly. Already a spacing of as little as three years contributes to a loss of prestige compared to what they were able to attain before their first births on av-

erage. Still, assuming a birth spacing of three years at the maximum, the most diminishing behavior for all educational groups is to participate in a part-time employment soon after the first birth: the expectable prestige at the career's high point at age 45 is far lower than it had been before those women decided for their first child and mostly even below the prestige level they started off with at career entry.

## 5. Summary and conclusion

Although research has already addressed the issue of how women in West Germany reconcile family and career and in what way their family obligations impact their careers (e.g. Engelbrech 1997; Grunow et al. 2006; Matysiak/Steinmetz 2006; Aisenbrey et al. 2009; Gangl/Ziefle 2009; Grunow et al. 2011), what has been underrepresented in the academic debate up to now is if and how women's careers are influenced by the way women embed their birth decisions into their life courses. Precisely, since two children are normatively and empirically prevalent in Germany, this question applies to timing the first birth as well as spacing the second. Hence, the central aim of our study was to understand the impact exerted by these two birth decisions on West German women's long-term careers. Specifically, we reconstructed (1) West German women's career development up to the age of 45 in general as well as before and after first birth and (2) the role of the timing of the first birth and the spacing of the second for women's career development. In both cases, a special focus was placed on the question if and how women's education alters the influences exerted by family formation and birth behavior on their careers.

Regarding women's career developments before and after the first birth, we could show that the period after family formation is firstly unexpectedly influential and secondly highly detrimental to women's careers. Even positive prestige attainments before the first births cannot ensure career stability afterwards. Particularly women with no or lower secondary education face the highest amount of insecurity once they are mothers. Considerable career developments before their first births, however, although being generally rather rare, can influence their long-term career remarkably. Highly educated women, in contrast, can chose from a variety of opportunities before family formation. The prestige drawn from these opportunities depicts a long-term career security beyond their transition to motherhood.

With respect to the impact exerted by the timing of the first births and their spacing of the second on women's careers, the analyses did not yield a general effect of the birth behavior itself. Instead, particularly for the spacing, the activities women participated in between both births have proven to be of major, yet very unexpected relevance: while bridging the births' spacing by exclusively caring for the first child for some years was shown to be the occupationally most rational decision, reentering the labor market part-time soon after the first birth has turned out to be highly detrimental in most cases. A full-time employment, instead, only pays off after participating in the labor market for several years while postponing the second birth. Apparently the West German institutional and normative framework, which encourages mothers to stay at home for several years to care for their children, confounds the positive consequences from labor market continuity and occupational commitment that could be obtained by returning quickly after the first child's

birth. Additionally, the prestige diminishing effect of a part-time employment suggests the existence of a 'mommy track': even though working part-time often enables mothers to flexibly combine family and career, these benefits apparently come at considerable long-term costs to the career (see also Engelbrech 1997; Hirschle 2011).

Regarding educational differences in the effects wielded by women's birth timing and spacing, it could be shown that education indeed influences the way in which women impact their career through their birth behavior. Firstly, the results suggested that higher educated women are able to time their first births in a way that proves to be beneficial, in terms of prestige, in the long term. Secondly, we found that the overall shorter spacing of highly educated women can be explained by their very high occupational profit from spacing births shortly: while the West German institutional and normative framework discourages returning to the labor market during the first years after the first birth, highly educated women seem to circumvent these obstacles to labor market continuity and commitment by keeping the period of consecutive childcare short. This finding adds valuably to the literature that researches the reasons for higher educated women's short birth spacing (e.g. Kreyenfeld 2002; Bernhard/Kurz 2007). A short spacing of births even gives highly educated women the chance to accumulate prestige beyond the high attainment they achieve before their family formation – while mothers of two children with low education seem to fall beneath their prestige at career entry in any event.

Although answering many open questions, our study also leaves some questions still unanswered to future research. Firstly, since the period after family formation has proven to be very influential and has not been fully explained so far, a closer look particularly at the activities after the consecutive periods of childcare, i.e. women's labor market behavior after their last births, would be worthwhile. Another focal point of interest would be to examine the impacts wielded by birth behavior on long-term career for both East and West German women. Particularly interesting in this regard is a long-term comparison, specifically after German reunification and in the light of the latest changes in paradigm concerning Germany's family policies (e.g. Bujard 2013).

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*Tobias Putz & Henriette Engelhardt*

# The effects of the first birth timing on women's wages: A longitudinal analysis based on the German Socio-Economic Panel

## Die Einkommensseffekte des Zeitpunkts der ersten Geburt: Eine Längsschnittanalyse auf Basis des Sozio-oekonomischen Panels

**Abstract**:
While the wage effects of a birth, the so-called "motherhood wage gap", have already been analyzed in more detail, studies exploring the timing of this life event still tend to be rare. Moreover, the large majority of existing evidence on this topic is based on data from the United States. Research using other data sources, for example research based on German data, is almost completely missing. By focusing on the causal effects of the timing of the first birth on women's wages in their subsequent life time (up to age 45), this paper seeks to contribute to this research gap. Based on longitudinal data of the German Socio-Economic Panel (SOEP), estimated fixed-effects panel models indicate that the negative wage effects of a first birth can primarily be observed for those women, who bear their first child relatively late. Furthermore, the estimated models provide evidence that the negative wage effects related to late motherhood can especially be observed for women with a low and intermediate level of education as well as for women who were married at first birth. Moreover, it seems that only young mothers experience an increase in their wages as the time since the first birth elapses. At last, yet for late mothers only, the negative effects of childbirth increase with the length of the work interruption around first birth. Overall, in contrast to the existing literature, these results indicate negative wage effects of a delayed first birth. Thus, according to the well-established "motherhood wage gap", these results can be considered as indication for a "late motherhood wage gap".

**Zusammenfassung**:
Während der Effekt einer Geburt auf das Einkommen unter dem Stichwort „motherhood wage gap" bereits eingehend untersucht wurde, existieren bisher nur vereinzelt Arbeiten, die die Effekte des Zeitpunkts dieses Ereignisses analysieren. Die große Mehrheit bestehender Befunde basiert darüber hinaus auf amerikanischen Daten. Untersuchungen, die andere Datenquellen nutzen, wie zum Beispiel Studien auf Basis deutscher Daten, fehlen bisher fast vollständig. Der vorliegende Beitrag versucht diese Lücke zu schließen. Im Mittelpunkt steht dabei die Untersuchung des kausalen Effekts des Geburtszeitpunkts auf das Einkommen im weiteren Lebenslauf (bis zum 45. Lebensjahr). Die Schätzungen von Fixed-Effects-Panel-Modellen mit Längsschnittdaten des Sozio-oekonomischen Panels (SOEP) deuten darauf hin, dass die negativen Einkommenseffekte, die durch die Geburt des ersten Kindes entstehen, vor allem für solche Frauen beobachtet werden können, die ihr Kind zu einem relativ späten Zeitpunkt zur Welt bringen. Die negativen Effekte des Geburtstimings zeigen sich insbesondere für niedrig- und mittelgebildete Frauen sowie für verheiratete Frauen und verlieren für frühe Mütter mit dem Abstand vom Geburtsereignis an Einfluss. Darüber hinaus nehmen die negativen Effekte einer Geburt für späte Mütter mit der Länge der kindesbedingten Erwerbsunterbrechung zu. Im Gegensatz zur vorliegenden Literatur deuten die Befunde damit auf negative Einkommenseffekte durch eine späte Mutterschaft hin, so dass in Anlehnung an die bereits bekannte „motherhood wage gap" eher von einer „late motherhood wage gap" gesprochen werden kann.

***Key words***: motherhood wage gap, first birth, birth timing, wage, labor market

***Schlagwörter***: motherhood wage gap, Erstgeburt, Geburtszeitpunkt, Einkommen, Arbeitsmarkt

## 1. Introduction

In the past decades, the majority of the industrial countries faced profound changes in their labor markets and family lives (Goldin 2006; Sobotka 2008; van de Kaa 1997, 2002). According to this, many countries experienced growing labor force participation rates of women (U.S. Bureau of Labor Statistics 2013) and a dramatic decline in their fertility rates, which in most countries dropped below the replacement level (OECD 2012a). Closely related to the declining fertility rates, many countries also faced a considerable increase in the age of mothers at their first birth (OECD 2012b). These profound changes can also be observed for West Germany: looking at the time period from 1960 to 2011, the total fertility rate fell from approximately 2.4 to 1.4 (Bundesinstitut für Bevölkerungsforschung 2013a), while at the same time the labor force participation rate of women increased from approximately 48% to 71% (Statistisches Bundesamt 2013a) and the average age of mothers at their first birth rose by approximately 3 years (Bundesinstitut für Bevölkerungsforschung 2013b).

Facing these changes, previous research mainly examined how fertility affects employment (Matysiak/Vignoli 2008; Schröder/Pforr 2009; van der Lippe/van Dijk 2002) and how employment affects fertility (Balbo et al. 2013; Bhaumik/Nugent 2005; Kreyenfeld 2004; Schröder/Brüderl 2008). With regard to the declining birth rates, research primarily investigated the social and individual reasons of this development (Billari 2008; Caldwell/Schindlmayr 2003; Lutz et al. 2006; Morgan 2003). Lastly, looking at mothers' rising age at first birth, research especially explored the consequences (Sobotka 2004, 2010) as well as the reasons for this development (Bloemen/Kalwij 2001; Caucutt et al. 2002; Gutiérrez-Domènech 2008; Kreyenfeld 2008; Mills et al. 2011). Thus, research has mainly been focused on mother's age at first birth as a dependent variable. Only few studies have systematically analyzed the timing of the first birth as an independent variable. This is especially surprising, since theories, like the life course theory and the human capital theory, suggest an enormous influence of the first birth timing on numerous areas of life (Elder 1994; Kohli 1985; Mincer 1974; Mincer/Ofek 1982; Mincer/Polachek 1974).

By analyzing the effects of the first birth timing on women's wages, this paper seeks to contribute to this field of research. Thus, the present study can be seen as a complement and supplement to the debate on a "motherhood wage gap" or a "motherhood wage penalty" (Budig/England 2001; Gamboa/Zuluaga 2013). The underlying research question can be stated as the following: Does the timing of the first birth have a causal effect on the wages of West German women?

By focusing on this issue, the present study may contribute to a better understanding of the mechanisms underlying the continuous delay of the first birth to later life stages in the last decades. Given the high importance of a woman's age for her fecundity (ASRM 2006; Balasch 2010; Ng/Ho 2007) as well as the strong correlation between a woman's age and the risk of miscarriages (Coste et al. 1991; Fretts et al. 1995), this development has often been associated with the decreasing total fertility rates of the last decades (Kohler et al. 2002). Moreover, the birth of a child can also be seen as an important factor

for the "gender pay gap" (Ziefle 2004: 229). For this reason, this paper can also contribute to a better understanding of an important factor for social inequality and thereby help to derive recommendations for political interventions.

The remainder of this paper is structured as follows. Section 2 provides a brief summary of the existing literature and outlines its weaknesses. In section 3, the theoretical background is discussed and the hypotheses for the empirical analysis are introduced. Following this, section 4 describes the methodological approach and the data basis used for the empirical analyses. Section 5 provides the results of the descriptive and multivariate analysis. A discussion of the empirical findings is provided in Section 6. Finally, in section 7, the limitations of this paper are highlighted and suggestions for future research are made.

## 2. Review of the literature

Studies focusing on the employment effects or the economic consequences of a birth for women are well-established in the social sciences (Anderson et al. 2002; Anderson et al. 2003; Angrist/Evans 1998; Avellar/Smock 2003; Bender et al. 2003; Cristia 2008; Fitzenberger et al. 2013; Gangl/Ziefle 2009; Gash 2009; Jacobsen et al. 1999; Matysiak/Vignoli 2008; Petersen et al. 2010; Schröder/Pforr 2009; Trappe/Rosenfeld 2000; Ziefle 2004). Although there are large differences between the existing investigations, the majority of analyses points in one direction: comparing mothers with childless women, the birth of a child has negative employment effects – with regard to wages, this result is often called the "motherhood wage gap" (Anderson et al. 2003; Gamboa/Zuluaga 2013). Substantially less attention has been given to the employment effects of the first birth timing. For instance Brewster and Rindfuss (2000: 291) note (but see also Troske/Voicu 2013: 485; Zerle et al. 2012: 47): „Investigators have focused on the decision to have children or not and the number of children, but additional aspects of fertility are likely to be relevant. Birth timing and spacing, for example, may comprise key components of strategies to balance work and family responsibilities." Although the number of studies contributing to this research field has increased in recent years, "the implications of first birth timing on career outcomes are not yet fully understood." (Karimi 2014: 56)

One of the first research areas investigating the effects of the first birth timing on employment has been the research on teenage childbearing. Most of these studies indicate positive employment effects with a delayed birth (Fletcher/Wolfe 2009; Hofferth/Moore 1979; Lee 2010). Apart from these findings, which probably can only difficultly be applied to other stages of life, a new research area has emerged, analyzing the employment effects of the first birth timing for a wider range of ages. Some of these analyses especially focus on the effects of the first birth timing on women's wages.

The majority of these analyses indicate that a delayed first birth has a positive impact on women's financial situation (Amuedo-Dorantes/Kimmel 2005; Blackburn et al. 1993; Buckles 2008; Chandler et al. 1994; Drolet 2002; Ellwood et al. 2004; Herr 2007, 2012; Kind/Kleibrink 2012; Miller 2011; Taniguchi 1999). Miller (2011: 1071) for instance states: "Motherhood delay leads to a substantial increase in earnings of 9% per year of delay [*and to*] (…) an increase in wages of 3% (…)". The positive effects of a delayed first birth are of-

ten explained with regard to the human capital of the observed women (Herr 2007; Taniguchi 1999). Herr (2007: 5), for example, concludes that the two factors "hours worked" and "longest labor force exit" provide the strongest explanatory power for the effects of the first birth timing observed in her study. Yet, she also shows that, depending on the educational background of the observed women, these human capital related factors are only able to explain half of the wage effects connected to the first birth timing (Herr 2007: 4f.). Beblo and Wolf (2002), as well as for example Boll (2011), analyze the effects of the timing of (child-related) work interruptions on wages by using simulations based on the human capital theory, and thereby follow a different methodological procedure. While Beblo and Wolf (2002: 91) conclude that later work interruptions have more negative wage effects, a finding that can at least partially be applied to late births as well, Boll's (2011: 173ff.) findings suggest a more varied picture. However, overall and consistent with the majority of the previously presented studies, Boll's (2011: 185ff.) analysis likewise indicates positive effects of delayed motherhood on wages. Although the majority of the existing literature provides evidence for positive effects of a delayed first birth, there are a few studies indicating different results as well. Based on Swedish data, for example, Karimi (2014: 23) concludes "that motherhood postponement has negative effects on women's labor market outcomes". As an explanation, Karimi (2014) stresses the importance of the spacing of subsequent births. The late mothers of her sample are more likely to space further births in shorter time intervals, resulting in longer career interruptions (Karimi 2014: 56). In line with Karimi (2014), Schulze (2009: 159) also concludes negative effects of a late motherhood by analyzing the "socio-economic consequences of fertility" for couple households.

In addition to these findings, some of the existing studies emphasize the importance of the educational background for the relationship between birth timing and women's wages. It seems that highly educated women profit most from a delayed first birth (Amuedo-Dorantes/Kimmel 2005; Buckles 2008; Gustafsson 2001; Herr 2007; Miller 2011). Looking at highly educated women, Amuedo-Dorantes and Kimmel (2005: 38) even conclude a wage boost resulting from a delayed child birth. As an explanation for this finding, they discuss unobserved factors, especially factors that characterize "good" and "bad" jobs (Amuedo-Dorantes/Kimmel 2005: 39).

Apart from the importance of the educational background, a few existing studies furthermore indicate that the wage effects of a birth or of the birth-timing also vary according to the time elapsed since the first birth. However, the findings concerning these effects are heterogeneous. Thus, while some analyses indicate that the wage effects of the birth timing decrease as time since the birth passes (Chandler et al. 1994; Drolet 2002) other analyses indicate continuously increasing wage effects of motherhood (Buckles 2008; Ellwood et al. 2004).

All in all, the majority of existing studies report positive wage effects resulting from delayed childbirth, especially when comparing early and late mothers. Furthermore, the existing studies indicate that a late first birth is particularly profitable for highly educated women. Lastly, the negative wage effects seem to vary with the time elapsed since the first birthing. Nonetheless, despite these apparently distinct findings, the existing literature contains shortcomings.

First, the majority of the presented studies uses data from the National Longitudinal Survey and is therefore based on a "unique historical cohort" (Taniguchi 1999: 1018) of

women, which limits the extent to which these results can be applied to women of other birth cohorts. Second, life courses as well as careers are not solely determined by individual decisions, but are to a large extent structured by welfare state arrangements and shaped by socio-cultural conditions (Levy 2012: 356ff.; Mayer 2009: 414). Therefore the extent to which the presented results, which were primarily based on data from the United States, can be applied to women of other countries, like for example Germany, remains unclear. Accordingly, welfare state arrangements can vary strongly between different countries (Esping-Andersen 1990) and can lead to variations in the "gender pay gap" (Mandel/Shalev 2009) as well as in the "motherhood wage gap" (Gangl/Ziefle 2009). Third, the presented studies, at least partially, use different definitions of birth timing. Thus, despite the seemingly consistent findings, the question arises to which extent these different definitions might contribute to variations of the observed effects. In fact, even though there are some studies trying to analyze the effects of the first birth timing on numerous areas of life, there is no common definition of the "first birth timing". This applies not only to the definition of age ranges, used to identify late and early births (Zerle et al. 2012: 47), but also to the actual definition of first birth timing itself. In most existing studies birth timing is defined as the "age at first birth" (Blackburn et al. 1993; Miller 2011), however, there are some other definitions as well. For example, Herr (2012), as well as Karimi (2014), define the timing of the first birth relative to the labor market entry of the observed women, Troske and Voicu (2013) define it relative to marriage, Chandler et al. (1994), as well as Drolet (2002), lastly define the timing of the first birth as difference between the "actual" and the "predicted age at first birth".

Based on these shortcomings the present study adds to the literature in several aspects. First, given the fact that compared "with the wealth of American evidence that uses longitudinal data and fixed-effects estimators to identify the impact of childbirth [*on women's wages*], corresponding analyses for other countries still tend to be rare" (Gangl/Ziefle 2009: 346), we add to existing research by analyzing this important topic based on German data and therefore in a different structural and cultural setting. Second, we allow the effects of the first birth to vary by the timing of this life event, an aspect of the birth biography which has only rarely been analyzed until now (Karimi 2014: 56; Troske/Voicu 2013: 485; Zerle et al. 2012: 47). Finally, we not only rely on one single definition of birth timing, but use two different measuring instruments, namely, the age of the observed mothers at the birth of their first child as well as their career position at the birth of their first child. By using these two definitions of birth timing we are not only able to take the multidimensionality of fertility and labor market behavior into account (Brewster/Rindfuss 2000), but to directly compare the estimated effects of different definitions of the first birth timing for the same women.

## 3. Theoretical background and research hypotheses

Much of existing research is characterized by a narrow view on the relationship between fertility and women's employment, not explicitly taking the timing of childbearing into account (Brewster/Rindfuss 2000: 291; Troske/Voicu 2013: 485). Accordingly, the same

holds true for the existing theoretical considerations used to explain the observed effects. In a first step, this section provides a brief summary of these theoretical considerations. Based on this review, in a second step, the research hypotheses for the empirical analyses are developed.

One of the most popular approaches to explain the effects of a birth on women's wage is based on the human capital theory (Baum 2002; Boll 2011; Miller 2011). The underlying idea of this theoretical explanation is that the individual wage of a specific woman can be described as a function of her labor force experience and her education (Beblo/Wolf 2002; Mincer 1974; Mincer/Ofek 1982). Following this, the negative wage effects of a birth can be attributed to three mechanisms: opportunity costs, accumulation effects and depreciation effects, which are primarily generated by the child-related work interruptions connected to births. First, these career interruptions lead to an interrupted accumulation of new human capital ("accumulation effect").Thus, while women with a continuous employment biography are able to steadily accumulate wage-relevant human capital, mothers who experience a child-related work interruption are lagging behind in their human capital accumulation, an effect that should increase with the length of the labor force exit. Moreover, because mothers experiencing a child-related work interruption are not able to use their human capital during such a career break, negative wage effects of a birth might also be caused by the depreciation of existing human capital ("depreciation effect") (Baum 2002; Mincer/Ofek 1982). Lastly, the direct wage losses caused by "opportunity costs" may contribute to the wage differences between mothers and childless women as well. Although the human capital theory provides convincing explanations for the observed effects, this approach alone is insufficient to fully understand the existing findings. Thus, a variety of studies show that the negative wage effects of a birth remain in force, even after controlling for numerous aspects of human capital (Anderson et al. 2003; Avellar/Smock 2003; Budig/England 2001). Following this, Waldfogel (1997: 216) concludes: „Taking time out of the labor market is certainly an important part of the explanation for mothers' lower earnings, but it is not the whole story."

Based on the assumption that individuals as well as households have only limited resources like time and money to maximize their utility functions, the new home economics can also contribute to a better understanding of the negative wage effects of motherhood (Becker 1982; Becker 1991; Budig/England 2001). This concept offers an explanation for the negative wage effects of a birth even if no work interruptions exist and hence, the human capital stock of mothers and childless women is identical (Becker 1985). These negative birth effects can be explained by the fact that beginning with the birth, more time and energy has to be invested in household tasks, while less effort can be spend on paid labor. However, following Becker's (1985) work effort hypothesis the availability of time as well as energy is limited to the individual (Anderson et al. 2003: 275; Bielby/Bielby 2002), so that these additional tasks may lead to productivity losses. For instance, mothers may not be able to fully use their leisure time for recuperation.

Some studies also stress the importance of statistical discrimination to explain the negative effects of a birth (Correll et al. 2007; Waldfogel 1998). Following this approach, mothers may be systematically exposed to discrimination, for example, they may be passed over for promotions, which can lead to negative effects on their wages in the long run. This explanation is closely connected to the signaling approach (Akerlof 1970),

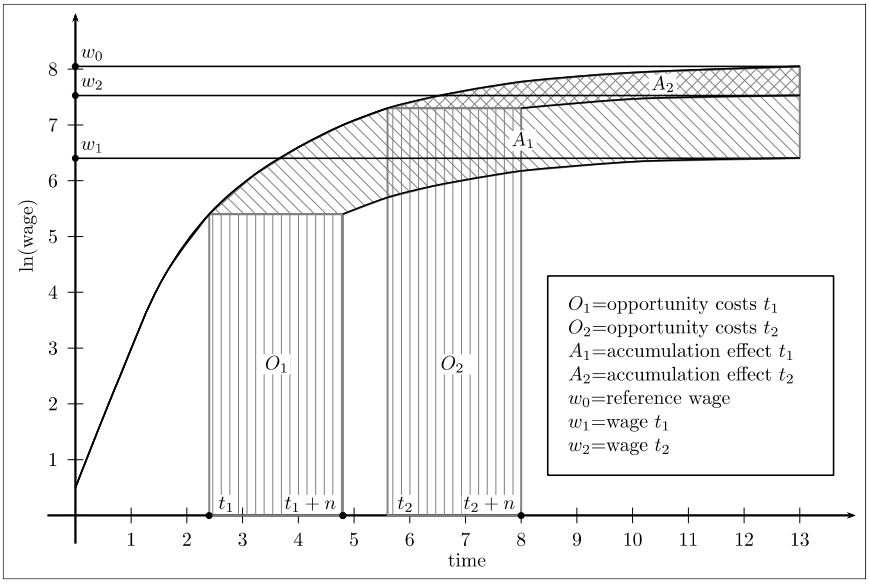
which explains that employers try to choose the most appropriate candidate (for example) when it comes to promotions. However, because information about the candidate's qualification is scarce, employers rely on certain easily available signals used as indicators for the qualification of a candidate. Motherhood might thereby be a signal for future role conflicts (Duxbury et al. 1994; Hammer et al. 2003) which could lead to productivity losses. Hence, employers probably prefer childless women, and that, on the other hand, leads to a systematic discrimination of mothers (Correll et al. 2007).

The negative wage effects of motherhood can also be explained through changes in the labor market behavior of mothers after childbirth, so that the observed wage effects may not be caused by external factors, but solely by self-selection (Budig/England 2001: 207f.). Following this explanation, mothers may adapt their labor market behavior around the birth of their child in a way which is more compatible with motherhood. For example, women might shift from full-time to part-time employment or refuse promotions to cope with both tasks, as a mother and as employee. However, part-time jobs are, for instance, often connected with lower payments (Wolf 2010). Some empirical studies seem to support such an explanation (Drobnič et al. 1999) by providing evidence for a changed market behavior after childbirth.

At last, the wage effects caused by childbirth may be no causal effects, but rather the result of unobserved heterogeneity (Budig/England 2001; Taniguchi 1999). In this case, motherhood would have no direct effect on women's wages. Instead, mothers and childless women would vary in certain unobserved characteristics, like for instance their work orientation, which are also related to their wages. If the assumption of unobserved heterogeneity is true, the observed effects of childbirth on the wages of women might be no causal effects, but rather the effect of these unobserved characteristics (Taniguchi 1999: 1010). Closely related to this argumentation, it is also possible that the observed effects are not the result of births affecting wages, but rather the result of wages affecting births (Herr 2012: 14). Accordingly, women may anticipate the moment in their careers in which their wage growth begins to decrease and hence decide to become a mother. Both of these explanations are especially important for the selection of an appropriate method of analysis.

However, although each of these concepts may provide consistent explanations for the observed effects, it is hard to find empirical evidence confirming these approaches (Correll et al. 2007: 1297). Furthermore, given the complexity of the underlying mechanisms, it seems inappropriate to explain the observed effects with one single approach. Rather, it seems adequate to interpret existing findings as results of different interdependent processes, although it may be possible that some of these processes are of particular importance for specific subgroups.

*Figure 1*: A graphical illustration of the wage effects of the timing of the first birth based on the human capital theory: opportunity costs and accumulation effects




*Note*: Own representation based on Miller (2011: 1074ff.) and Wetzels (1999: 97).

*Hypotheses*

The human capital theory, summarized in the previous section, can not only provide a better understanding for the wage effects of a birth, but also of the birth timing (Miller 2011; Wetzels 1999). Accordingly, this concept points to three effects that may vary with respect to the timing of birth: opportunity costs, accumulation effects and depreciation effects. Figure 1 summarizes the first two effects mentioned. It can be seen that the opportunity costs increase with time. Although, even if the opportunity costs may have an influence on lifetime income, there is no reason to assume that these effects also affect the hourly wage rate. Therefore, they are not described in more detail. Similar to the opportunity costs, the depreciation effects should also gain in importance as time passes. It can thus be assumed that women, who bear their child later in life, have already accumulated more human capital, which then can be depreciated during child-related career breaks (Boll 2011: 174; Mincer/Ofek 1982). In contrast to the opportunity costs and the depreciation effects, Figure 1 indicates that the accumulation effects lose their importance over time. In summary, based on the human capital theory, different wage effects depending on the birth timing can be assumed. Given the existing findings, it thereby seems appropriate to suppose positive wage effects of a delayed first birth. In addition to the human capital theory, the signaling approach also indicates wage effects varying by the first birth timing. According to this approach, it can be argued that an early birth should be a more negative signal to employers than a late birth, for example with regard to the labor market attachment. This would lead to a stronger discrimination of early mothers and thereby in the long run to lower wages. Finally, the negative wage effects of an early birth can also be

explained by using the new home economics. Based on this theory, early mothers may suffer more from productivity losses than late mothers, because, for example, they have accumulated less life experience and therefore face more family-work-conflicts. Following these theoretical considerations, the first research hypothesis, which will empirically be analyzed, states: *the timing of first birth directly affects women's wages ($H_1$). Based on the previous theoretical considerations and existing empirical findings, it can be assumed that especially an early motherhood has negative wage effects.*

Furthermore, the human capital theory also indicates that it is not the age at first birth, which is important for women's wages, but rather the position these women have achieved in the wage curve up to the birth of their first child. However, because the age at first birth comprises no information on this career position, in the empirical analyses the timing of the first birth is not only measured as the age at first birth, but also as the timing relative to the labor market entry. This relative definition of birth timing is not only closer connected to the literature on wage growth (Herr 2007: 2), but is also linked stronger to the life course theory, which not only stresses the importance of the timing of life events, but also of their spacing to other life events like, for example, the labor market entry (Elder 1994: 6). Therefore, the second hypothesis to be tested states*: the observed wage effects of the first birth timing will vary according to the used measuring instrument ($H_2$). Based on the theoretical considerations presented above, the relative definition of the first birth timing should thereby lead to stronger effects.*

Based on the considerations summarized in Figure 1, it can further be assumed that the effects of the first birth timing vary with the slope of the underlying wage curve, with an increasing slope leading to a growing importance of each of the human capital effects described in hypothesis 1 and thereby to a rising importance of the first birth timing as a whole. In contrast, the effects of the timing of the first birth should lose importance as the slope of the underlying wage-curve decreases and should fully disappear in cases of missing wage growth (Miller 2011: 1075). Given that jobs with a steep wage curve are probably also jobs that make high demands on the educational background of the employee (Connolly/Gottschalk 2006), this argumentation as well as existing findings (Herr 2007; Miller 2011) lead to the third research hypothesis: *the importance of the first birth timing increases with a growing slope of the underlying wage curve and thereby with a growing educational background of the observed women ($H_3$).* Another theoretical explanation for this hypothesis is given by the signaling approach: Following this concept, an early birth should be a negative signal especially for highly educated women, since they are more often working in much higher demanding jobs than their lower educated counterparts.

Based on the human capital depreciation and the interrupted human capital accumulation during a child-related career break, it can further be assumed that the wage effects of the first birth vary with the length of the child-related work interruption around this life event (Beblo/Wolf 2002: 91). However, the influence of the birth timing on this is hard to predict. On the one hand, it is possible that the length of the child-related work interruption gains importance if the birth occurs later in life, because by then there is more human capital accumulated that can be depreciated during a career break. On the other hand, as the bulk of human capital is accumulated in early career stages, the opposite may also be possible. This argumentation leads to the fourth hypothesis: *the wage effects of the first birth timing vary depending on the length of the child-related work interruption around first birth ($H_4$).*

Moreover, existing findings also indicate that the wage effects of the first birth timing vary with the time elapsed since birth. Following, for instance, the signaling approach, the negative wage effects of first birth should not occur immediately after reentering the labor market, but rather on the long run. In contrast to this argumentation, short-term wage effects based on the depreciation of existing human capital are, however, also possible. These considerations lead to the fifth hypothesis: *the wage effects of the first birth timing vary depending on the time elapsed since the first birth ($H_5$).*

At last, it will be analyzed, if the wage effects of the timing of first birth vary depending on the marital status at first birth – a hypothesis based on the new home economics. Following this approach, in absence of a specialization of spouses, women who were unmarried at the time of their first birth should experience lower wage effects of the first birth timing than married women, who mostly can rely on a working partner and are therefore able to specialize themselves in household tasks. The variation of the effects of the first birth timing on women's wages with the marital status may also provide evidence for the underlying mechanisms behind these effects and can especially contribute to better understand, whether the observed effects are – at least in parts – the results of a changed labor market behavior after the first birth or not (Budig/England 2001: 218). Empirical evidence for this hypothesis, based on research about the "motherhood wage gap", is ambivalent (Budig/England 2001; Taniguchi 1999). Following this line of reasoning the last hypothesis to be tested is: *women who were married at the time of their first birth experience larger wage effects of the first birth timing than women who were not married at first birth ($H_6$).*

## 4. Data, Sample and Methods

The empirical analyses are based on data of the German Socio-Economic Panel (SOEP). The SOEP is an annually conducted panel survey representative for Germany which began in 1984 and comprises personal interviews of all household members aged 17 years or older (Wagner et al. 2007, 2008). The major advantages of the SOEP are the detailed collection of the households' and individuals' economic situation as well as the detailed collection of the birth biography.

Given that generative behavior is sequential (Huinink/Kohli 2014: 1314) and it is therefore inappropriate to assume that the financial consequences, which arise from subsequent births are equal to those of the first birth, the following analyses focus on the wage effects of the first birth timing only.

The unbalanced panel sample, used for the analyses, is based on the SOEP waves 1984 to 2010 including the following restrictions on the sampled West German women: age ranging between 17 to 45 years[1]; entered the labor market until the age of 35[2]; pro-

1 The limitation of the sample to women aged between 17 and 45 years was introduced due to the reproductive phase of women that is usually specified by the age range between 15 to 49 years (Hinde 1998: 96; Rowland 2003: 235). Although the chosen age range can lead to the problem that early mothers have more time for further wage growth after the first birth, this should only marginally influence the estimated results, since the presented models not only control for the women's age, but

vided realistic data on their wages and their working hours, while being in the labor market. To be able to precisely measure the causal effects of the first birth timing, the sample was further restricted to women, who provided data at least at three points in time: in the year before the first birth, in the year of the first birth and in the year after the first birth. Finally, to measure the wage effects of a first birth, the sample comprises only women that at least once provided data on their wages before the first birth. After the operationalization, the final sample contains 1.676 women of which 383 women bore their first child during the observation period.

*Dependent Variable*

The dependent variable, used for the analyses, is the log hourly wage of the observed women[3]. This variable is based on the "current gross labor income in euros" that is provided by the SOEP, whereas item non-response was imputed by a two stage-procedure (Frick/Grabka 2005). Given the possibility that wage differences between early and late mothers may be influenced by differences concerning one-time payments, those payments were proportionally added to the wages (Beblo/Wolf 2000: 8). Furthermore, wages were deflated by the consumer price index provided by the German Bundesbank (Beblo/Wolf 2003: 565). Additionally, to obtain the hourly wage, the monthly income was first calculated on a weekly basis and then, using the actual working hours, converted into the hourly wage. Individuals providing implausible data, outliers[4] and self-employed people were excluded. At last, the logarithmized hourly wage was calculated using the natural logarithm. Since using this transformation would lead to an exclusion of all non-working episodes, a wage of 0.01 € was assumed for these cases.

*Independent variables*

For a detailed analysis of the wage effects of the timing of the first birth, two different instruments are used: the "('biological') age at first birth" (Taniguchi 1999) and "the 'relative' age at first birth" (Herr 2012). While the former is identical to the mostly used "mothers' age at first birth", the "relative age" is calculated as difference between the age at first birth and the age at labor market entry (Herr 2012: 5). Both instruments are implemented in two different ways: as a binary and as a categorial variable. While the former uses the mean value of each of the definitions of the first birth timing as a threshold, the latter is based on the first and fourth percentile to identify "late" and "early" motherhood and on the second and third percentile to define "normal" motherhood. In accordance with the statistical method used, the measures of the timing of the first birth are in-

also for the time elapsed since the first birth. Furthermore, as is shown by the sensitivity analyses, the main results remain stable even after this sample limitation is removed.

2 The labor market entry is defined as the point in time at which an observed woman has spent at least 6 months in full-time employment, part-time employment or unemployment.

3 The generation of the dependent variable is based on Boll's approach (2011: 41f.).

4 To minimize the influence of implausible values and outliers, women with an income in the bottom 1% of the income range as well as women with an income in the top 1% of this range were excluded from the sample. However, as is shown by the sensitivity analyses, the main results remain stable, even after this sample limitation is removed.

cluded in the models as interactions with the time varying variable "birth of the first child".

In addition to the birth timing, the analyses also include measures for the further birth biography, the employment biography, the current employment situation as well as for the sociodemographic background of the observed women.

*Table 1*: Mean values of the used variables by the age at first birth and the relative age at first birth

| Variable | Age at birth | | | Relative age at birth | | | Childless |
|---|---|---|---|---|---|---|---|
| | 19-26 | 27-32 | >32 | 0-5 | 6-11 | >11 | women |
| Log. hourly wage (in €/h) | 2,24 | 2,54 | 2,70 | 2,36 | 2,53 | 2,58 | 2,44 |
| *Birth biography* | | | | | | | |
| Number of children | 1,27 | 0,96 | 0,68 | 1,15 | 0,98 | 0,78 | 0,00 |
| Time since first birth | 5,55 | 3,50 | 2,15 | 4,54 | 3,86 | 2,64 | 0,00 |
| Length of the work interruption around first birth | 2,28 | 1,73 | 1,38 | 2,01 | 1,81 | 1,52 | 0,00 |
| *Employment biography (in months)* | | | | | | | |
| Full-time experience | 49,02 | 80,06 | 116,00 | 36,66 | 79,47 | 134,11 | 85,20 |
| Part-time experience | 34,55 | 20,93 | 14,80 | 28,45 | 23,12 | 17,60 | 6,81 |
| Unemployment experience | 3,40 | 1,78 | 4,32 | 3,17 | 1,87 | 4,35 | 3,08 |
| Household experience | 16,90 | 9,33 | 7,88 | 12,80 | 11,34 | 8,68 | 1,55 |
| School/ (Vocational) Training experience | 52,70 | 73,68 | 90,82 | 76,95 | 73,99 | 59,58 | 75,96 |
| Motherhood experience | 17,82 | 14,66 | 11,69 | 16,63 | 14,98 | 12,44 | 0,00 |
| Time in gap | 0,46 | 1,45 | 0,24 | 1,03 | 1,10 | 0,30 | 0,55 |
| *Current employment situation* | | | | | | | |
| Full-time | 0,22 | 0,36 | 0,47 | 0,23 | 0,36 | 0,46 | 0,63 |
| Part-time | 0,38 | 0,29 | 0,22 | 0,37 | 0,29 | 0,24 | 0,10 |
| Not-working | 0,34 | 0,32 | 0,30 | 0,35 | 0,32 | 0,29 | 0,18 |
| School/ Training | 0,06 | 0,03 | 0,01 | 0,06 | 0,03 | 0,02 | 0,09 |
| Length of the time at the workplace | 2,92 | 4,19 | 4,72 | 2,82 | 4,02 | 5,25 | 5,02 |
| *Sociodemographic background* | | | | | | | |
| Age | 28,93 | 31,21 | 34,75 | 29,12 | 31,44 | 34,08 | 28,77 |
| Married | 0,71 | 0,63 | 0,61 | 0,69 | 0,65 | 0,61 | 0,21 |
| Divorced/ widowed | 0,01 | 0,02 | 0,05 | 0,00 | 0,02 | 0,06 | 0,04 |
| Single | 0,28 | 0,34 | 0,34 | 0,31 | 0,33 | 0,33 | 0,75 |
| *N=Number of persons* | 100 | 188 | 95 | 114 | 182 | 87 | 1.293 |

*Note*: Results not weighted.
*Source*: SOEP waves 1984-2010, own calculations.

*Birth biography:* This includes the time elapsed since the first birth, the length of the child-related work interruption around the first birth as well as a variable measuring further births to control for the birth biography. As the descriptive results in Table 1 show, for both definitions of the first birth timing, a delayed first birth is related to a decreasing number of children as well as to a shorter time period since the first birth.

*Employment biography:* Besides the birth biography the analyses also include information on the employment biography of the observed women. Table 1 provides evidence that this is not only necessary from a theoretical point of view (Mincer 1974), but also from an

empirical one. To control the different employment biographies, detailed measures of the labor force experience are included in the empirical analyses: the full-time, part-time, school/training, unemployment, household and motherhood experiences, the time spent in an unspecified status ("time in gap") and, to control for non-linear effects, the squared versions of these variables. As far as possible, these variables were built on a monthly basis[5]. Only in cases where no monthly information was available, yearly information was used. As is shown in Table 1, early and late mothers also differ with regard to these variables. Thus, early and late mothers are not only in different stages of their careers, but also seem to follow different career paths. Accordingly, independent from the measuring instrument used, late mothers accumulated more full-time, less part-time, as well as less household experiences than early mothers.

*Current employment situation:* To control the current employment situation of the observed women, measures of their current labor force status as well as the length of the time at the workplace are included in the statistical models. As presented in Table 1, late mothers work more often full-time and at the same time less often part-time than early mothers. Furthermore, late mothers are less often unemployed or in school/training. Finally, the length of the time at the workplace also varies systematically with regard to the first birth timing.

*Sociodemographic background:* Because the wages as well as the employment dynamics of the women observed are likely to be influenced by their sociodemographic background, controls of these factors are also added in the analyses. These comprise the current age of the women, the squared version of this variable as well as their current marital status.

*Methodological approach*

Facing the methodological issues of unobserved heterogeneity and endogeneity which are connected to the events of interest, the estimation of the effects of the first birth timing on women's wages based on survey data places high demands on the analytical methods selected.

Based on the existing literature, three different methodological approaches can be differentiated to analyze the wage effects of the first birth timing. While, for instance, Herr (2012) uses simple OLS regressions to analyze these effects, Taniguchi (1999) uses fixed-effects panel analyses to measure the causal effects of the first birth timing. At last, Miller (2011), like for instance Herr (2007), uses instrumental variables to analyze the wage effects of the first birth timing.

Due to the fact that a simple OLS approach fails because of the complexity of the mechanisms underlying the relationship of interest and the quality of instrumental variables is not testable in principle[6], in line with Taniguchi (1999), the following analyses are based on fixed-effects panel models. Estimating the wage effects of the first birth timing using fixed-effects models thereby enables measuring these effects without the influence of unobserved heterogeneity. Finally, to take the endogeneity of the underlying processes into account, different model specifications are used and several robustness checks are conducted.

5 To assure that no individual accumulates more than 12 months of labor force experience per year, overlaps between different employment episodes were removed during the data operationalization process. This procedure was based on Boll's approach (2011: 43ff.).

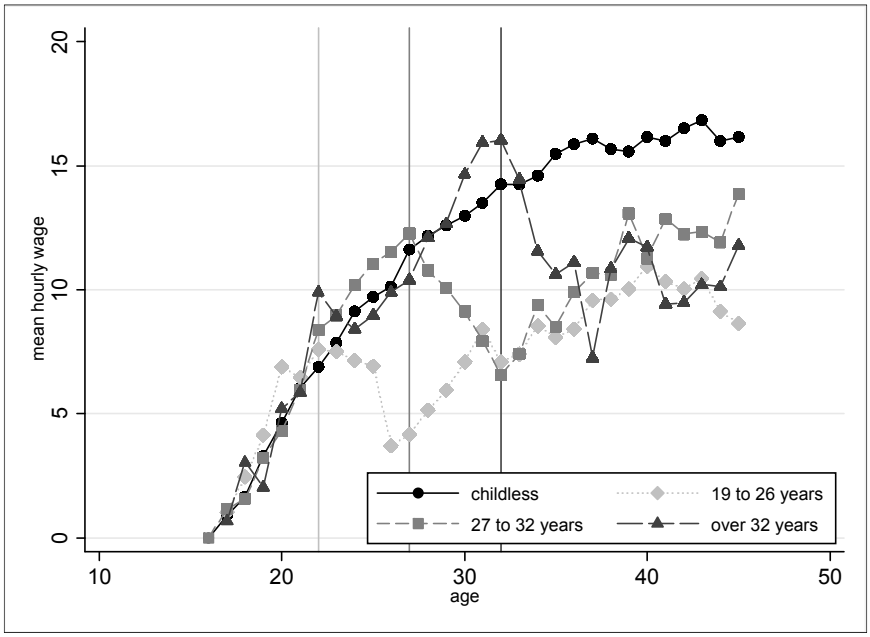
6 A detailed discussion on the use of instrumental variables for this topic is given by Ellwood et al. (2004: 14ff.).

# 5. Results

## 5.1 Descriptive analysis

As the mean values presented in Table 1 indicate, even on the basis of descriptive analyses, wage differences between late and early mothers can be observed, with late motherhood leading to wage benefits. Furthermore, Table 1 also indicates that late mothers even earn higher wages than their childless counterparts. Thus, in line with the majority of existing studies, Table 1 provides evidence for positive wage effects of a delayed first birth. However, given that early and late mothers are in different stages of their careers (see Table 1), these results have to be treated cautiously as the differences between the observed timing groups cannot be compared directly. To control for the different career stages of early and late mothers multivariate analyses are needed.

*Figure 2*: Development of the mean hourly wage by the biological age at first birth




*Note*: Results not weighted.
*Source*: SOEP waves 1984-2010, own calculations.

Based on the biological age at first birth, Figure 2 shows the age-specific wage curves of early and late mothers, presenting clear patterns: before the first birth, even when comparing mothers to childless women, the presented wage curves of the different timing groups are very similar indicating that none of these groups pre-selects itself into more mother-friendly but worse paid jobs. However, after the first birth the wage curves of each of the timing groups begin to fall sharply and start to differ from the wage curve of childless

women, probably caused by the child-related work interruptions connected to motherhood. Furthermore, it has to be pointed out that the wage curves of each of the timing groups seem to converge on the long run. Lastly, Figure 2 indicates that the time span needed to regain the wage earned previous to the first birth differs between the observed timing groups. While mothers of the earliest timing group need about 6 years to recover from their child-related work interruption, mothers of the medium age group need about 12 years. The wages of mothers of the oldest age group never seem to recover from first birth.

## 5.2 Fixed-effects results

The following results of the fixed-effects models are exclusively based on women, who bore their first child during the observation period[7]. Table 2 presents the wage effects of the first birth timing using the biological age. Table 3, on the other hand, shows the results based on the relative age at first birth.

As is shown in Table 2, the results based on the biological age at first birth provide a uniform appearance: independent of the operationalization of the underlying variable used to measure the timing of the first birth, especially late mothers seem to experience a "motherhood wage gap". Thus, only late mothers earn lower wages after their first birth. Depending on the operationalization of the used measuring instrument, these negative wage effects can either be observed for mothers at the age of over 29, 32 or, though only marginally significant, 27 years at the time of their first birth. Furthermore model 2 indicates that the negative wage effects related to the first birth increase as the birth is delayed to older ages. *Because these findings indicate different wage effects of the first birth depending on the age at this life event, the first research hypothesis can be confirmed ($H_1$).*

In contrast to these findings, the results based on the relative age at first birth provide no evidence for significant wage effects of the first birth timing (see Table 3). *Thus, as the results of the first birth timing vary depending on which definition is used, the second hypothesis is also verified ($H_2$)*. However, against the theoretical considerations of the second hypothesis, the findings emphasize the importance of the biological age at first birth rather than the importance of the relative age at first birth.

Looking at the models separately estimated for women with different educational backgrounds (see Tables 2 and 3), the results based on the biological age at first birth indicate that the negative wage effects of late motherhood can especially be observed for women with an intermediate level of education. However, in contrast to the theoretical considerations and to the existing findings, the estimated models do not show significant effects of the first birth timing on the wages of highly educated women[8]. The estimations

7 As previously described and in accordance with the used statistical approach, the variables of the timing of the first birth are included in the form of interactions with the time varying variable "birth of the first child". Following this approach, the estimated effects can be treated in accordance to the common interpretation of interaction coefficient.

8 Because this result could be explained through the low number of highly educated women, who bear their first child previous to the age of 30, the estimations were repeated using education-specific thresholds for early and late motherhood (results available upon request). The results, however, largely remained unchanged.

based on the relative timing, on the other hand, show significant wage effects for women with both a low and an intermediate level of education. Yet, the coefficient for women with an intermediate level of education only reaches marginal significance. Additionally, even if only marginally significant as well, these models also indicate positive wage effects of an early first birth for highly educated women. *Summarizing these results, the estimations indicate different wage effects depending on the educational background of the observed women. Hence, hypothesis 3 is at least partially confirmed ($H_3$).*

*Table 2*: Fixed-effects results based on the 'biological' age at first birth (β-coefficient, t-values in parentheses)

| | **Model 1** | **Model 2** | **Model 3 (low level of education)** | **Model 4 (intermediate level of education)** | **Model 5 (high level of education)** | **Model 6 (un-married)** | **Model 7 (married)** |
|---|---|---|---|---|---|---|---|
| Birth of the first child | 0.033<br>[0.9587] | 0.0552<br>[1.2024] | -0.0342<br>[-0.5036] | 0.0279<br>[0.7239] | 0.1298<br>[1.3431] | 0.0309<br>[0.5610] | 0.0348<br>[0.7610] |
| Birth * Birth ≤ 29 years | – | – | – | – | – | – | – |
| Birth * Birth > 29 years | -0.1099***<br>[-2.9445] | – | -0.0874<br>[-1.3972] | -0.0900**<br>[-2.1455] | -0.0341<br>[-0.3550] | -0.0192<br>[-0.3403] | -0.1558***<br>[-3.5626] |
| Birth * Birth 19-26 years | – | – | – | – | – | – | – |
| Birth * Birth 27-32 years | – | -0.0724*<br>[-1.7582] | – | – | – | – | – |
| Birth * Birth > 32 years | – | -0.1851***<br>[-2.9773] | – | – | – | – | – |
| *Number of observations* | 5.662 | 5.662 | 1.121 | 3.692 | 849 | 1.621 | 4.041 |
| *Number of groups* | 383 | 383 | 73 | 240 | 70 | 113 | 270 |

*Note*: Results weighted; the dependent variable is the log hourly wage, not presented are the coefficients of the period dummies, the birth biography, the employment biography, the current employment situation, and the sociodemographic background; significance level: * p<0.1, ** p<0.05, *** p<0.01 (based on Huber-White-Sandwich estimations);

*Source*: SOEP waves 1984-2010, own calculations.

In line with the theoretical considerations, the estimated models based on the biological age furthermore provide evidence for the assumption that the wage effects of the first birth timing vary systematically with the length of the work interruption around the first childbirth (see Table 4 in the appendix). Following this, the length of the work interruption around first birth seems to be especially important for late mothers, whereby each additional year significantly leads to lower wages. *Consequently, the fourth hypothesis is confirmed by the estimated models ($H_4$).*

Besides these findings, some of the existing studies have shown that the effects of the first birth on women's wages vary depending on the time elapsed since first birth (Chandler et al. 1994; Ellwood et al. 2004). Independent of the definition of the first birth timing, this finding is confirmed by the estimated models. Following this, in Table 4 (see appendix) it can be seen that each year which further elapses since first birth has positive effects on the wages of early mothers. However, for late mothers no such "wage recovery" can

be identified. *According to these results, the fifth hypothesis of the present study is also supported by the empirical findings ($H_5$).*

Lastly, to verify the hypothesis of different wage effects of the first birth timing depending on the marital status at first birth, the models were separately conducted for married and unmarried women (see Tables 2 and 3). Following this approach, the results based on the biological age at first birth indicate that the previously observed negative wage effects connected to late motherhood are limited to women who were married at the birth of their first child. Contrary to these results, the estimations based on the relative definition of the first birth timing do not show any significant effects. *In accordance with these findings the sixth hypothesis of the present study can also be confirmed, at least when using the age at first birth as definition of the first birth timing ($H_6$).*

*Table 3*: Fixed-effects results based on the 'relative' age at first birth (β-coefficient, t-values in parentheses)

| | Model 1 | Model 2 | Model 3 (low level of education) | Model 4 (intermediate level of education) | Model 5 (high level of education) | Model 6 (unmarried) | Model 7 (married) |
|---|---|---|---|---|---|---|---|
| Birth of the first child | 0.006 [0.1690] | -0.0115 [0.2525] | 0.0024 [0.0335] | 0.0208 [0.5517] | 0.1010* [1.9377] | 0.0426 [0.7606] | -0.0246 [-0.5494] |
| Birth * Birth ≤ 8 years | – | – | – | – | – | – | – |
| Birth * Birth > 8 years | -0.0562 [-1.2376] | – | -0.1412** [-2.2924] | -0.0845* [-1.8534] | 0.0003 [0.0046] | -0.0858 [-1.3250] | -0.0429 [-0.8187] |
| Birth * Birth 0-5 years | – | – | – | – | – | – | – |
| Birth * Birth 6-11 years | – | -0.001 [0.0228] | – | – | – | – | – |
| Birth * Birth > 11 years | – | 0.0157 [0.2730] | – | – | – | – | – |
| *Number of observations* | 5.662 | 5.662 | 1.121 | 3.692 | 849 | 1.621 | 4.041 |
| *Number of groups* | 383 | 383 | 73 | 240 | 70 | 113 | 270 |

*Note*: Results weighted; the dependent variable is the log hourly wage, not presented are the coefficients of the period dummies, the birth biography, the employment biography, the current employment situation, and the sociodemographic background; significance level: * p<0.1, ** p<0.05, *** p<0.01 (based on Huber-White-Sandwich estimations);

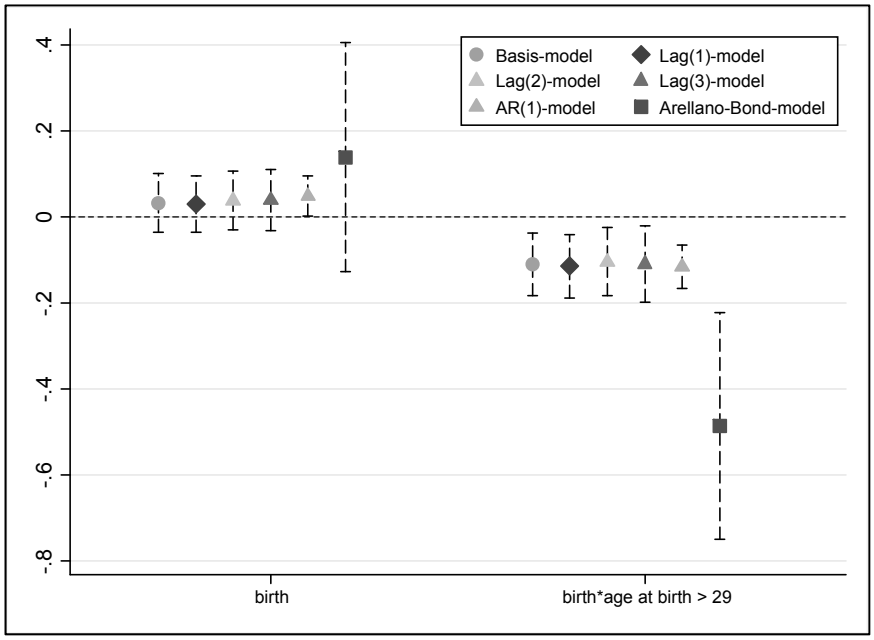
*Source*: SOEP waves 1984-2010, own calculations.

Summarizing the above, the results of the fixed-effects models indicate that the often stated finding of a "motherhood wage gap" can be especially observed for mothers who bear their first child relatively late in life. Furthermore, the results also provide evidence that the negative wage effects of such a late first birth can specifically be observed for women with low and intermediate levels of education as well as for mothers who were married when they gave birth to their first child. The estimated models also indicate that the wage effects connected to late first births vary with the length of the work interruption around childbirth. Additionally, the findings show that at least the wages of early mothers increase as the time since the first birth elapses. Lastly, the estimations demonstrate that the observed wage effects of the first birth timing vary according to the underlying definition of this variable.

*Sensitivity analysis*

To evaluate the robustness of the presented results, the estimations were repeated based on both, different model specifications and different sample compositions[9] (Myrskylä/ Margolis 2012).

*Figure 3*: Results of the sensitivity analyses based on the age at first birth (binary) – point-estimations and 95%-confidence intervals




*Note*: Results of the basis-models, lag(1)-models, lag(2)-models, lag(3)-models and AR(1)-model weighted; estimations of the basis-models, lag(1)-models, lag(2)-models, lag(3)-models and Arellano-Bond-models based on Huber-White-Sandwich estimations.

*Source*: SOEP waves 1984-2010, own calculations.

First of all, to account for the possibility of correlated error terms, which can lead to inefficient estimations, the models were repeated allowing for autocorrelation (AR(1)). As it is exemplarily shown in Figure 3, when using this model specification, the estimated results remain largely unchanged.

Since the relationship between the timing of the first birth and women's wages can also be influenced by the effect of the wages on the timing of the first birth, dynamic panel models were estimated in a next step. The results presented in Figure 3 exemplify that even after controlling for lagged versions of the dependent variable (up to 3 years), the effects of the timing of the first birth on women's wages largely remain unaffected.

In a last step, the presented models were repeated using the Arellano-Bond procedure that not only uses lagged versions of the dependent variable for the estimations, but also

9 Results of the sensitivity analyses available upon request.

includes lagged versions of the independent variables as instruments (Arellano/Bond 1991). Even though the estimated coefficients change when this model specification is used, the estimated results still show significant negative wage effects caused by a late first birth (see Figure 3).

Lastly, in addition to these tests, some of the sample limitations were gradually removed to evaluate how the presented results depend on the underlying sample composition. In a first step, the sample was no longer limited to women aged between 17 and 45 years; results remained relatively stable. To increase the number of observations, in a second step, the estimations were conducted again, this time including self-employed women and outliers. However, even after these changes of the sample composition the basic results remained relatively stable.

Summarizing the above, the sensitivity analyses provide evidence for a relatively high consistency of the presented findings. Especially the main effects of the first birth timing remained stable, both after the conducted robustness checks and after the changes of the sample composition.

## 6. Discussion

The goal of the present study was to investigate, whether the timing of the first birth has causal effects on the wages of West German women. Given the estimated results based on the data from the German Socio-Economic Panel this can be confirmed. However, in contrast to the majority of the existing findings, the results of the fixed-effects panel estimations indicate negative wage effects of delayed childbearing. Depending on the operationalization of the underlying measuring instrument, these negative effects can either be observed for women aged above 27, 29 or 32 years at the time of their first birth. Thus, present results are consistent with the findings of Karimi (2014) and Schulze (2009), who also conclude negative wage effects caused by late first births. The differences in the results between the present study and the majority of the existing analyses are probably due to differences in the empirical approaches used to measure the effects of the first birth timing. According to that, the presented results do not imply early mothers to earn higher wages than late mothers. In fact, the presented estimations rather indicate that late mothers earn lower wages after their first birth, an effect that cannot be observed for early mothers. Thus, as the empirical approach, used to assess the influence of the first birth timing on women's wages can have a large influence on the results obtained, the differences between the present study and the existing literature can not necessarily be explained by different effects of the first birth timing. However, altogether, the presented findings rather indicate a "late motherhood wage gap" than a general "motherhood wage gap".

A possible explanation for this "late motherhood wage gap" might be the assumption that late mothers are more willing to "sacrifice" their careers for their first child. Accordingly, given the fact that later mothers have lower chances for a pregnancy and a shorter time period remaining to become a mother, the desire for a child may be greater among late mothers, resulting in such a higher willingness to "sacrifice" the own career for a planned child. Early mothers, on the other hand, might think they could miss a potentially promising career. Based on the new home economics, a further explanation for this "late

motherhood wage gap" may be the fact that late mothers already achieved a solid financial situation and a well-established position in life, so that productivity losses are more "affordable" to them. Early mothers, on the other hand, may have to invest more of their time and energy in their careers in order to provide the best possible conditions for their child. Moreover, it is also possible that late first births have negative wage effects, because these births take place in a stage of life, where many crucial transitions are made, a stage Bertram et al. (2011: 96) call the "rush hour of life". However, a more methodological explanation of the "late motherhood wage gap" is possible as well. As Figure 2 has already shown, in comparison to late mothers, early mothers need a shorter time span to regain the wages they earned previous to the birth of their first child. Thus, in line with the underlying fixed-effects approach, the presented findings may also be interpreted as an effect caused by the different wage levels early and late mothers have achieved before the birth of their first child. Lastly, following Karimi's (2014) argumentation, the effects may also be caused by a different birth spacing of early and late mothers. However, since the direction of the main results remained stable, even after the analyses were repeated based on a subsample of women who exclusively gave birth to their first child during the observation period, birth spacing seems to be no sufficient explanation for the observed effects[10].

Furthermore, the estimated results have shown that the observed effects of the timing of the first birth on the wages of women depend on the underlying definition used to measure the timing of the first birth. Thereby especially the age at first birth lead to significant effects. On the contrary, when using the 'relative' age at first birth no significant effects emerged in the basic models. In accordance with these results, both of these instruments seem to measure slightly different kind of effects: while the relative birth timing presumably measures a woman's stage in her wage curve and therefore mechanisms which are controlled for by the independent variables, the biological age seems to additionally measure further wage-relevant aspects, like, for example, the effects produced by statistical discrimination.

In addition, the presented results have also shown that the negative wage effects caused by late motherhood are limited to women with a low and intermediate level of education (Fitzenberger et al. 2013: 58). In contrast to these findings, though only marginally significant in one model, highly educated women seem to experience a "wage boost" when becoming a mother in earlier life stages. Maybe for highly educated women an early motherhood leads to an employment interruption in a relative favorable career stage. However, even the absence of any significant effect of the first birth timing on the wages of highly educated women is an interesting result: this finding might reflect the different conditions for flexible work arrangements between less and highly educated women, that may help to balance work and family life and thereby reduce the negative effects on women's wage (Anderson et al. 2003: 273). However, more detailed analyses were not feasible due to the low number of observations.

According to the theoretical considerations summarized in the fourth hypothesis, the estimations have also shown that the effects of the timing of first birth vary systematically with the length of the career interruption experienced around this life event. Following this,

10 Results available upon request. Further analyses were not feasible due to the low number of observations.

the presented results indicate that the length of the child-related work interruption gains importance as the birth occurs later in life, maybe because by then there is more human capital accumulated that can be depreciated during such a career break (Beblo/Wolf 2002).

As it was assumed by the fifth hypothesis and in line with, for instance, the findings of Fitzenberger et al. (2013), the estimated models have also shown that the wages of early mothers increase as the time since the first birth passes. However, for late mothers no significant effects could be observed. These findings can probably also be attributed to the different wage levels early and late mothers have achieved previous to the birth of their first child. Nevertheless, it is also possible that late mothers already have reached a stage in their career in which their wage growth begins to stall.

Finally, and in line with the theoretical considerations of the sixth hypothesis, the results based on the biological age at first birth have shown that the negative wage effects caused by late motherhood are especially limited to women who were married at the time of their first birth. A possible explanation for this may be the assumption that women who bear their first child while being married are more likely to be able to rely on their spouse as breadwinners and thus experience negative effects on their wages, even when controlling for their current labor market situation as well as for their employment biography (Budig/England 2001: 218). The finding that these results are limited to late mothers can maybe be explained by the differences in importance of the own career for early and late mothers: early married mothers may have to concentrate more on their careers than their late counterparts, since it is more likely that their partners may not earn enough money "to make ends meet". The own career may therefore be of higher priority for early mothers, which results in the observed effects.

The finding that the negative effects of the timing of the first birth on women's wages can exclusively be observed for married women, can also help to gain a better understanding of the mechanisms underlying the observed wage effects (Budig/England 2001: 218). Following this, these effects cannot be explained by differences in the human capital of the observed women or by differences in the actual labor force status of these women, since these factors were controlled for in the estimated models. The observed effects can also not be explained with the help of the signal theory, as on the basis of this theoretical concept an early unmarried birth should be a more negative signal to employers than a late married birth. However, a possible explanation for the presented findings is the assumption of a different productivity of married and unmarried mothers. Following that, contrary to married mothers, unmarried mothers can independently of the timing of the birth not "afford" productivity losses caused by this life event, because they have higher needs for their careers. In contrast, late married mothers may have ideal conditions for productivity losses, like for example a spouse who earns good money or a relatively good financial situation.

## 7. Summary

The negative effect of motherhood on women's wages, the so-called "motherhood wage gap", is a well-established finding in existing literature. However, evidence based on German data as well as on the effects of birth timing is scarce. Therefore, this investigation focused on the effects of the first birth timing on the wages of West German women.

The estimated fixed-effects models have shown that the wage effects caused by a first birth vary systematically with the timing of this life event, even after controlling for detailed measures of the human capital as well as of the employment biography of the observed women. According to the well-established "motherhood wage gap", these empirical findings provide evidence for a "late motherhood wage gap".

Although these results were robust to several model specifications, there also are some limitations. First of all, further analyses of the underlying mechanisms were partially not possible due to the low number of observations. Especially the estimations separately conducted for women of different educational backgrounds suffered from this. Furthermore, though the presented models controlled for detailed measures of the individual career of the observed women, characteristics of the current employer as well as of the current partner were not included in detail. However, based on theoretical assumptions and the presented results, this seems reasonable for a better understanding of the underlying mechanisms. Besides these limitations, the findings of the present study also point to further research questions for future analyses.

First of all, the estimated results are limited to West Germany. Therefore, the extent to which these results can be applied to other samples of women, like for instance East German women, remains unclear. Furthermore, as already stressed by Taniguchi (1999: 1018), the effects of the timing of the first birth on men's wages also remain unknown. Although there are some studies analyzing the effect of a birth on men's wages (Pollmann-Schult/Diewald 2007), empirical evidence on the effects of the timing of the first birth on men's wages is rare (Kind/Kleibrink 2012). Second, given the differences between the findings of the present study and the findings of the existing literature, the question arises, whether these discrepancies are the result of different effects of the first birth timing or whether they can rather be attributed to the different data basis or to the different empirical approaches used. To answer this question and to gain a better understanding of the underlying mechanisms, international comparative analyses of the effects of the first birth timing are needed. Such analyses can especially help gain a better understanding of the influence of the institutional and cultural framework on the observed effects of the first birth timing. Third, the timing of the first birth is only one aspect of the birth biography. Thus, for example, the life course theory not only stresses the importance of the timing of life events, but also the importance of their spacing and sequencing (Elder 1994: 6, 2003: 9ff.). Because of these complex influence possibilities, future studies should not only focus on the effects of the timing of the first birth on wages, but should also consider further aspects of this important life event. Fourth, given the fact that despite the changes in family life most of the births in West Germany still take place within marriages or partnerships (Statistisches Bundesamt 2013b: 39), it seems especially interesting to not only focus on the effects of the first birth timing on the wages of women or men, but to additionally focus on the financial consequences of the first birth timing for the household as a whole (Schulze 2009). Based on the assumption of an efficient specialization of the household members (Becker 1985, 1991), it might be that the effects of the first birth timing on wages are reduced or even neutralized when looking at the household as a unit, at least for some partnership constellations.

Although there are still some open questions and some limitations the present study provided interesting insights into the relationship between the timing of the first birth and

women's wages. Thus, based on the underlying sample, the often concluded finding of a "motherhood wage gap" seems to be limited to mothers who bear their first child relatively late in life. Hence, our results rather indicate a "late motherhood wage gap". It must be stressed, however, that even though the conducted analyses consistently showed that a late first birth leads to negative effects on the wages of women, these results do not indicate that later mothers have lower wages than early mothers. Based on the statistical approach used for the analyses, these results rather indicate that late mothers have lower wages after the birth of their first child, an effect that cannot be observed for early mothers. Although this may limit the comparability to the results of other studies, the presented findings provide clear evidence for the assumption that early and late mothers experience different wage effects caused by their first birth. This is an important finding, because it shows that, to fully understand the economic consequences connected to motherhood, it is not sufficient to rely on motherhood as a binary category or as a simple transition, but to consider additional aspects of this important area of life. Although the estimated effects differ dependent on the underlying definition of the first birth timing, the timing of the first birth, measured as a woman's age at birth or her career position at first birth, thereby seems to be such an important aspect. However, further research on this important topic is needed especially in view of its political relevance, for as Petersen et al. (2010: 1286) state: "Nothing can be done about the natural law that women give birth, but its social and economic consequences are obviously amenable to modification (…) ".

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# Appendix

*Table 4:* Fixed-effects results based on the relative and biological age at first birth (β-coefficient, t-values in parentheses)

| | Biological age | | | Relative age | |
|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | | **Model 1** | **Model 2** |
| Time lag since first birth | 0.0209** [2.4172] | – | Time lag since first birth | 0.0202** [2.2497] | – |
| Length of the work interruption around the first birth | – | 0.0097 [1.5371] | Length of the work interruption arround the first birth | – | -0.0053 [-0.6970] |
| Time lag * Birth ≤ 29 years | – | – | Time lag * Birth ≤ 8 years | – | – |
| Time lag * Birth > 29 years | 0.0035 [0.6568] | – | Time lag * Birth > 8 years | 0.0024 [0.4557] | – |
| Length of work interruption * Birth ≤ 29 years | – | – | Length of work interruption * Birth ≤ 8 years | – | – |
| Length of work interruption * Birth > 29 years | – | -0.0240*** [-3.1464] | Length of work interruption * Birth > 8 years | – | 0.0002 [0.0250] |
| *Number of observations* | 5.662 | 5.662 | | 5.662 | 5.662 |
| *Number of groups* | 383 | 383 | | 383 | 383 |

*Note*: Results weighted; dependent variable is the log hourly wage, coefficients of the period dummies, the birth biography, the employment biography, the current employment situation, and the sociodemographic background not presented; significance level: * p<0.1, ** p<0.05, *** p<0.01 (based on Huber-White-Sandwich estimations).

*Source*: SOEP waves 1984-2010, own calculations.

*Henriette Engelhardt & Jessica Schreyer*

# Timing of first birth and well-being in later life

## Der Zeitpunkt der ersten Geburt und das Wohlbefinden im späteren Leben

**Abstract**:
A large body of literature has documented a negative association between early childbearing and well-being in later life. The effects of late parenthood are mixed, due to different social and physiological mechanisms as well as selection processes for the timing of first birth. This article extends the literature by employing propensity score matching to estimate effects of birth timing on life satisfaction net of observed selectivity. A sensitivity analysis using Rosenbaum bounds provides hints on remaining unobserved selectivity. The analysis of data from the German Socio-Economic Panel shows that the timing of first birth has no effect on well-being in later life both for women and men. In the case of the naïve estimator, the negative effects of early births and positive effects of late births for women are caused by selection processes.

***Key words***: parenthood, age at first birth, life satisfaction, well-being, propensity score matching

**Zusammenfassung**:
In der Forschungsliteratur wird häufig ein negativer Zusammenhang zwischen einem frühen Zeitpunkt der ersten Geburt und dem Wohlbefinden im späteren Leben beobachtet. Die Effekte der späten Elternschaft werden durch eine Mischung aus unterschiedlichen sozialen und physiologischen Mechanismen sowie durch Selektionsprozesse für den Zeitpunkt der ersten Geburt bewirkt. Dieser Artikel erweitert bisherige Befunde durch Anwendung des Propensity Score Matching zur Schätzung der Effekte des Timings der ersten Elternschaft auf die Lebenszufriedenheit unter der Kontrolle beobachteter Selektivität. Durch eine Sensitivitätsanalyse mittels Rosenbaum Bounds werden Hinweise auf verbleibende unbeobachtete Selektivität gegeben. Die Analyse auf Basis der Daten des Sozio-oekonomischen Panels (GSOEP) zeigt, dass der Zeitpunkt der ersten Geburt keinen Einfluss auf das spätere Wohlbefinden von Frauen und Männer hat. Im Falle des naiven Schätzers sind die negativen Effekte früher Geburten und die positiven Effekte später Geburten für Frauen auf Selektionsprozesse zurückzuführen.

***Schlagwörter***: Elternschaft, Timing der ersten Geburt, Lebenszufriedenheit, Wohlbefinden, Propensity Score Matching

## Introduction

Beyond doubt, parenthood carries birth costs and benefits that change life in many ways. Children may be a source of joy, strengthen social ties within the family and create new social roles for adults. On the other hand, becoming a parent increases and often changes the division of labor in the household frequently decreases the quality of the parental partnership and may strain the parent's well-being (Nomaguchi/Milkie 2003; Margolis/Myrskylä 2011).

Thus, empirical evidence on the relation between fertility and well-being is mixed. Most papers find a negative association between children and well-being among individuals in childbearing years (Cleary/Mechanic 1983; Gore/Mangione 1983; Lovell-Troy 1983; McLanahan/Adams 1987). While, compared to young couples without children, young parents seem to be particularly unhappy around birth (Cleary/Mechanic 1983; Lovell-Troy 1983; McLanahan/Adams 1987), there is no difference in well-being between older parents and non-parents (Koropeckyi-Cox et al. 2007; Rempel 1985; Ross/Huber 1985).

However, the fertility and well-being nexus may change over the life cycle (Umberson et al. 2010; Margolis/Myrskylä 2011). Among the elderly, no relationship is found between parenthood and life satisfaction (Connidis/McMullin 1993; Koropeckyi-Cox et al. 2007; Rempel 1985; Ross/Huber 1985). Studying parental happiness trajectories, Myrskylä & Margolis (2012) show that well-being increases before birth, which has also been highlighted by Angeles (2010), Clark/Gerogellis (2013), Clark et al. (2008) and Frijters et al. (2011).

Less is known about the impact of the timing of birth on well-being in later life. For the child-rearing years, research suggests "that women who postpone childbearing are more 'ready' and less stressed by having children" (Myrskylä/Margolis 2012: 6), possibly because older mothers have more social capital and higher status at work allowing greater financial flexibility and options for childcare, all easing the transition to parenthood. From a life-course perspective, the question arises whether this effect persists in mid- and later life. In this paper, we aim to contribute to this question by studying the effect of the timing of first birth on subjective life satisfaction from age 50 onwards, using data from the German Socio-Economic Panel (SOEP). We use propensity score matching methods and Rosenbaum bounds which partially allow for controlling of unobserved heterogeneity and selection into parenthood.

## Background

Social scientists have increasingly drawn their attention to well-being measured by subjective indicators such as happiness, life satisfaction or subjective health. Most researchers now agree that it is crucial to take a life-course perspective when examining people's subjective well-being, and that subjective well-being often changes after an important life event such as the birth of a child (Plagnol 2010; Umberson et al. 2010). Early life-course experiences may have long-term implications for well-being throughout middle and later life (Ha et al. 2008).

From a life-course perspective, age at first birth is regarded as an important factor in the processes of cumulative advantage and disadvantage (Elder et al. 2004; Kuh/Ben-Schlomo 2004). An early transition to parenthood has been associated with truncated educational and occupational opportunities, economic hardship, and increased marital instability (Umberson et al. 2010). These factors may have enduring impact on well-being in the short and long run (Booth et al. 2008).

Research on the long-term consequences of childbearing on psychological well-being is rare and may benefit from studies on physical well-being which have largely focused on the effects of age at first birth and parity (Grundy/Kravdal 2008; Mirwosky 2005). The emerging health patterns suggest that early childbearing and high parity are disadvantageous for self-rated health in the long run. Early childbearing is, for example, associated with higher rates of mortality (Doblhammer 2000; Mirowsky 2005; Grundy 2009; Grundy/Kravdal 2008; Hank 2010), and an overall negative association between higher parity and mortality (Doblhammer/Oeppen 2003; Grundy 2009; Grundy/Kravdal 2008, 2010; Grundy/Tomassini 2005; Smith et al. 2002; Kington et al. 1997). Moreover, childbearing characteristics may have effects on other dimensions of physical as well as mental health at older ages (Waldron 1998; Henretta et al. 2008; Spence 2008; Read/Grundy 2011; Read et al. 2011; Taylor 2009).

The mechanisms linking fertility to self-rated health in later life are potentially numerous. Fertility may relate to later life well-being through distinct physiological and social processes (Spence 2008). For instance, early childbearing and high parity may impede educational attainment and occupational careers (McElroy 1996; Ermisch 2003), while late childbearing may trigger physical health problems (Cooper et al. 1999; Alonzo 2002; Myrskylä/Margolis 2012). Due to social support and care, the timing of births and number of children may also be related to well-being in later life (Smith et al. 2002). Additionally, spatial proximity of parents to their children is important for receiving support and care (Yi/Vaupel 2004).

Moreover, well-being seems to differ between fathers and mothers (Read/Grundy 2011). Usually, it is assumed that becoming a parent has a stronger effect for women than it has for men since, compared to fathers, mothers are more involved in housework and experience more stress in reconciling work and family life (Nomaguchi/Milkie 2003). However, several studies show a stronger increase in female well-being after birth compared to men (Clark et al. 2008; Kohler et al. 2005; Myrskylä/Margolis 2012).

## Selection mechanisms

Next to these potential mechanisms, the correlation between childbearing and well-being in later life may be a statistical artifact: Uncontrolled earlier life conditions may influence both fertility and well-being (Rich-Edwards 2002). For instance, socially deprived women may have a lower age at first birth and are also more prone to report lower well-being. "Some of the same social factors that may select young people into parenthood and/or result in large family size – such as low SES in childhood/adolescence and alternative […] family structures – are shown to have an effect on health, psychological morbidity, and mortality later in the life course" (cf. Spence 2008: 3). Most studies have not taken into

consideration the role of life conditions before first birth; only a few studies account for selection mechanisms driving the relationship between parenthood and well-being (Grundy/Tomassini 2005, 2008, 2010).

## Early parenthood

Existing studies on the relation between early childbearing and later health outcomes suggest that early parenthood is negatively correlated with physical health in later life (Waldron 1998; Grundy/Holt 2000; Mirowsky 2002). Early childbearing has also been associated with higher rates of depression and worse mental health (Koropeckyj-Cox et al. 2007; Mirowsky/Ross 2002; Kalil/Kunz 2002; Henretta 2007).

Early childbearing has typically negative consequences for the mother's life course. A young age at first birth may lead to low educational attainment (McElroy 1996) and ensuing socioeconomic disadvantage (Hobcraft/Kiernan 2001). Lower educational attainment, sustained unemployment, higher parity and a lower standard of living may partly explain the association between early childbearing and physical health (Mirowsky 2002). However, the association seems to abide under control of key social and economic indicators (Grundy/Holt 2000). Higher levels in later life depression may be partly due to earlier marriages, lower educational attainment, higher risk of economic hardship, and worse physical health for young parents (Koropeckyj-Cox et al. 2003; Mirowsky/Ross 2002). Regarding selection effects, young women from disadvantaged families are at a greater risk for teenage childbearing (cf. Spence 2008: 4).

## Late parenthood

Empirical evidence regarding the relationship between late childbearing and well-being in later life is mixed (cf. Spence 2008: 4). Mirowsky (2002) calculates an optimal age at first birth for women at around 30 and a statistically significant downturn in expected health with delay of the first birth beyond that age. The health impact of age at first birth remained significant for women after adjustment for education, parity, unemployment history, and economic hardship. Yi/Vaupel (2004) demonstrate that oldest-old Chinese women with births after age 35 are less likely to have limitations in activities of daily living, being cognitively impaired and showing symptoms of depression, after adjustment for demographic characteristics, family support, social connection and health practice. Mirowsky and Ross (2002) showed that the lower depression rates among late mothers and fathers are attributable to later marriage, higher levels of socioeconomic resources, and better physical health of men and women who delay parenthood.

Mirroring the mixed empirical evidence, the mechanisms at work in the late childbearing and health nexus are ambiguous. "On one hand, postponed childbearing may allow a woman to attain her desired level of education, marry and establish a stable relationship and home environment, and improve financial security. Moreover, mothers (particularly late childbearers among whom offspring are relatively young and able to provide assistance) may be more likely to receive care in old age from their children (Yi/Vaupel

2004). However, having children late (ages 35 and older), particularly first births, is associated with negative health during the time of pregnancy, such as pre-eclampsia, pregnancy-induced hypertension, and gestational diabetes" (cf. Spence 2008: 5), which may result in long-term health problems. Regarding selection processes, Smith et al. (2002) and Yi and Vaupel (2004) stressed that more robust women may age more slowly and are therefore able to have children later in life.

This paper underscores both selection processes for the timing of first birth, as well as the importance of social and physiological mechanisms linking age at first birth and well-being. Potential confounding and mediating factors are socioeconomic status, family characteristics, and other individual attributes that may influence both the timing of the transition to parenthood and the well-being in later life. In the present study, we do not aim to contribute to the discussion of the underlying mechanisms of early and late parenthood on well-being. Instead, our focus is on the verification of a causal effect of the timing of childbirth on well-being, and the measurement of the relevance of underlying selection processes as suggested by Williams et al. (2011). In the spirit of experimental research as the gold standard for estimating causal effects, this study applies a counterfactual analysis with observational data using a propensity score matching approach (Morgan/Winship 2007).

## Data, methods and variables

The present study uses data from the German Socio-Economic Panel (SOEP). The SOEP is an annually collected longitudinal survey that covers a broad range of topics including household composition, employment, occupation, earnings, health, and satisfaction indicators. It was first conducted in 1984 for West Germany, with the new federal states of Germany added in 1991 after reunification. The data we use for our analyses were collected in 2011.

We take a gendered perspective in our analyses. The analytical sample consists of 3,806 women and 2,817 men aged 50-79 years in 2011, for whom valid data on evaluation of life satisfaction (1,065 missing values) and age at first parenthood (10 missing values) are available. Furthermore, we exclude respondents who are without German citizenship or childless.

### Propensity score matching and Rosenbaum bounds

Based on Rubin's counterfactual account to causality with observational data, this study applies a propensity score matching approach (Morgan/Winship 2007). The idea is to find for each early/late parent (case) a matching observation from the group of 'proper' timers (control) with the same (or at least very similar) X values and to achieve balance on all pre-treatment assignment variables among matched cases and controls. However, if X contains several variables there is a large probability that no exact matches could be found. Rosenbaum and Rubin (1983) proved, that instead of X the propensity score (the probability of being a case) can be used in the matching algorithm. If the propensity score

is a consistent estimator, the matched pairs are balanced on both observed and unobserved preexisting characteristics.

In the following analysis, we first estimate a logit model to calculate the predicted probabilities of early (late) parenthood compared to 'normal' timing, which are used as the propensity scores (Caliendo/Kopeinig 2008). In this model, all observed covariates are measured prior to occurrence of parenthood. Second, we matched early (late) parents to those with 'proper' timing using the propensity scores. Among the control group, the matched cases include only those who are close enough to early (late) parents in terms of the propensity scores. Among a variety of matching algorithms, we consider nearest-neighbor, kernel and radius matching.[1] Third, we examine whether early (late) parents and their matched counterparts are balanced on observed covariates. If the propensity score estimation model is well specified, there should be little difference in the observed covariates between these two groups. We test whether the matching process achieves a significant reduction in absolute bias measured by the standardized percentage mean difference in each covariate between the case group and the control group (Lee 2010). Finally, we assess differences in well-being between early (late) parents and their matched counterparts by calculating average treatment effects on the treated (ATT).

In the matching procedure it could happen that a certain portion of early (late) parents cannot be matched to the control group due to extreme values on the propensity scores. If this common support problem appears, one can only estimate the causal effects of early (late) parenthood for the matched subset of the treated group (Heckman et al. 1998). As shown below, we do not find common support for 30 cases of early (late) parents.

Another crucial assumption of propensity score matching is ignorable treatment assignment assumption: conditional on observed covariates, timing of parenthood is independent of well-being in later life (Rubin 1977). Even if propensity score matching achieves a balance between early/late parents and their matched counterparts in terms of preexisting observed characteristics, the estimate of the ATT may be sensitive to unobserved characteristics that influence both birth timing and well-being. The sensitivity analysis developed by Rosenbaum (2002) addresses the strength of such an unobserved variable to evaluate the estimated causal effects from propensity score matching. The Rosenbaum bounds method allows to quantify the 'hidden bias' problem by assessing "how strongly an unmeasured confounding variable must affect selection into treatment in order to undermine the conclusions about the causal effect from a matching analysis" (DiPrete/Gangl 2004).

1 Nearest neighbors (2) with replacement: Those respondents of the control group, whose propensity scores are closest to respondents of the treatment group (with two nearest neighbors in contrast to the default of only one comparison unit), are used for matching. Matching with replacement means that a control unit can be a best match for more than one treated unit. Epanechnikov kernel matching: All treated are matched with a weighted average of all controls with weights that are inversely proportional to the distance between the propensity scores of treated and controls each participant is matched to a weighted average of all respondents of the control group. Type Epanechnikov of kernel is default. Additional analyses with Gaussian kernel yield similar results. The bandwidth of 0.06 is default. Radius Matching (0.001): Respondents of the control group are matched to respondents of the treatment group if their propensity score is arranged in a predefined radius or caliper as neighborhood of the propensity score of the treated unit. We use 0.001 as a more rigorous caliper than default 0.005.

## Variables

*Dependent variable:* The analyses comprise the global current life satisfaction as the key outcome. Responses to the question 'How satisfied are you with your life, all things considered?' range from 0 (completely dissatisfied) to 10 (completely satisfied) and show how positively or negatively respondents evaluate their lives.

*Explanatory variables:* The main explanatory variable is the timing of the birth of the first child. By subtracting the age of the first-born child from the age of the respondents, their age at first parenthood is obtained (restricted to a minimum of 14 and a maximum of 58 years). Furthermore, three groups classify the age pattern, as we expect no linear effect but differences between those age groups. 'Early' indicates the age at which not more than roughly one quarter of the interviewed persons already had their first child, whereas 'late' indicates the last quarter in the age range of the respondents' age at first parenthood. Because of variations in age range arising across the sexes and (however smaller) the birth cohort of the respondents, the dummies early and late timing account for both variables (see Table 1). A 'normal' timing – arranged between the maximum age of the early group and minimum age of the late group – operates as the reference category.

*Table 1*: Timing of first parenthood in years (minimum to maximum age), by sex and birth cohort (number of bases in parentheses)

| | Women | | | Men | | |
|---|---|---|---|---|---|---|
| **Birth cohort** | **Early** | **Normal** | **Late** | **Early** | **Normal** | **Late** |
| **Cohort 1952-1961** | 14-21 (458) | 22-27 (663) | 28-42 (395) | 16-24 (288) | 25-30 (518) | 31-51 (358) |
| **Cohort 1942-1951** | 14-20 (431) | 22-25 (402) | 26-43 (374) | 16-24 (234) | 25-31 (460) | 32-54 (254) |
| **Cohort 1932-1941** | 15-21 (261) | 22-26 (505) | 27-48 (317) | 17-24 (190) | 25-30 (317) | 31-58 (198) |
| **N** | 1,150 | 1,570 | 1,086 | 712 | 1,295 | 810 |

*Source*: SOEP 2011, own calculations.

The comparisons between early (late) and normal timing of first parenthood show statistically significant differences in the average life satisfaction of women (via two-sample t-test with equal variances, see left part of Table 3). Early age at first motherhood is associated with lower life satisfaction, and a late timing with a higher satisfaction level. The t-test indicates differences in life satisfaction of men merely when contrasting early vs. normal timing, where a younger age at first fatherhood is associated with lower life satisfaction. It seems that timing of first parenthood and current life satisfaction are connected in some way. With this method however, it is neither possible to verify if there is a causal linkage, nor if selection effects produce the significant differences in the means.

Social background, socio-demographic and socio-economic factors and cultural norms regarding fertility decisions determine family formation and especially its timing. The following five *covariates* – which are available in the data and ideally placed at the time before or around the first birth – are statistically significant correlated with the timing of parenthood and current life satisfaction. This means that both comparison groups

originally differ in these covariates. We distinguish three different birth cohorts because the intercohort trend towards longer years of education (via educational expansion) may result in postponement of family formation and therefore higher ages at first birth. A good measure for life socio-economic status is the highest degree of education achieved (on the basis of ISCED 1997), which has normally already been obtained before the birth of the first child. In addition, marital status at the time of first parenthood is considered since marriage can be connected to familial and financial security. Besides, a religious denomination may influence the timing of the first birth as a result of religious and social conventions. Due to the fact that it reflects the status at the time of the interview, the data may underestimate the proportion of religious persons at the time of first parenthood, considering that the probability of leaving a religious denomination increases with age. Another variable accounts for respondents who lived in East Germany in 1989. This consequently enables to control for conditions of socialization as parenthood at early ages was exemplary for people in the German Democratic Republic (GDR).

## Results

The following Table 2 presents the result of logit models predicating early and late parenthood. Furthermore, it demonstrates the initial heterogeneity between early (late) parents and their counterparts. In many cases there are statistically significant effects which means, that respondents with early (late) parenthood compared to normal timing are different in that covariates. Particularly early mothers are statistically different from mothers with normal timing at the .05 level in terms of almost all preexisting observed covariates (except religious denomination).

*Table 2*: Odd ratios from logit model predicting timing of first parenthood status, by sex and birth cohort

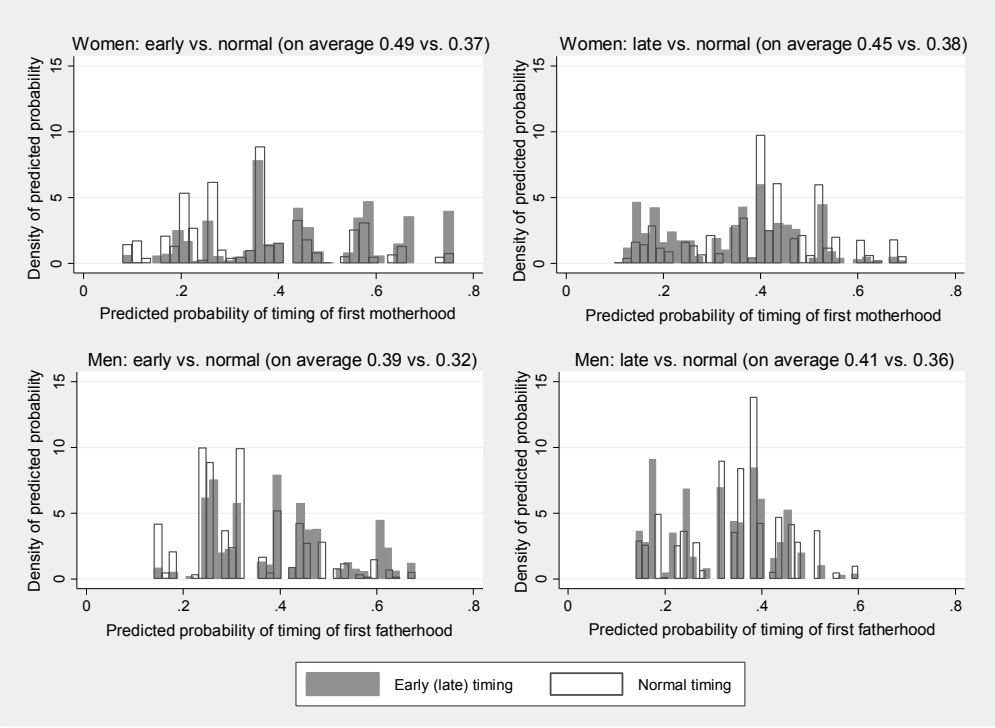
| | Women | | Men | |
|---|---|---|---|---|
| **Covariates** | **Early** | **Late** | **Early** | **Late** |
| Birth cohort | | | | |
| Cohort 1942-1951 | **1.646**$^{***}$ | **1.653**$^{***}$ | 1.076 | **0.754**$^{**}$ |
| Cohort 1932-1941 | **0.706**$^{**}$ | 1.151 | **1.422**$^{**}$ | 0.896 |
| Highest achieved degree of education | | | | |
| Not yet or merely finished school | **2.186**$^{***}$ | 0.849 | 0.971 | 1.077 |
| University degree | **0.347**$^{***}$ | **2.001**$^{***}$ | **0.504**$^{***}$ | **1.694**$^{***}$ |
| GDR | **2.223**$^{***}$ | **0.297**$^{***}$ | **1.979**$^{***}$ | **0.355**$^{***}$ |
| Religious denomination | 0.908 | 0.913 | 0.818 | 1.004 |
| Married at first parenthood | **0.438**$^{***}$ | **1.308**$^{**}$ | **0.516**$^{***}$ | **0.718**$^{**}$ |
| **N** | 2,632 | 2,579 | 1,970 | 2,066 |
| **Pseudo $R^2$** | 0.093 | 0.054 | 0.057 | 0.040 |

*Note:* Reference categories: normal timing, birth cohort 1952-1961, vocational education, lived in West Germany in 1989, no religious denomination, have never/not yet or not anymore been married at time of first parenthood. Levels of significance: $^{*}p\leq0.05$, $^{**}p\leq0.01$, $^{***}p\leq0.001$.

*Source:* GSOEP 2011, own calculations.

Within the logit estimations the predicted probabilities of receiving treatment, which are used as the propensity scores, are calculated. Clearly, there is much discrepancy between the two groups regarding the probabilities to belong to the treatment group. The propensity scores shown in Figure 1 do mismatch in many classes of the propensity score and are on average higher for respondents of the treatment group. At the same time, in each class there are a certain number of non-treated individuals as well. This, we can assume that common support is given.

*Figure 1*: Predicted probabilities of early and late parenthood, by sex and timing

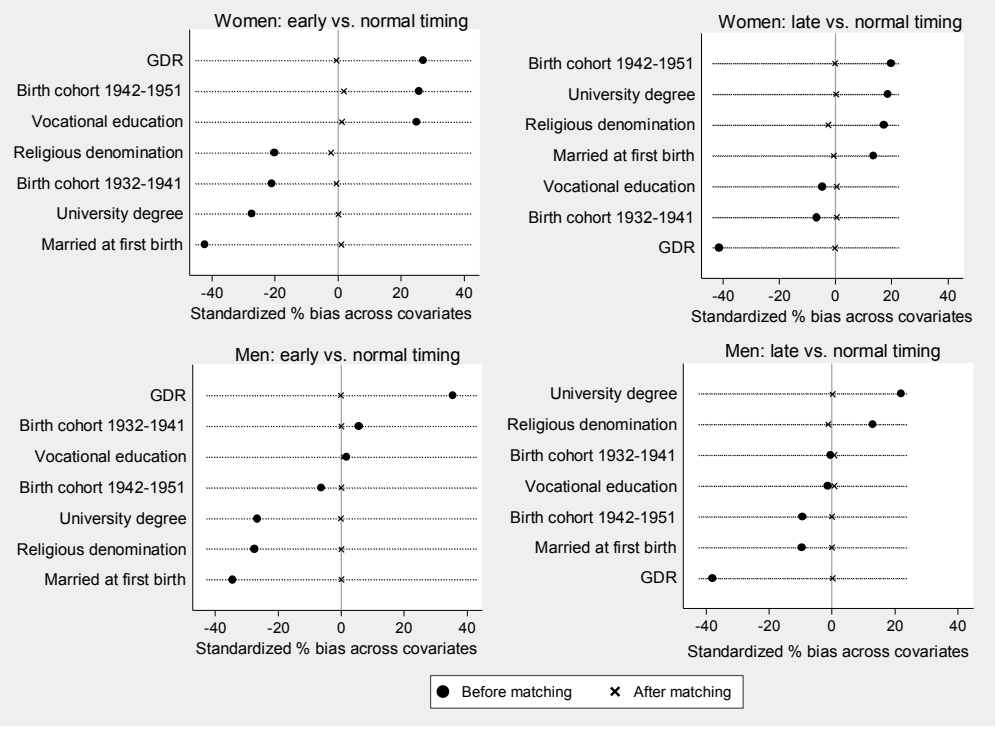



*Source*: SOEP 2011, own calculations.

Using these propensity scores, we generate a sample consisting of early (late) parenthood respondents and their matched cases whose propensity scores are sufficiently close to each other. Balance tests approve that the matching created a good balance quality with no systematic differences in the distribution of covariates between both groups. A t-test proves that the differences between the means in each covariate are no longer significant after matching. Relating to this, the dot charts in Figure 2 show the 'standardized bias' before and after matching as percentage heterogeneity between both groups regarding a specific variable. The closer the symbol to the zero-line, i.e. the smaller the percentage standardized bias, the better the matching balanced the treatment group and the control group. Every chart shows strong bias reductions (near to perfect homogeneity) in the covariates through matching. Consequently, all the mentioned tests prove that it was possible to gen-

erate an appropriate control group which is similar enough to the treatment group to be used for a reliable estimation of treatment effects.

*Figure 2*: Standardized percentage bias for each covariate before and after matching, by sex and timing




*Source*: SOEP 2011, own calculations.

Finally, we assess differences in well-being between early (late) parents and their matched counterparts. The average differences between the means of both groups are presented in Table 3 as average treatment effects on the treated (ATT) – in the first line before, and in the second line after matching. Despite different algorithms, the matching results are quite similar. This means that the results are robust regarding the type of matching.

*Table 3*: Propensity score matching estimates of the effects of timing of first parenthood, different algorithms, ATT before and after matching (t-statistic in parentheses)

| Sex of respondent | Timing of first parenthood | Differences in the average life satisfaction (early/late vs. normal) | Matching algorithm | | |
|---|---|---|---|---|---|
| | | | Nearest Neighbor | Kernel | Radius |
| Women | Early | 6.7 vs. 6.9 | -.25 (-3.48) | -.25 (-3.48) | -.25 (-3.48) |
| | | (3.76) | -.19 (0.79) | .49 (1.29) | -.14 (-1.70) |
| | Late | 7.1 vs. 6.9 | .21 (3.19) | .21 (3.19) | .21 (3.19) |
| | | (-3.11) | -.03 (0.09) | .47 (1.03) | -.01 (-0.11) |
| Men | Early | 6.8 vs. 7.0 | .15 (-1.85) | -.15 (-1.85) | -.15 (-1.85) |
| | | (1.97) | -.07 (0.26) | .02 (0.06) | .02 (0.28) |
| | Late | 7.1 vs. 7.0 | .08 (1.12) | .08 (1.12) | .08 (1.12) |
| | | (-1.11) | -.06 (-0.20) | -.11 (-0.26) | -.07 (-0.90) |

*Source*: SOEP 2011; own calculations.

The average differences between the means of early timing and normal timing of first motherhood seems to indicate a significant negative treatment effect of early timing on the life satisfaction of female respondents in older ages. After matching and taking into account the covariates birth cohort, education, marital status, religious denomination and GDR (lived in East Germany in 1989) this treatment effect is definitely smaller and not statistically significant anymore. The comparison between late and normal timing of mothers, conversely, shows a significant positive treatment effect before matching, and a no longer significant treatment effect after matching. The treatment effect for male respondents is not significant right from the start, which means that the timing of first fatherhood produces no differences in the average life satisfaction between men with normal and divergent timing.

Table 4 presents the Rosenbaum bounds for the effect of early (late) parenthood in the presence of unobserved heterogeneity. This allows assessing how large the selection bias problem would need to be to completely wipe out propensity score matching estimates for the effect of timing of first parenthood. The indicator Gamma Γ shows the magnitude of selection bias on unobserved covariates that would predict the timing of parenthood status, expressed as an odds ratio. As Γ approaches 1.4, the effect of early motherhood on life satisfaction becomes statistically insignificant at the .05 level. This means that in order to challenge the matching estimate, an unobserved covariate should cause the odds ratio of early childbearing to differ between early mothers and their matched counterparts by a factor of 1.4. A selection bias with such magnitude is larger than the estimated effect of oldest birth cohort university degree, membership in a religious denomination or being married at first parenthood. The effect of late motherhood on life satisfaction does not become insignificant until Γ approaches 1.6. A selection bias with such magnitude is larger than the estimated effect of birth cohort, not having finished school yet, having lived in East Germany in 1989, membership in a religious denomination or being married at first parenthood. In contrast, the effects of timing of first fatherhood are very vulnerable to hidden bias, as a selection bias occurs for unobserved variables with a very small impact on timing of first fatherhood.

*Table 4*: A sensitivity analysis using the Rosenbaum bounds of the causal effects of timing of first parenthood, by sex and timing

| Timing of first parenthood | Γ | *p*-critical |
|---|---|---|
| Early motherhood | 1.0 | <0.001 |
| | 1.1 | <0.001 |
| | 1.2 | <0.001 |
| | 1.3 | <0.001 |
| | 1.4 | 0.130 |
| Late motherhood | 1.0 | <0.001 |
| | 1.1 | <0.001 |
| | 1.2 | <0.001 |
| | 1.3 | <0.001 |
| | 1.4 | 0.001 |
| | 1.5 | 0.020 |
| | 1.6 | 0.110 |
| Early fatherhood | 1.0 | 0.06 |
| Late fatherhood | 1.0 | 0.06 |

*Notes*: Γ is the odds ratio of differential treatment assignment due to an unobserved covariate; p-critical ($p \leq 0.05$) from the Wilcoxon signed rank tests.

*Source*: SOEP 2011, own calculations.

## Summary

A large body of literature has documented a negative association between early childbearing and well-being in later life. The effects of late parenthood are mixed due to different social and physiological mechanisms as well as selection processes for the timing of first birth. This article extends the literature by employing propensity score matching with a sensitivity analysis using Rosenbaum bounds to estimate effects of birth timing on well-being net of observed selection effects.

The empirical analyses are based on data from the German Socio-Economic Panel. Applying a naïve estimator yields negative effects of early births and positive effects of late births for women. For men, there is no effect of early and late fatherhood. After matching on the propensity score, we did not find any significant effect of early or late parenthood on well-being for women and men. Therefore, not the age at first motherhood itself, but self-selection into a differing timing of first motherhood as predisposition produces the initial variations in life satisfaction. In summary, we suggest that that there is no causal linkage between the timing of first parenthood and the evaluation of life satisfaction in later life for either females or males.

Several limitations of this study warrant mention. First, it should be recognized that the propensity score matching analysis combined with the Rosenbaum bounds method is not a solution to all issues regarding selectivity. Matching can only be done on observables and the Rosenbaum bounds give us a hint on the required strength of unobservables to chance the estimated causal effects. For males, the fit of the propensity scores of early (late) parenthood was less successful compared to females, and the Rosenbaum bounds

indicated a large potential of hidden bias. Second, this study addresses the effects of first birth timing on well-being in later life using observational data. An alternative approach would be using twin studies as a source of quasi-natural experiment report (Pudrovska/ Carr 2007). Whether or not early or late first parenthood has long-term consequences, therefore, remains an important topic for future research. Third, it is likely that structural changes influence the association between timing of first birth and well-being later in life. This study does not contribute to this question. Research on fertility timing could benefit from comparisons of different age groups, and cohort data linking fertility timing to macro-level social changes. Fourth, since the relative importance of fertility history may depend on the institutional context (Aassve et al. 2010; Margolis/Myrskylä 2011), it would be worthwhile to replicate the findings for Germany with data from other countries. Finally, research on the fertility history and well-being nexus would benefit from more insights about the social and physiological consequences of early and late parenthood.

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# Effects of age at first birth on health of mothers aged 45 to 56

## Effekte des Alters der Mutter bei Erstgeburt auf ihre Gesundheit im Alter zwischen 45 und 56 Jahren

**Abstract**: Employing the data from the Survey of Health, Ageing and Retirement in Europe (SHARE) for 13 European countries, we analyse the relationship between mother's age at first birth and her health at age 45 to 56. Compared to mothers who gave birth at middle age, we found a significantly higher risk of illness among young first-time mothers. In a first step, we show that this effect largely remains after controlling for selection effects which determine age at first birth. Next, we examine whether the biosocial view could be confirmed. This approach explains the negative effect of early births on later health through a lack of social and economic resources during young mothers' life course. Thus, fewer resources are expected to affect health outcomes. However, the results indicate that the negative effect of young age at first birth remains even after controlling for health-related resources throughout the life course. The operationalisation of health-related resources as well as unobserved effects might be regarded as possible explanations for this. Due to data restrictions, indicators for educational history, job history and social support, that are all likely to depend on age at first birth and also affect later health, could not be taken into account. The results identify mechanisms of cumulative social inequality when disadvantaged women become mothers at younger age and thereby further increase their risk of disease.

**Zusammenfassung**: Anhand der Daten des Survey of Health, Ageing and Retirement in Europe (SHARE) für 13 europäische Länder wird der Zusammenhang zwischen dem Alter der Mutter bei Erstgeburt und ihrer Gesundheit im Alter von 45 bis 56 Jahren untersucht. Im Vergleich zu Müttern, die ihr erstes Kind im mittleren Alter bekommen haben, zeigen sich signifikant höhere Erkrankungsrisiken unter jungen Erstgebärenden. In einem ersten Schritt wird gezeigt, dass dieser Effekt auch unter Berücksichtigung von Selektionseffekten, welche das Alter bei Erstgeburt bestimmen, weitgehend bestehen bleibt. Anschließend wird untersucht, ob sich der biosoziale Ansatz, der den negativen Effekt früher Geburten auf die spätere Gesundheit anhand geringerer sozialer und ökonomischer Ressourcen im Lebensverlauf von jungen Müttern erklärt, bestätigt. Die Ergebnisse zeigen jedoch, dass sich ein junges Alter bei Erstgeburt auch unter Berücksichtigung von gesundheitsrelevanten Ressourcen im Lebensverlauf negativ auf die Gesundheit auswirkt. Mögliche Erklärungen liegen in der Operationalisierung der gesundheitsrelevanten Ressourcen und in unbeobachteten Effekten. Aufgrund von Datenbeschränkungen konnten Indikatoren zur Bildungs- und Berufshistorie und zur sozialen Unterstützung, die vom Alter bei Erstgeburt abhängig sein können und die spätere Gesundheit beeinflussen, nicht berücksichtigt werden. Die Ergebnisse zeigen Mechanismen kumulativer sozialer Ungleichheit auf, wenn benachteiligte Frauen jünger Mütter werden und dadurch ihre Gesundheitsrisiken zusätzlich verstärkt werden.

***Key words*:** motherhood, health, young mothers, birth timing

***Schlagwörter*:** Mutterschaft, Gesundheit, junge Mütter, Alter bei Erstgeburt

## Introduction

The relationship between motherhood and later health is extremely complex and an ongoing topic of debate in various disciplines. The effect of motherhood on health depends on a variety of individual characteristics like e.g. the mother's socioeconomic status, her fertility behaviour or her relationship status and history (Beral 1985; Kington et al. 1997; Doblhammer 2000; Floderus et al. 2008; Spence 2008; Dupre et al. 2009; Read et al. 2011). Effects of mother's age at first birth on her later health play an important part in this discussion. Since the age of first-time mothers at the time of family formation keeps increasing in most European countries, this aspect is especially interesting (OECD 2011).

Young mothers more often experience physical and mental as well as functional impairments in later life (Henretta 2007; Spence 2008; Taylor 2009; Read et al. 2011). While there is a consensus in empirical research about the health implications of young motherhood, the impacts of late motherhood are less clear. Some studies show that late motherhood is connected to better health in old age (Doblhammer 2000; Yi/Vaupel 2004). Others do not find any general (Alonzo 2002; Spence 2008) or even negative health effects of comparatively old age at first birth on later health (Cooper et al. 2000; Mirowsky 2005).

On these grounds, theoretical approaches and their implications with regard to the effects of age at first birth on later health will be tested using a data set that has not yet been analysed with the purpose of answering the research question presented here: How does age at first birth affect health at later age? The SHARE study has two advantages: Firstly, it is a new data source that can be used for testing whether findings from the recent state of research could be reproduced and therefore prove reliable. In doing so, we can contribute to the existing literature. Secondly, it allows us to incorporate information on mothers' circumstances before and after first birth. Therefore, not only determinants that might both affect the timing of first birth and later health, but also influences of circumstances after first birth that affect health in later life, can be analysed. This comprehensive approach offers the opportunity to examine different theories concerning the health situation of mothers.

## Effects of mother's age at first birth on her later health: Theory and state of research

The relationship between mother's age at first birth and her later health can be explained by different sociological and sociobiological theoretical approaches. The biodevelopmental and the biosocial view play an important role. The two approaches differ in that the first focuses on complications during pregnancy and childbirth, while the latter emphasises problems of motherhood that have long-term social effects. Both above-mentioned problems can have an effect on the later health of mothers (Mirovsky 2005: 34).

According to the ***biodevelopmental view***, the optimal age for first birth with regard to later health is directly after puberty, when the body is still young and energetic and has not yet been harmed by chronic diseases (Mirowsky 2005: 32f). With increasing age, not only fecundity decreases, but the risks during pregnancy and birth grow for both mother and child (Gosden/Rutherford 1995). By contrast, the ***biosocial view*** emphasises the influence of age at first birth in connection to social factors that later on affect health. This approach postulates that with regard to later health, motherhood should be postponed for as long as possible in order to achieve a sufficient educational attainment, establish a stable marriage and a secure socioeconomic status (SES). Previous research provides evidence that a person's educational attainment and SES affect her or his health throughout her or his life course (e.g. Ross/Wu 1995). Moreover, the biosocial view acknowledges that from a certain age onwards, the aging reproductive system and the occurrence of chronic diseases may counterbalance the positive effect of a postponed first motherhood (Mirowsky 2005).

So far, study results about the influence of age at first birth on later health clearly support the biosocial view (Geronimus/Korenman 1992; Hobcraft/Kiernan 2001; Hofferth et al. 2001; Mirowsky 2005; Pudrovska/Carr 2007; Spence 2008; Taylor 2009).

The connections between age at first birth and later health are manifold (for an overview see Figure 1). In the following paragraphs, they will be discussed separately for young, middle-aged and older first-time mothers. Additionally, a connection to the abovementioned theoretical views will be drawn.

## Early motherhood and health

On the one hand, the mechanisms among young mothers can be divided into selection effects (see Figure 1) that can be attributed to circumstances during childhood, and on the other hand, into mechanisms that work according to the biosocial view (see Figure 1).

*Selection effects for young motherhood*

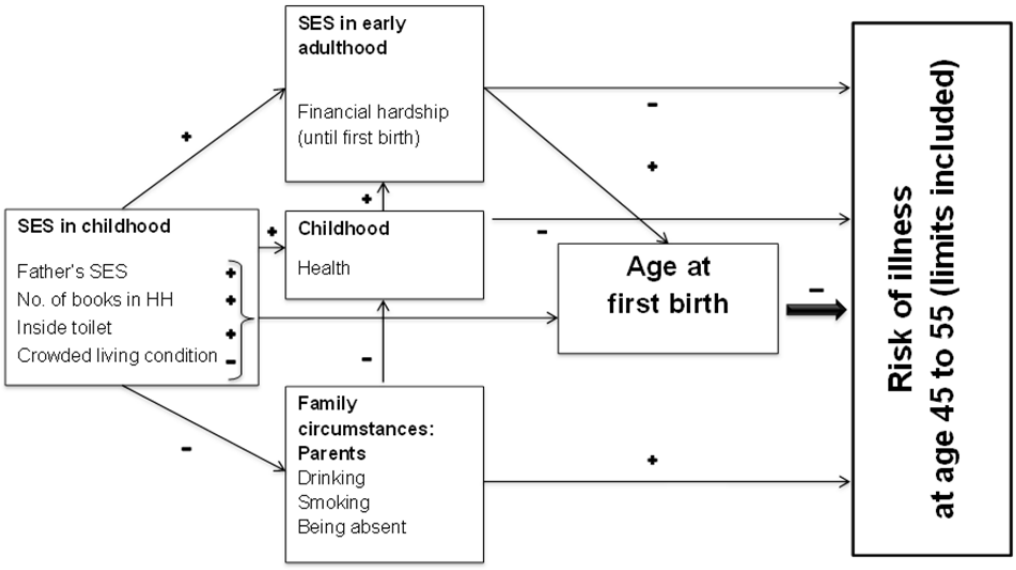
Empirical findings suggest that women with a disadvantaged socioeconomic background relatively frequently have children early in life (Hobcraft/Kiernan 2001; Henretta et al. 2008; Spence 2008; Taylor 2009). Thus, the poorer health of these women in later life might be attributed to their social background.

Important indicators to support this are the parents' SES or the father's SES, respectively (Olausson et al 2001: 72; Taylor 2009: 495). Moreover, the social situation in the family, such as an intact family (or the absence of a parent) seems to play an important role (for an overview see Blackwell et al. 2001: 1270; Hofferth et al. 2001: 260; Mirowsky 2002: 326; Pudrovska/Carr 2007: 106). An overview of the relevant factors and their relation in the selection process can be found in Figure 1. In addition to the description of positive and negative relationships, the indicators we use in our analysis are outlined.

Firstly, the parents' high SES has a positive influence on mother's health during her childhood (Case et al. 2002; Currie 2009). Secondly, there are direct (Blackwell et al. 2001) and indirect negative effects of poor health during childhood on later health. Poor health during childhood affects participation in education (Case et al. 2002) and thereby

has a negative effect on a person's SES in later life (Case et al. 2002; Currie 2009). As mentioned before, a person's higher SES is connected to better health (e.g. Ross/Wu 1995). Since there are several pathways how childhood health affects later health, it is crucial to control for childhood health in the present analysis.

*Figure 1*: Connection between childhood indicators, age at first birth and risk of illness at age 45 to 55. Authors' own graph.




For the association between better childhood health and parents' higher SES, health-related factors such as healthier nutrition, more frequent preventive health care or a better living environment play an important role. Moreover, health-related behavioural factors correlate with parents' income (for an overview see Blackwell et al. 2001: 1270; Case et al. 2002: 1309).

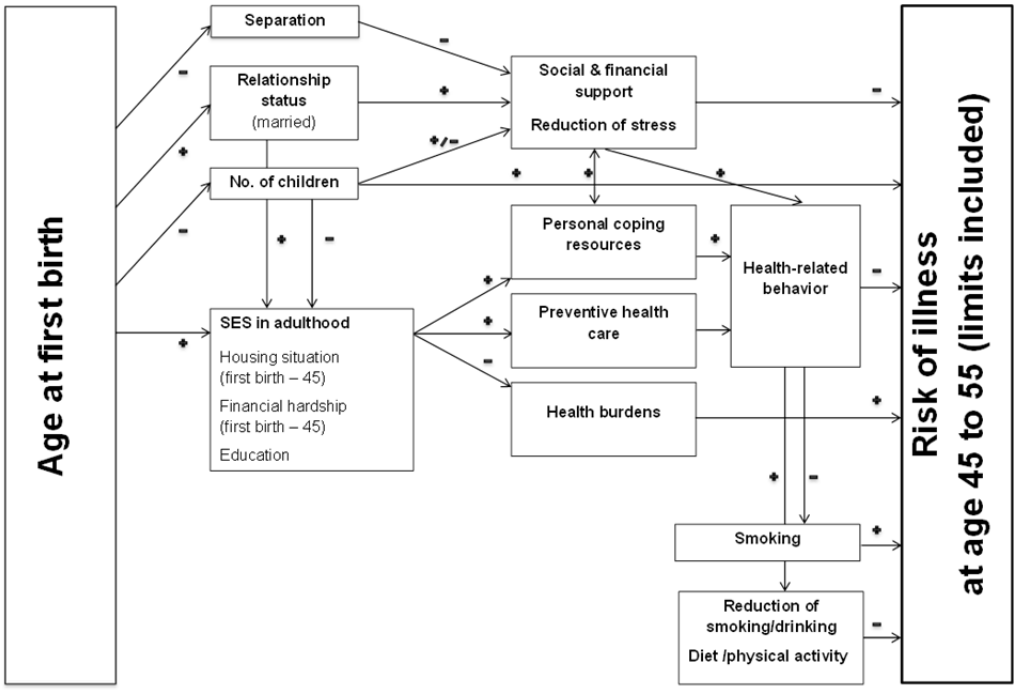
Controlling for mother's childhood health is not only beneficial for analysing the selection effect of who becomes a young mother, but it also offers additional benefits for our further analysis. Particularly, in a second step, we will examine the influence of health-related factors that occur after first birth on later health. For example, SES during adulthood is associated with a range of health-related outcomes (see e.g. Ross/Wu 1995). Since SES during adulthood is influenced amongst others by childhood health, childhood health is also an important factor in the second step of our analysis. The complex interactions between mother's age at first birth and her later health are depicted in Figure 2.

*Circumstances in adulthood – the biosocial view*

Early motherhood and the resulting additional burden can hinder acquisition of human capital which is known to have a positive influence on health. Often, becoming a mother early in life decreases participation in education (Hobcraft/Kiernan 2001: 515; Hofferth et

al. 2001: 264; Olausson et al. 2001; Taylor 2009). On the one hand, this may be due to time constraints, as young mothers may have to use their time and resources to care for their child instead of investing them in education (Waldron et al. 1998). On the other hand, young mothers have possibly not had enough time to develop coping resources needed to handle the challenges of motherhood. This lack of coping resources might hamper the acquisition of human capital (Hofferth et al. 2001: 259), as „humans mature reproductively about a decade before they mature socially" (Mirowsky 2002: 316).

*Figure 1*: Age at first birth and health in later life measured by periods of ill health at age 45 to 55. Authors' own graph.




Research findings show that compared to older mothers, young mothers' marriages are more often unstable (Hobcraft/Kiernan 2001: 515; Taylor 2009: 499). Also, young mothers more frequently have a disadvantaged social status (Olausson et al. 2001; Ermisch 2003; Taylor 2009). The mechanism between individual adult SES and individual adult health works similarly to the above-mentioned mechanism between parents' SES and children's health.

In this context, health-related behaviour constitutes an important factor. It can be attributed to personal coping resources, preventive health care behaviour and health burdens (Mielck/Helmert 1998). Results indicate that individuals with lower SES are more often smokers and they report less physical activity. Furthermore, they more often show problematic drinking patterns (for an overview see Burkert et al. 2012: 256). Thus, it seems that due to their social disadvantage, young mothers engage more frequently in health risk

behaviour such as smoking (Holm/Olausson in Olausson et al. 2001: 73; for an overview see Hugg et al. 2007: 60). Also, they use preventive health care less often than older mothers (Mirowsky 2005: 34).

When considering the impact of a stable marriage on health, in principle, it can be assumed that a relationship has a positive effect on health. That is because an intimate relationship may offer financial security, social support and promote health-conscious behaviour (Waldron et al. 1998; Dupre et al. 2009: 553; Bruhn 2011: 214ff.; for an overview see Choi/Marks 2011: 717f.). Previous research provides evidence that by way of comparison with unmarried women, married women report the best state of health (Kostiainen et al. 2009; Sperlich et al. 2011: 739). However, the connection between relationship status and health does not only depend on the status per se, but also on the quality of the relationship (Umberson et al. 1996; Dupre et al. 2009; Gruenewald/Seeman 2010; Choi/Marks 2011). Studies show that young mothers are not only married less often at the time of first birth (Olausson et al. 2001; Ermisch 2003), but they also more frequently live in single households later in live (Olausson et al. 2001; Ermisch 2003: 14). For this reason, we will not only incorporate mother's relationship status at the time of first birth, but also consider relationship separations after first birth that may provide information on relationship quality.

It can be assumed that women who start having children early in life also have a higher number of children throughout their lifetime (Morgan/Rindfuss 1999; Olausson et al. 2001; Henretta 2007). While some study results and theories suggest positive effects (for an overview see Smith et al. 2002) or no significant effects (Henretta 2007; Spence 2008) of high parity on mother's health, the majority of findings indicate that a high number of children influences mother's health negatively (Doblhammer 2000; Smith et al. 2002, Floderus et al. 2008: 72; Read et al. 2011). This negative effect can be attributed to the time and attention children need and the increasing amount of housework in large families. These psychological and physical demands go along with less flexibility for mothers (Floderus et al. 2008: 79). Additionally, biological causes are plausible explanations, as physical strain increases with each birth.

In the case of positive or absent effects of high parity on mothers' health, unobserved selection effects surely play an important role. Possibly only very healthy women can have many children during their lifetime (Smith et al. 2002: 186ff.).

## Late motherhood and health

In contrast to young mothers, the mechanisms linking late first birth to health in later life, and the actual health effects from late birth are less clear. For example, Doblhammer (2000) and Yi and Vaupel (2004) find a positive correlation between comparatively late birth and better health in later life. Contrarily, Mirowsky (2005) reports negative effects.

So far, research on older mothers appears to be rather unsystematic. Especially with respect to age, the classification of a mother as 'old' varies within a relatively wide age range of 30 to 40 years at birth. Often, a justification for the age classification is entirely absent (for an overview see Zerle et al. 2012). However, it can be assumed that research on older first-time mothers will gain in importance. In the future, researchers will be able

to access larger samples of older first-time mothers, as there is a strong trend in Europe to postpone the birth of the first child (Mirowsky 2002: 316).

*Positive effects*

The underlying mechanisms of late birth's positive effects on mothers' health are as diverse as the results themselves. Yi and Vaupel (2004) observe positive effects of late births for Chinese women aged 80 to 105 years. The authors describe four factors that are possibly responsible for this effect: (1) social factors such as family support and health-related behaviour; (2) biological changes caused by giving birth at an older age; (3) genetic and other biological characteristics and (4) selection effects (see following paragraphs).

Firstly, social factors comprise positive effects of own children's support in old age, of a change in health-related behaviour and of the factor of time. Analogous to the argumentation concerning young mothers, the latter factor refers to the idea that older first-time mothers theoretically have had sufficient time to invest in their own health-related resources (such as education, stable relationship, financial security etc.). A further assumption states that mothers, who postponed the birth of their first child until quite late in life, enjoy better support in old age from their own children. That is because children are comparatively young when their parents are in old age and they are therefore better equipped to help their parents (Yi/Vaupel 2004: 48). Especially in rural areas, parents profit not only from financial, but also from direct support from their children (for example in housekeeping and in farming) (Smith et al. 2002: 186). Literature research has shown that individuals who have better access to social support also have better health (e.g. Strine et al. 2008; Cornwell/Waite 2009; Weyers et al. 2010; Gruenewald/Seeman 2010: 226ff.). Children are the second most important component of social ties (partners are the most important) in adult and family networks and thus play an important role in supporting their parents (for an overview see Smith et al. 2002: 187). It is also plausible that women who have their first child late in life specifically care for their health, as they are at more risk during pregnancy and at birth than younger mothers. Furthermore, good health is important for being able to take responsibility for raising children and to see the own children and grandchildren grow up (Yi/Vaupel 2004: 48).

Secondly, biological changes that are connected to giving birth can positively affect women's later health (a detailed description of biological mechanisms and relevant genetic characteristic can be found in Yi/Vaupel 2004). Moreover, Myrskylä and Margolis (2012) report that the first child's birth has more positive and more long-lasting positive effects on the subjective well-being of older parents and on parents with higher resource endowments than on younger and less endowed parents. Scientific literature shows that subjective well-being positively influences health (Diener/Chan 2011). These findings about a late first birth's positive effect on health in later life are in accordance with the bio-social view.

*Selection effect for late first-motherhood*

Older first-time mothers' good health in later life may be attributed to a selection effect and biological reasons. Hence, late first birth does not necessarily have to be connected to better health per se. Rather, it might be attributed to the fact that only very healthy women are fecund and fertile for a very long time (Smith et al. 2002: 201, Yi/Vaupel 2004: 49).

*Negative effects*

Negative effects of late birth are often associated with late birth's physical strain. From a certain age onwards, a women's body does not seem to be able to cope with that strain (for an overview see Mirowsky 2005: 35).

Results from Alonzo (2002) and Spence (2008) do not suggest general negative effects of comparatively late birth on mother's later health, but they illustrate that a differentiated analysis of health impairments and diseases in old age seems reasonable. Both studies show negative effects of late birth on a range of specific diseases such as cardiovascular diseases and risk factors (diabetes and hypertension), blood abnormalities, dental health, physical mobility and vision difficulties (Alonzo 2002). In addition to physical impairments, mental health (e.g. depressive symptoms) was found to be affected (even when controlling for current and childhood SES, support from children and physical health) (Spence 2008).

Mirowsky's analysis of optimal age at first birth (2005) indicates that women's health (measured by seven separate indicator groups) deteriorates when they have their first child after the age of 40. Similarly, Cooper et al. (2000) show that women's mortality risk is highest when they give birth at age 40 and older.

## Mechanisms among middle-aged mothers

Middle-aged first-time mothers are expected to have better health later in life than young first-time mothers, due to the additional time available to accumulate health-related resources before first birth. In comparison to older first-time mothers, middle-aged first-time mothers should report better later health as they can expect less physical strain from giving birth and rearing children.

From the above discussion it is evident that examining effects of mother's age at first birth on her later health requires a life course perspective. Certain indicators (such as SES) influence both age at first birth and health, thus making an analysis of the connection between age at first birth and health difficult. Being able to control for circumstances during childhood (e.g. parents' SES) allows us to separate the selection effect on age at first birth from the net effect of age at first birth on later health.

## Research question and hypotheses

This study addresses the question of how mother's age at first birth affects her later health. Based on previous research and theory, we expect that comparatively young and comparatively old first-time mothers report poorer health than mothers who had their first child at an age classified as 'middle-aged' according to their country and their specific birth cohort. We are particularly interested in answering the question of whether those assumed effects remain when controlling for circumstances during childhood that both influence age at first birth (selection effect) and later health. In a second step, we control for health-related indicators after first birth that might be affected by age at first birth. The

goal of the second step is to analyse whether the direct effect of mother's age at first birth on her later health can be explained by those health-related indicators. Assuming that these indicators explain the mechanisms linking age at first birth to her later health, the direct effect of age at first birth should disappear, when controlling for them. The second part of the analysis should be regarded as an excursus though, because it is not possible to control for all health-related indicators in periods exclusively after first birth due to data constraints. Thus we cannot restrict the influence of those health-related indicators on later health to the time after first birth as we assume in the model.

We use the first, the second and the third wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) to test our hypotheses. The target population of this longitudinal study are individuals aged 50 years and older. In 2004/05 the first study wave and in 2006/07 the second study wave were conducted. The third wave about retrospective life histories (SHARELIFE) was conducted in 2008/09 with the goal to collect data on participants' previous life and connect them with the first two waves of the study. In the present study, analyses are based on data from 13 European countries. Participating countries are Denmark, Sweden, Germany, France, Belgium, Switzerland, Austria, the Netherlands, Spain, Italy, Greece, Poland and the Czech Republic. A detailed description of the methodological framework and the data collection of the SHARE study can be found in Börsch-Supan et al. (2013).

## Sample

We use a sample of 11.469 mothers who were born in 1954 or earlier and whose age at their first child's birth is known.

Mothers who reported own experience of migration (N=460) were excluded from our sample for reasons of higher unobserved heterogeneity. A procedure of this kind involves advantages and disadvantages: indicators from childhood, youth and adulthood are analysed controlling for country-specific heterogeneity. For migrants, country-specific heterogeneity of at least two countries exists to varying extents. Moreover, the effects of each country are unknown. Consequently, estimation results for determinants of mother's later health could be distorted when including migrants. Estimating the model solely for individuals without migration experience facilitates the analysis. However, such a change of the population also changes the individual probability of developing an illness, since this individual probability can only be calculated relative to the population. When interpreting the results, it has to be kept in mind that the coefficients were estimated based on a population that does not exist in this form.

Mothers of adopted children were included in the sample if they also had a biological child and this child was the oldest of all children in the family. This will ensure that the first child of all mothers in the sample can both have a social and a biological effect.

A further restriction of the sample was necessary due to our operationalisation of the dependent variable 'health in later life'. Mother's later health is measured by state of health at age 45 to 55 (limits included). The beginning of this observation period was chosen because women's fecundity decreases and risk during pregnancy increases in their mid-thirties (Gnoth et al. 2003; Ritzinger 2013), most women enter menopause at age 50

to 55 (McKinlay 1996) and as a consequence, most women's childbearing ends in their mid-forties (Eurostat 2014). Thanks to this timeframe of the dependent variable, we can examine all births' causal effects on mother's later health. However, mothers who had a child at age 45 or older did not end their reproductive phase before the start of the dependent variable's observation period. These were excluded from the sample. The end of the dependent variable's observation period at age 55 (limit included) was chosen so that for reasons of comparison we would have data for the same age span of 11 years for all participants – even from the youngest survey participants who were aged 50 in the first wave. At the time of the third wave taking place up to five years later, participants reported on their state of health throughout their lifetime. We employ this information for our dependent variable. The youngest respondents were then aged 55 – this is the maximum age at which we have information on health from all participants. This comparatively small time frame of 11 years of 'later health' (age 45 to 55, limits included) obviously presents some restrictions. The main one is that the study looks at a short time range in life that stands rather at the beginning of a rapid increase in prevalence of health problems with advancing age. Recent statistics show that in 2010 in the EU-27 countries, average chronic morbidity increased from about 20% at age 40 to 40% at age 60 to more than 60% at age 80 (Robine/Cambois 2013: 2). Our age span thus covers a period where chronic morbidity rate is still relatively low. All in all, due to item non-response N=9762 mothers are included in the analysis.

## Operationalisation

### Dependent variable: later health

The present study aims at analysing the effect of age at first birth on the risk of illness at age 45 to 55. We define women as being ill if they reported at least one period of ill health or disability that lasted not less than one year and that started and/or ended within the defined 11 years. Serious illnesses that lasted for less than one year but influenced the respondent's daily life for more than one year were included as well.

### Independent Variable: Age at first birth

Age at first birth is operationalised in a cohort- and country-specific way. Mothers are divided into three birth cohorts: *cohort 1* consists of birth cohorts up to and including 1938, *cohort 2* comprises births during and shortly after Second World War (1939-1947) and *cohort 3* is constituted of women born 1948 to 1954. On the strength of its robustness against outliers, we used the median to divide age groups. All women who had their first child at least two years before the cohort- and country-specific median age were defined as *young first-time mothers* while all first-time mothers who gave birth two and more years after the cohort- and country-specific median age were specified as *older first-time mothers. Middle-aged first-time* mothers serve as reference category for which we do not

expect any specific effects. An overview of the country- and age-specific classification of mothers' age at first birth is provided in Table 4 in the appendix.

This age classification does not only take into account country-specific differences in age at first birth, but it also incorporates varying trends over time. The sample consists of 22% young, 50% middle-aged and 28% older first-time mothers. Our age group distribution resembles the one from the empirical classification of Zerle et al. (2012) who used the first and third quartile point to define young and older mothers. However, our cutting points are on average at earlier ages than the ones in Zerle and colleagues' study on younger German birth cohorts.

## Control variables in childhood before first birth

*Socioeconomic status in childhood*

The SHARE survey provides several socioeconomic indicators from childhood, such as the main breadwinner's socioeconomic status, the number of books at home, having had an inside toilet and having experienced crowded living condition at the age of ten. Except for crowded living conditions, all indicators are dummy variables. The income of respondent's parents or respondent's income in adulthood could not be used due to data restrictions.

The main breadwinner is defined as having a high socioeconomic status if her or his occupation at respondent's age of ten was reported as professional, technical or managerial (operationalisation based on Engelhardt et al. 2012). Further indicators are number of books in the household (more than 25 books yes/no), having an inside toilet and crowded living conditions. Crowdedness is calculated dividing the number of people per household by the number of rooms. Kitchen, hallway and bathroom(s) are excluded from the number of rooms.

*Family circumstances in childhood*

Information on specific childhood circumstances such as the *absence of a biological parent* and parents' *smoking* and *alcohol drinking patterns* is included in the SHARE data as well. According to the SHARELIFE questionnaire, the absence of a biological parent in the household, meaning respondent's father or mother, refers to the age of ten while information on parents' or guardians' smoking and drinking patterns refer to respondent's entire childhood up to and including the age of 15. Parents' drinking pattern is indicated by the information whether parents or guardians drank heavily during childhood.

*Health in childhood*

A control variable for general childhood health is *self-rated health* up to age 15. The values *excellent* and *very good* were grouped together into the category *very good*, the value *good* was carried over and the remaining categories *fair, poor* as well as the spontaneous value *health varied a great deal* were combined into *poor* health. As a result of expected bias due to recall problems, we forgo the possibility of using information on sick leave from school or specific illnesses during childhood in favour of the subjective self-rated health in childhood.

*Socioeconomic status in adolescence and early adulthood before first birth*

In early adulthood before first birth, we use *periods of financial hardship* as indicators for respondents' socioeconomic status. Mothers, who experienced a period of financial hard-

ship in childhood, adolescence or early adulthood before first birth, are represented in the variable *financial hardship before first birth*.

## Control variables in adulthood after first birth

*Socioeconomic status in adulthood*
For the time period after first birth, we use information on the housing situation and periods of financial hardship as indicators for mother's socioeconomic status.

The variable *housing* was coded into the following three categories: tenant, member of a cooperative, living rent-free or other; owner and not yet established own household before age of 45. It provides an indication of mother's financial background and her resources. Respondents, who reported having possessed housing property at least once between first birth and age of 45, were coded as owners.

*Family status*
On the basis of SHARE data, we can also control for the total number of children, relationship status at first birth and the number of separations (including divorces) between first birth and age 45.

The *number of children* indicates maternal strain and stress that may influence mother's later health. Since we do not expect a linear effect on the dependent variable, we test the influence of different numbers of children separately, using a single child as reference category. Regarding the *relationship status*, we distinguish between *married* and *unmarried living together with a partner* as well as *single or living apart from a partner respectively*. Couples living together seem to enjoy advantages similar to those of marriage. While empirical results do indicate that couples who live together report better health than single people, they nevertheless report poorer health than married couples (Wu et al. 2003). For this reason, we distinguish between spouses and unmarried couples living in one household.

The relationship status and the number of *separations* can indicate the degree of support and financial security that a mother has in her relationship. Since the number of relationship breakdowns and the dependent variable do not show the functional form assumed by the logistic regression model (Kohler/Kreuter 2008: 283ff.), we dichotomise the variable into the new indicator *at least one separation between first birth and age of 45*.

*Education*
Using the ISCED-scale, *education* was grouped into three country-specific categories. Respondents belonging to the highest third of the country-specific distribution are coded as having high education, the second third as having a medium level of education and the lowest third as having the comparatively lowest level of education in the respective countries. Since some mothers reach their highest level of educational attainment before and others after first birth, this variable disregards the time of first birth. Thus the education variable can theoretically both influence and be influenced by timing of first birth. In order to model the selection effect on age at first birth correctly, education is only used as an indicator in adulthood after first birth.

*Health-related behaviour*
In the literature, health-related behaviour is seen as an important indicator for health. It is also closely connected to a person's SES (Mielck/Helmert 1998). Also, as previous discussions suggest, comparatively older mothers are more likely to show better health-related behaviour. Consequently, we control for mother's smoking patterns and changes in health-related behaviour.

Respondent's *smoking pattern* refers to her or his entire life course. The variable indicates whether the respondent has ever smoked either cigarettes, cigars, cigarillos or pipe on a daily basis for more than one year. Unfortunately it is impossible to determine the specific period of smoking throughout the life course of the mothers due to data restrictions. There are two distinct categories of indicators for changes in health-related behaviour: First*, increasing physical activity* and/or *changing diet*, second, *reducing alcohol consumption* and/or *stop smoking*[1]. Each of those is only registered if the behaviour lasts at least for one year with the goal of improving health. In order to represent solely self-directed behaviour change (and not a "forced" change due to illness), only those mothers who did not report any illness before their change in health-related behaviour were coded as having changed their behaviour.

*Country-specific homogeneity*
Since we expect contextual factors such as differing resources, varying health care services and diverging epidemiological environments (occurrence of different illnesses) etc. to influence health (Elo 1992), we control for country differences by including country dummies in each of our models.

## Methods and models

Stepwise logistic regression models are used to explore the effect of age at first birth on risk of illness at age 45 to 56. Even though data were available for three waves, a pooled model was computed, because most of the variables used in estimations come from retrospective wave three. Information for health-related behaviour at different points in time would be available, but refers to the respective survey date, which is not consistent with the period of observation used for our analysis. Thus, a panel model was not estimated.

All models were tested for multicollinearity and proper functional relations. Average Marginal Effects (AME's) are used, as they allow for a robust estimation of coefficients' size, even for varying variance of the error term (when additional variables are included in stepwise models). Therefore, AME's are suitable for comparing effect sizes of differently nested models. Furthermore, interpretation is easier for AME's than for Odds Ratios: AME's indicate the average effect of the independent variable on the probability that the dependent variable equals one (Best/Wolf 2010, 2012).

1 This information is only available for predefined age categories. Thus, for the present study we grouped the two categories 16 to 25 years and 26 to 40 years together. A clear distinction between changes in behaviour before and after first birth is not possible.

In model 1 the effect of age at first birth on the dependent variable is tested controlling for birth cohort and country of origin. The aim is to show whether there is a basic correlation between age at first birth and health in later life. In model 2 the selection effect on age at first birth is examined. The model contains additional variables for childhood circumstances and similar factors, which originate from the time before the first birth and which influence both mother's age at first birth and her health in later life. When controlling for factors relevant to the time prior to first child's birth, a reduction of the effect of age at first birth on later health is expected. That is because it can be assumed that women from disadvantaged backgrounds become mothers earlier and show poorer health status in later life. Provided the effect of age at first birth is solely due to factors previous to first birth, the effect should disappear completely in model 2. In the last step, variables which are influenced by age at first birth and which could affect health in later life are added to model 3. Using this model, the biosocial view is tested. According to the biosocial view, the date of birth influences the accumulation of health-related resources throughout the life course. When taking these health-related factors in adulthood into account the effect of age at first birth on health in later life should vanish. The direct influence of age at first birth is expected to disappear in model 3.

## Results

### Descriptive results

Young first-time mothers experience more often an illness period at age 45 to 56 (13%) in comparison to middle-aged first-time mothers (11% with a period of ill health) and compared to older first-time mothers (9% show a period of ill health). The descriptive data show that women of comparatively young age at first birth seem to be disadvantaged in nearly every aspect. Childhood circumstances (such as parents' health behaviour) as well as living conditions (inside toilet, crowded living conditions etc.) prior to birth of first child are evidently more often poor compared to older first-time mothers (see Table 1).

*Table 1*: Mean values of young, middle-aged and older mothers

| Variables | Mean middle-aged mothers (ref. category) | Mean young mothers | Mean older mothers | Significance test for equality of proportions* |
|---|---|---|---|---|
| cohort 1 (<1939) | .34 | .37 | .33 | 0.0109 |
| cohort 2 (1939-1947) | .35 | .34 | .35 | 0.9973 |
| cohort 3 (1948-1954) | .30 | .29 | .32 | 0.0085 |
| **SES in childhood** | | | | |
| SES father (age 10) | .10 | .07 | .15 | 0.0000 |
| at least 25 books in HH (age 10) | .32 | .22 | .39 | 0.0000 |
| inside toilet (age 10) | .46 | .39 | .53 | 0.0000 |
| crowdedness of living (age 10) | 2.01 | 2.13 | 1.88 | 0.0000+ |
| **Family circumstances in CH** | | | | |
| parents smoked (up to age 15) | .61 | .62 | .59 | 0.0259 |
| parents drunk heavily (up to a. 15) | .07 | .11 | .06 | 0.0000 |
| at least 1 biological parent absent (age 10) | .10 | .14 | .08 | 0.0000 |
| **Health in childhood** | | | | |
| self-rated „excellent-very good“ | .66 | .66 | .69 | 0.0130 |
| self-rated „good“ | .24 | .23 | .23 | 0.7353 |
| self-rated “fair, poor or varying” | .08 | .09 | .06 | 0.0002 |
| **SES before first child's birth** | | | | |
| financial hardship (0-first birth) | .08 | .07 | .08 | 0.2097 |
| **SES in adulthood** | | | | |
| financial hardship (first birth-age 45) | .27 | .37 | .23 | 0.0000 |
| housing 1: did not establish own household before age 45 | .01 | .00 | .01 | 0.1712 |
| housing 2: tenant, other, members of a cooperative | .31 | .36 | .30 | 0.0000 |
| housing 3: homeowner | .67 | .62 | .68 | 0.0001 |
| **Relationship status** | | | | |
| number of children | 2.41 | 2.67 | 1.98 | 0.0000+ |
| relationship status at first birth: married | .94 | .86 | .91 | 0.0000 |
| relationship status at first birth: unmarried living together | .01 | .01 | .03 | 0.0000 |
| relationship status at first birth: single / not living together | .03 | .12 | .04 | 0.0000 |
| separation between first birth up to age 45 | .08 | .15 | .06 | 0.0000 |
| **Education** | | | | |
| low country specific education | .16 | .26 | .13 | 0.0000 |
| middle country specific education | .64 | .64 | .58 | 0.0001 |
| high country specific education | .18 | .08 | .27 | 0.0000 |
| **Health-related behaviour** | | | | |
| ever smoked daily | .32 | .35 | .33 | 0.0551 |
| increased physical activity +/ changed diet | .09 | .07 | .10 | 0.0064 |
| reduced smoking +/ reduced alcohol consumption | .04 | .03 | .06 | 0.0000 |

* Significance test for equality of proportions: do proportions of younger and older mothers differ significantly. Ha: difference !=0. Indicated are p-values. + t-test: do means of younger and older mothers differ significantly. N=9762.

*Source*: SHARE, SHARELIFE.

Older first-time mothers report a significantly better childhood health than young first-time mothers. The proportion of mothers with poor childhood health status is very small,

however, young mothers show significantly higher percentages in comparison to older mothers.

Additionally, the results for conditions in adulthood reveal that young mothers struggle more often with financial hardship between first birth and age 45 and own a house significantly less frequently. With regard to family status, young mothers have more children on average, are married in fewer cases at the time of first birth and experience more often at least one separation between first birth and the age of 45. Furthermore, older mothers show significantly higher levels of education, while young mothers on average obtain the lowest educational degrees.

Comparatively older mothers show significantly healthier behaviour with regard to changes of diet and physical activity, as well as to smoking and drinking behaviour. These findings are consistent with considerations by Yi and Vaupel (2004), which suggest that comparatively older mothers pay more attention to their health in order to be able to cope with the responsibility of child care and in order to be able to see their children and grandchildren grow up.

The descriptive data are consistent with current findings and are, all in all, in accord with the biosocial view. Furthermore, young mothers have lower childhood SES on average, indicating that there are selection processes for the age at first birth.

## Multivariate results

*Model 1 – Effect of age at first birth on health in later life*

Model 1 shows a significant difference between young and middle-aged mothers regarding the occurrence of at least one period of ill health between 45 and 56 years (see Table 2). Women, who gave birth to their first child comparatively early, on average show a nearly three percent higher likelihood of having at least one period of ill health at age 45 to 56.

Older first-time mothers show a lower risk of illness in comparison to middle-aged first-time mothers. The effect, however, is not significant. The significantly lower likelihood to show an illness in later life of the earliest birth cohort (born before and including the year of birth 1938) in comparison to the middle birth cohort (1939 up to 1947) can be ascribed to selection effects. The participants of the SHARE survey from the first cohort still alive today are the healthiest subsample of this cohort and do not representatively reflect the health condition of the entire cohort.

*Model 2 –Selection effects on age at first birth*

Model 2 is built up in a stepwise manner and considers childhood factors and indicators which are attributable to the period before the first child's birth. The inclusion of childhood SES indicators only leads to a slight reduction of the effect of age at first birth on health in later life. The effect still remains highly significant for young first-time mothers; the same happens when parents' behaviour in childhood is taken into account. The effect is reduced further, whilst remaining highly significant.

The covariates show the expected effects: Respondents with an inside toilet available at the age of ten show a significantly lower risk of illness at age 45 to 56 in comparison to

respondents without an inside toilet. Increasingly crowded living conditions in childhood raise the likelihood of becoming ill between the age of 45 to 56.

*Table 2*: Model 1: Effects of age at first birth on later health (period of ill health between the age of 45 and 56) and model 2 including childhood indicators

| **Model** | **1** | **2a** | **2b** | **2c** | **2d** |
|---|---|---|---|---|---|
| **Variables** | Average Marginal Effects/(SE) | | | | |
| **Age of mother at first birth** | | | | | |
| ref.: middle-aged mother | | | | | |
| young mother | 0.029*** | 0.027*** | 0.025*** | 0.024** | 0.024** |
| | (0.009) | (0.008) | (0.008) | (0.008) | (0.008) |
| older mother | -0.009 | -0.008 | -0.007 | -0.006 | -0.006 |
| | (0.008) | (0.007) | (0.008) | (0.008) | (0.008) |
| **Cohort** | | | | | |
| ref.: cohort 2 | | | | | |
| cohort 1 (<1939) | -0.038*** | -0.042*** | -0.041*** | -0.040*** | -0.042*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| cohort 3 (1948-1954) | 0.014* | 0.017* | 0.017* | 0.017* | 0.018* |
| | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| **SES in childhood** | | | | | |
| SES father (age 10) | | -0.004 | -0.003 | -0.004 | -0.004 |
| | | (0.010) | (0.011) | (0.011) | (0.011) |
| at least 25 books in HH (age 10) | | 0.007 | 0.008 | 0.009 | 0.009 |
| | | (0.008) | (0.008) | (0.008) | (0.008) |
| inside toilet (age 10) | | -0.020** | -0.019* | -0.019* | -0.019* |
| | | (0.007) | (0.007) | (0.007) | (0.007) |
| crowdedness of living (age 10) | | 0.006* | 0.006* | 0.006* | 0.005* |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| **Family circumstances in CH** | | | | | |
| parents smoked (up to age 15) | | | 0.014* | 0.014* | 0.014* |
| | | | (0.007) | (0.007) | (0.007) |
| parents drunk heavily (up to age 15) | | | 0.020 | 0.017 | 0.017 |
| | | | (0.011) | (0.011) | (0.011) |
| at least 1 biological parent absent (age 10) | | | 0.038*** | 0.035*** | 0.034*** |
| | | | (0.009) | (0.009) | (0.009) |
| **Health in childhood** | | | | | |
| ref.: "excellent -very good" | | | | | |
| self-rated health „middle" | | | | 0.011 | 0.011 |
| | | | | (0.008) | (0.008) |
| self-rated health „fair, poor or varying" | | | | 0.057*** | 0.056*** |
| | | | | (0.010) | (0.010) |
| **SES young adulthood** | | | | | |
| financial hardship | | | | | 0.028** |
| (up to first birth) | | | | | (0.011) |
| **Model fit** | | | | | |
| LL | -3235.10 | -3227.12 | -3215.51 | -3200.52 | -3197.34 |
| McFadden Pseudo R2 | 0.0305 | 0.0329 | 0.0364 | 0.0408 | 0.0418 |

All models with control for countries, N=9762.
***=p<=0.001 **= p<=0.01 *=p<=0.05 °p=<=0.10.

*Source*: SHARE, SHARELIFE.

Furthermore, parents' smoking habit or an absent parent at the age of ten increases the likelihood of experiencing a period of ill health between the age of 45 to 56. The remain-

ing covariates of model 2a and model 2b do not show significant effects. After adding self-rated health in childhood and SES in young adulthood before birth of first child to model 2c and to model 2d the effect of young age at first birth on later health remains highly significant. A poor or strongly varying health in childhood as well as a period of financial hardship increase the likelihood of illness at age 45 to 56. Although childhood factors partly explain the influence of age at first birth on later health, the statistical connection between young age at first birth and later health still remains when controlling for childhood factors. Hobcraft and Kiernan (2001) also found similar results. The SHARE data make it possible to observe the effects of mother's age at first birth on later health controlling for factors in adulthood. However, there may be distortions, as single indicators cannot be referred to the time of first birth. For this reason, results of model 3 may merely be seen as an excursus and an impulse for further research.

*Excursus: Model 3 – Effects of mother's age on conditions after birth of first child (biosocial view)*

In model 3 (see Table 3 which excludes listing single childhood factors) the control of childhood indicators and factors of young adulthood, which are described above, is maintained. Failing to control for childhood factors (regarding health as well as family background) would otherwise lead to an overestimation of the effects of adulthood SES (Blackwell et al. 2001: 1280). The model is extended by factors, that are – according to the biosocial view – influenced by mother's age at first birth, and that are expected to have an impact on health in later life. First, a model is estimated in which the indicators can be assigned specifically to the period before or after first birth. Hereafter, additional covariates are added, for which the time point of the first birth could not be considered in the operationalisation.

Adding the indicators of adulthood SES (financial hardship and residential status between first birth and the age of 45) decreases the effect of young age at first birth from 2.4% to 2.3% in model 3a. While residential status turned out to be insignificant for later health, there are significantly positive effects of financial hardship between time-point of first birth and age 45 on the likelihood of falling ill between the age of 45 and 56.

Taking family status (relationship status at time of first birth, occurrence of a separation between first birth and age 45 as well as number of children) into account in model 3b, the effect of young age at first birth slightly reduces to 2.1%. The number of children and the relationship status at the time of first birth do not show significant effects, whereas the occurrence of at least one separation between the birth of first child and the age of 45 significantly increases the likelihood of an illness period in later life.

Even after taking mother's education (model 3c) and changes in health-related behaviour as well as mother's smoking behaviour (model 3d) into consideration, the effect of young age at first birth remains significant. In the last two models only changes in diet and/or increased physical activity at age 16 to 40 increase the risk of illness at age 45 to 56, whereas smoking behaviour and education do not affect later health. However, the indicators of health-related behaviour and education cannot be assigned to the time-point of birth due to the data situation. Therefore, a causal link to age at first birth cannot be inferred. It is thus not surprising, that the effect of age at first birth does not disappear when controlling for these health-related variables.

*Table 3*: "Model 3": Effects of age at first birth on later health (period of ill health between the age of 45 and 56) including adulthood indicators

| **Model** | **3a** | **3b** | **3c** | **3d** |
|---|---|---|---|---|
| **Variables** | | **Average Marginal Effects/(SE)** | | |
| **Age of mother at first birth** | | | | |
| ref: middle-aged mother | | | | |
| young mother | 0.023** | 0.021** | 0.020* | 0.019* |
| | (0.008) | (0.008) | (0.008) | (0.008) |
| older mother | -0.006 | -0.007 | -0.007 | -0.007 |
| | (0.008) | (0.008) | (0.008) | (0.008) |
| **SES in adulthood** | | | | |
| financial hardship (first birth-age 45) | 0.014* | 0.011 | 0.010 | 0.011 |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Housing | | | | |
| ref: housing 3: homeowner | | | | |
| housing 1: did not establish own household | -0.059 | -0.060 | -0.061 | -0.060 |
| before age 45 | (0.043) | (0.043) | (0.043) | (0.043) |
| housing 2: tenant, other, | 0.003 | 0.001 | 0.001 | 0.000 |
| members of a cooperative | (0.007) | (0.007) | (0.007) | (0.007) |
| **Family status** | | | | |
| Number of children | | | | |
| ref: 1 child | | | | |
| 2 children | | -0.013 | -0.013 | -0.013 |
| | | (0.009) | (0.009) | (0.009) |
| 3 children | | -0.172° | -0.017° | -0.017 |
| | | (0.010) | (0.010) | (0.010) |
| 4 and more children | | -0.001 | -0.002 | -0.001 |
| | | (0.012) | (0.012) | (0.012) |
| Relationship status at first birth | | | | |
| ref: married | | | | |
| unmarried living together | | 0.008 | 0.008 | 0.010 |
| | | (0.021) | (0.021) | (0.021) |
| single/not living together | | -0.009 | -0.009 | -0.011 |
| | | (0.014) | (0.014) | (0.014) |
| separation between first birth up to age 45 | | 0.031** | 0.031** | 0.029** |
| | | (0.010) | (0.010) | (0.010) |
| Education ref: | | | | |
| middle country specific education | | | | |
| low country specific education | | | 0.010 | 0.009 |
| | | | (0.009) | (0.009) |
| high country specific education | | | -0.002 | -0.001 |
| | | | (0.009) | (0.009) |
| **Health-related behaviour** | | | | |
| ever smoked daily | | | | 0.009 |
| | | | | (0.007) |
| increased physical activity +/ changed diet | | | | -0.037** |
| | | | | (0.012) |
| reduced smoking +/ alcohol consumption | | | | -0.022 |
| | | | | (0.016) |
| **Model Fit** | | | | |
| LL | -3193.99 | -3186.15 | -3185.42 | -3178.21 |
| McFadden Pseudo R2 | .0428 | .0452 | .0454 | .0475 |

All models with control for countries, cohorts and childhood indicators, N=9762.
***p<=0.001 **= p<=0.01 *p<=0.05 °p<=0.10.

*Source*: SHARE, SHARELIFE.

In model 3 we tested whether the effect of age at first birth on later health can be explained by the operationalised mechanisms (resources, strains, health-related behaviour). However, with the given operationalisation the effect does not disappear, as was expected. This result is discussed in the following section.

## Conclusion and discussion

In this article, the influence of age at first birth on mother's health at age 45 to 56 was explored. First, mechanisms which influence the time of first birth and which are connected with later health were controlled. In a second step, we tested the assumption that the effect of age at first birth on later health can also be explained by health-related factors after birth, which vary with age at first birth.

In comparison to middle age at first birth, the analysis shows significant negative effects of young age at first birth on mother's later health at age 45 to 56. The biodevelopmental view, which postulates advantages on health in the case of a first birth given as early in life as possible, could therefore not be confirmed. The risk of illness for older mothers does not differ from the risk for mothers, which gave birth to child at middle age.

In the course of this analysis, controlling for childhood factors revealed only minor changes in the effect size and significance of mother's young age at first birth on later health at age 45 to 56. Women, who gave birth comparatively early in life, did more often have a disadvantaged family background, however, the effects of young age at first birth could not solely be reduced to this disadvantaged family background (selection effect in childhood). Our results are consistent with findings by Olausson et al. (2001), who point out that there is also a risk for a low SES in later life for those young mothers who were not exposed to a disadvantaged background.

According to the biosocial view, the remaining effect of age at first birth on later health can be explained by differences in SES and health behaviour in adulthood between young, middle-aged and older first-time mothers. Yet, even after controlling for SES in adulthood, family status and health behaviour, the effect of young age at first birth on health still remained. Thus, with the underlying operationalisation, the biosocial view could not be confirmed.

In the present study, the covariates in childhood are overall the more important factors with regard to later health in comparison to the adulthood indicators used. The missing effect of comparably older age at first birth may be a result of varying age classification for older mothers in different countries in this study ('older' mothers in e.g. the Netherlands range from age 28 upwards vs. 25 years and older in Austria in the youngest cohort). In comparison to other studies, our "older" mothers are comparatively young (see Table 4). This might have led to mixed effects of older and middle-aged mothers. These groups however experience de facto different biological and social consequences of first birth.

## Restrictions

The remaining effect of mother's young age at first birth could be due to missing information on health-related factors in adulthood, which can be influenced by mother's age at first birth. Missing factors of importance include household income in adulthood (as a better operationalisation of SES), mother's educational and occupational history[2], use of health care as well as reliability and extent of social support[3]. Thus, the importance of health-related factors in adulthood is probably underestimated in this study.

Based on SHARE data it was not always possible to control for conditions in periods *before* or *after* birth of first child (see section about variables in adulthood). Furthermore, childhood variables refer to different time spans (some reflecting the whole childhood up to an age of 15, others only specifically the situation at the age of 10). These aspects could lead to distortions, but are not avoidable due to the available data.

Additionally, in this study findings referring to teenage mothers are mixed with results for later (but still comparatively early) first birth. As our results show, there is also an effect of young age at first birth on later health when broad age classification is used. However, the effect may be stronger when using more rigid age classifications.

As mothers with migration experience were excluded, the results apply only to mothers without migration experience. Therefore, the results refer to a population, which does not exist it this form. The estimation of individual probability of developing illnesses could be biased.

Despite these restrictions the advantage of this analysis lies in its simple, but convincing approach of analysing different mechanisms with retrospective cross-sectional data in a stepwise model.

## Research perspectives

This study provides several opportunities for additional analyses about the effects of mother's age at first birth on her health.

A comparison of childless women with the mothers of the SHARE data set would have been a worthwhile addition to this study. This could have given additional information with regard to the influences of some factors such as relationship status or separa-

2 For consideration of physical strain during the life course, information about occupational trajectories is missing. As for on average younger mothers more frequently (as a result of their lower educational degrees) have manual occupations, higher health burdens can be expected; these influences could explain a part of the age effects at first birth on later health.
Additionally, a possible positive effect of a steady occupation on later health could not be observed. However, it can be assumed that – at least for the earlier cohorts – this circumstance is not of great importance as the occupation of women – independent of husband and household – can only be expected in larger numbers in later cohorts.

3 It remains uncertain to what extend mother's age at first birth influences her social contacts. It may be possible that age at first birth does not only influence women's educational attainment and SES but it might also prevent the formation of strong and tight networks, because mothers invest time and energy in bringing up their children.

tion on risk of illness. Unfortunately, this was not possible due to low case numbers. In addition, a comparison with fathers could have added information about the purely sociobiological effects of parenthood.

Furthermore, revealing underlying effects of young age at first birth on later health constitutes an interesting field of additional research, as there is some clear intergenerational continuity in age at first birth. Children of young parents also give birth to their own children comparatively early (for an overview see Pudrovska/Carr 2007: 105). Thus, the analysis of multigenerational fertility biographies could be worthwhile.

Generally, an analysis of the entire fertility history and its association with mother's health seems promising. This approach would not only enable a more detailed investigation of effects of age at first birth, but it could also consider age at last birth or influences of timing and spacing of births as explanatory factors. Based on British data, Read et al. (2011) show that short birth intervals of less than 18 months influence mother's later health negatively. In less industrialised societies a spacing of 24 months is recommended between births to keep optimal health (during and after birth) (WHO 2006). It remains unclear to which extent later negative consequences of narrower spacing can be traced back to sociobiological or purely biological factors.

Furthermore, a cross-country comparison of fertility behaviour and health may be a good option in order to explore context effects such as family policy frameworks. Thus, institutionalised childcare services, mothers' work history patterns and their effects on later health could be examined. The change of fertility behaviour in society needs deeper insight into causes and effects of age at first birth.

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## Appendix

*Table 4*: Cohort-specific age of middle-aged first-time mothers in years

| Country | Age of middle-aged first-time mothers in years* | | |
|---|---|---|---|
| | Cohort 1 (< 1938) | Cohort 2 (1939-1947) | Cohort 3 (1948-1954) |
| Austria | 22-26 | 20-24 | 20-24 |
| Belgium | 23-27 | 22-26 | 22-26 |
| Czech Republic | 21-25 | 20-24 | 20-24 |
| Denmark | 22-26 | 21-25 | 22-26 |
| France | 22-26 | 22-26 | 22-26 |
| Germany | 22-26 | 21-25 | 21-25 |
| Greece | 23-27 | 23-27 | 22-26 |
| Italy | 23-27 | 22-26 | 22-26 |
| the Netherlands | 24-28 | 23-27 | 23-27 |
| Poland | 21-25 | 20-24 | 20-24 |
| Spain | 24-28 | 23-27 | 22-26 |
| Sweden | 23-27 | 22-26 | 22-26 |
| Switzerland | 24-28 | 23-27 | 23-27 |

* Based on the country- and cohort-specific median of age at first birth. Middle-aged first-time mothers: Median age +/- 2 years. Young mothers <2 years of median, older mothers >2 years of median age.

*Claudia Karwath, Ilona Relikowski & Monja Schmitt*

# Sibling structure and educational achievement: How do the number of siblings, birth order, and birth spacing affect children's vocabulary competences?

## Geschwisterstrukturen und Bildungserfolg: Zur Bedeutung von Geschwisteranzahl, Geburtenreihenfolge und Geburtenabstand für die Wortschatzkompetenzen von Grundschulkindern

**Abstract**

Empirical evidence suggests that sibling structure influences children's educational outcomes: While the negative effect of the number of siblings is quite consistent, there are mixed findings for birth order and birth spacing. According to the resource dilution hypothesis, differences between siblings occur because siblings have to share family resources. Having a larger number of siblings, being a later-born child as well as narrow age gaps between siblings can affect the parental resources available for each child, which may thus negatively affect educational outcome. To study the effects of sibling structure, we use longitudinal data from the BiKS-8-14 study at the end of elementary school, focusing on children's vocabulary competences.

Our results indicate an expected negative effect for increasing number of siblings particularly when children originate from families with a lower educational background. Regarding birth order, we also find differential effects by parents' education, as only children from less educated families suffer from being a later-born child. No effects can be identified for children's birth gaps in relation to younger siblings as soon as number of siblings is being considered, whereas longer spacing between a child and his/her older siblings is positively related to vocabulary competences. With respect to possible changes across time, sibling effects appear to be rather stable at the end of primary education.

**Zusammenfassung**

Empirische Befunde weisen auf einen Einfluss von Geschwisterstrukturen auf den Bildungserfolg von Kindern hin: Während der negative Einfluss der Geschwisteranzahl als unstrittig gilt, zeigen sich unterschiedliche Ergebnisse hinsichtlich Geburtenreihenfolge und Geburtenabstand. Nach der Resource-Dilution-Hypothese können Disparitäten im Bildungserfolg darauf zurückgeführt werden, dass Ressourcen bei bestimmten familialen Strukturen aufgeteilt werden müssen. Kinder mit einer größeren Geschwisteranzahl, später geborene Kinder sowie Geschwister mit kurzen Geburtenabständen können durch geringere zur Verfügung stehende Ressourcen im Bildungser werb benachteiligt sein. Mithilfe der Längsschnittstudie BiKS-8-14 werden Geschwistereffekte bei Kindern am Ende der Grundschulzeit hinsichtlich ihrer Wortschatzkompetenzen untersucht.

Die Ergebnisse deuten auf einen negativen Effekt größerer Geschwisteranzahl hin, insbesondere bei niedrigem familialen Bildungshintergrund. Mit Blick auf die Geburtenreihenfolge können Nachteile im Wortschatz lediglich für später geborene Kinder aus Familien mit niedrigen Bildungsniveaus festgestellt werden. Hingegen zeigen sich keine Effekte beim Geburtenabstand zu jüngeren Geschwistern, sobald die Anzahl der Geschwister berücksichtigt wird, während sich ein größerer Geburtenabstand zu einem älteren Geschwisterkind positiv auf den Wortschatz auswirkt. Weiterhin erweisen sich die

Auswirkungen von Geschwisterstrukturen am Ende der Grundschulzeit als äußerst konstant.

***Keywords*:** sibling structure, number of siblings, birth order, birth spacing, educational outcome, longitudinal study, family resources

***Schlagwörter***: Geschwister, Geschwisteranzahl, Geburtenreihenfolge, Geburtenabstand, Bildungserfolg, Längsschnittstudie, familiale Ressourcen

## 1. Introduction

Empirical research has repeatedly revealed the persistence of educational inequalities caused by families' human capital, economic, and cultural resources (e.g., Baumert et al. 2001; Prenzel et al. 2004; Becker 2004). Current research increasingly focuses on characteristics influencing a child's educational success in addition to classical social background characteristics as well as on underlying mechanisms leading to resource-specific educational outcomes. From this perspective, the family structure (such as single-parent families or family size) is an important dimension worth gaining attention (e.g., McLanahan/Sandfur 1997; Ginther/Pollak 2003; Hannan/Halpin 2014). One crucial aspect of family structures concerns the role of siblings in the course of educational attainment, as components of sibling structures can generate inequalities.

Particularly U.S. studies provide evidence that children's number of siblings, their position in the birth order as well as their age gaps to other siblings exert influence on various educational outcomes, such as intelligence, school attainment, competence achievement, but also on employment, partnerships, or health outcomes (e.g., Hauser/Sewell 1985; Downey 1995; Conley 2000; Steelman et al. 2002; Wolter 2003; Black et al. 2005; Caceres-Delpiano 2005; Kantarevic/Mechoulan 2006; Buckles/Munnich 2012; Nguyen 2013). This research focus has been largely neglected in the German context so far. Although studies on diverse sibship topics, for instance relationships of siblings or rivalry between siblings, are quite elaborated (e.g., Kasten 1993a, 1993b, 1998, 2003), empirical research in the context of sibship and education is rather rare (e.g., Bauer/Gang 2001; Helbig 2013; Schulze/Preisendörfer 2013) and should therefore be pursued in a more comprehensive way.

One prominent explanation on why sibship structure should be relevant for educational outcomes has been contributed by the resource dilution hypothesis, which states that the availability of family resources is dependent on the number of children. In larger families, resources (e.g., parental time or monetary resources) have to be distributed among more children, which could negatively affect their educational outcomes. Furthermore, additional effects on family resources are expected for birth spacing and birth order, as, for instance, smaller birth gaps may additionally reduce parental attention paid to each child, and first-born children could potentially benefit more from time spent with their parents than later-born siblings.

However, from an empirical perspective the picture is not that clear. While empirical findings quite consistently show a negative effect of an increasing number of siblings on educational outcomes (e.g., Downey 1995; Conley/Glauber 2005), some studies do not identify an independent effect of sibling group size when additionally controlling for birth order (e.g., Black et al. 2005; Helbig 2013). Although birth order effects are mostly reported to advantage first-borns and disadvantage last-borns (e.g., Behrman/Taubman 1986; Härkönen 2014), these findings are inconsistent, as some studies report opposite (e.g., Ejrnaes/ Pörtner 2002) or no effects (e.g., Hauser/Sewell 1985). Similarly, some studies reveal no effects of birth spacing on educational outcomes at all (e.g., Nguyen 2013), whereas others confirm a negative effect of short birth gaps (e.g., Buckles/Munnich 2012; Powell/Steelman 1990, 1993). Besides – with only a few exceptions (e.g., Hanushek 1992; Iacovou 2001) – it is longitudinal analyses that are missing in this field of research, although it should be an interesting aspect to examine the changing character of sibling effects over time.

In this paper, our aim is to analyze the effect of sibling group size, birth order, and birth spacing on the competence development of elementary school students in Germany. Using data from the BiKS research group ("Educational processes, competence development and selection decisions in preschool- and school age") allows us to study children's vocabulary competences across three biannual time points in the two German federal states of Bavaria and Hesse. Before presenting our empirical approach and results, a review of the theoretical background and current state of research on sibling structure and educational outcome is given in the following.

## 2. Sibling effects: Theoretical considerations and empirical evidence

Concerning the effects of siblings on educational outcomes, various theoretical assumptions and a large body of empirical research exist. However, this has mostly been conducted in the U.S. context, while in the German research literature, the role of sibling components, such as the relationships of siblings or birth order, are merely addressed theoretically (e.g., Kasten 1993a, 1993b, 1998, 2003; Pinquart/Silbereisen 2009; Keddi et al. 2010) and rarely analyzed empirically. We are only aware of five empirical studies in Germany that analyze the relationship of sibship and educational outcomes (Bauer/Gang 2001; Jacob 2010; Schulze/Preisendörfer 2013; Helbig 2013; Härkönen 2014).

From a theoretical perspective, two main approaches are prevalent to explain the influences of sibship on educational outcomes: the confluence model and the resource dilution hypothesis.

## The confluence model

The confluence model of Zajonc/Markus (1975) explains the development of intellect in a family by taking the following factors into consideration: family size, birth order, and age spacing. The authors argue that all three factors influence the intellectual development altogether. The confluence model assumes a decreasing intellectual environment with increasing family size as the family intelligence level is divided by the number of family members[1]. Consequently, Zajonc/Markus (1975) presume that first-born children tend to have a better intellectual development, because they share the intellectual environment only with their parents. In contrast, a newborn (additional) child is born into a lower intellectual environment that must be shared with the parents and the older sibling. Besides, birth spacing is regarded as relevant: longer spacing supposedly signifies an advantage, as the intellectual environment of the whole family rises – even though the overall family size increases – during longer periods of birth gaps, which should, in turn, be beneficial to the newborn child. However, this approach cannot be tested with our data and also needs to be criticized. Since the model entirely concentrates on intellectual development, it does not sufficiently explain in which way the intellectual environment influences educational outcomes (Powell/Steelman 1990; Steelman et al. 2002), and while family size effects are consistent with the theory's assumption, there is criticism that birth order or birth spacing are not (Steelman et al. 2002).

## The resource dilution hypothesis

In our study, we therefore primarily focus on the second approach: the resource dilution hypothesis. This hypothesis was first brought up by Dumon (1890) and was further developed e.g., by Blake (1989) and Steelman et al. (2002). The underlying mechanism can be explained easily: In each family, resources are available that need to be shared between children. Family resources include several kinds of resources such as parental time spent with children (e.g., Blake 1989; Hanushek 1992), material goods (e.g., Powell/Steelman 1989, 1991, 1993), cultural opportunities (e.g., Blake 1989; Downey 1995), intellectual stimulation (e.g., Powell/Steelman 1990), and human capital (e.g. Bagger et al. 2013), to mention just a few examples.

1 Zajonc/Markus (1975) calculate the intellectual environment of families the following way: Each parent has an intellectual value of 100, whereas newborns have a value of near zero. The value of newborns increases with age, which leads to an increase of the intellectual environment within the family. Considering this assumption, the intellectual environment for a family with two parents and a newborn is calculated as follows: (100 + 100 + 0)/3 = 67. However, for a family with two parents, a first-born child that has reached an intellectual value of 40 and a second born child with a value of near zero, the intellectual environment decreases to (100 + 100 + 40 + 0)/4 = 60.

### Number of siblings

"The amount of resources that can be allocated to any given child, though, depends not only on the amount of resources in the family (e.g., parental income) but also upon the number of children (and, collaterally, how they are spread out in age). In other words, the larger the family, the greater the dilution of resources, and in turn the lower the educational progress of the child" (Steelman et al. 2002: 251). Therefore, the driving factor in this model is the number of children, which influences the amount of resources available within a family.

Since the mid-1960s the function of sibship size has been conclusively proven empirically, revealing a quite consistent picture and confirming the model's assumption: With a rising number of siblings, educational outcomes decrease (e.g., Blau/Duncan 1967; Featherman/Hauser 1978; Blake 1981, 1985, 1989; Hanushek 1992; Powell/Steelman 1993; Downey 1995; Conley/Glauber 2005; Jaeger 2007; Bagger et al. 2013; Helbig 2013), and this negative effect of sibling group size remains robust also when families' socioeconomic positions are being considered (e.g., Blake 1989; Iacovou 2001). However, Bauer and Gang (2001) did not identify an overall sibship size effect with respect to years of schooling in the German context, expect for the group of West German males and foreign-born females both having only sisters in the family. The authors attribute the non-significant main effect of sibling size to comparatively low costs of schooling in Germany.

### Birth order

Linking the resource dilution model to birth order, it is assumed that children born in different sibling ranks should be affected by the resource distribution. For example, first-borns do not have to share family resources, such as parental time or parental involvement, with other siblings – at least for a certain amount of time – a condition from which first-born children particularly benefit (e.g., Behrman/Taubman, 1986; Steelman et al. 2002; Jaeger 2007) early in life and which they may maintain even later on (e.g., Kantarevic/Mechoulan 2006), whereas later-born children have to share these kind of resources with their older siblings right from the beginning.

Although empirical evidence with regard to birth order is quite mixed, it is mostly first-born children that are found to have better educational chances than later-borns, as shown by Behrman/Taubman (1986), Iacovou (2001), Kantarevic/Mechoulan (2006), Bagger et al. (2013), Schulze/Preisendörfer (2013), and Härkönen (2014) for different educational outcomes (such as years of schooling, school grades, or test scores). However, other researchers could not discover the theoretically expected positive effects for first-borns (e.g., Jaeger 2007; Ejrnaes/Pörtner 2002). According to Hauser and Sewell (1985), there is no independent influence of birth order on educational attainment as soon as relevant variables (such as parental education) are controlled for, as "[…] the effect of the socioeconomic variables, particularly parents' education, eliminates the suppressor effect that led to the appearance of birth order differentials in schooling" (Hauser/Sewell 1985: 19).

For Germany, recent studies by Helbig (2013) and Schulze/Preisendörfer (2013) have also revealed mixed results: According to Helbig (2013), the fact of having older siblings who attended the academic secondary school track ("Gymnasium") or acquired the German university entrance qualification ("Abitur") increases children's chances to attend the academic track themselves. If this is not given, transition probabilities are negative for the younger child. The positive finding could be explained by parents' higher educational aspirations for their children when older children attended "Gymnasium" or acquire "Abitur" (Helbig 2013). Schulze/Preisendörfer (2013) show that parents of high socioeconomic status show lower educational aspirations for their later-borns if older children have already reached a higher secondary educational degree. The contrary is the case in less privileged families: Here, older siblings' participation in higher secondary education leads to more ambitious educational aspirations for the younger child. These results are explained by the family's motive for status maintenance, which in families of high socioeconomic status is already achieved as soon as an older child reaches a higher level of education, whereas in families of lower socioeconomic status parents "learn" from their older children and therefore increase their educational aspirations for the younger children (Schulze/Preisendörfer 2013).

### Birth spacing

Besides the number of siblings and birth order, birth spacing can influence the dilution of resources as well. Larger birth gaps can positively influence economic investments in children, as parents with children born in wider intervals have the opportunity to recoup their capital for expensive investments in all their children (Steelman et al. 2002). Close spacing, on the one hand, is assumed to be disadvantageous, as families – for example – might not be able to afford tuition fees for each child during their school years (e.g., Powell/Steelman 1993) or parents have to limit their time spent with each child (e.g., reading and playing; Powell/Steelman 1990, 1993; Buckles/Munnich 2012). On the other hand, short birth gaps can also be positive in some respect, as parents have the opportunity to share the costs of clothes or toys between closely aged children (Steelman et al. 2002).

Generally, research on birth spacing and educational outcomes appears to be less prominent when compared with analyses on number of siblings and birth order, which is mainly a problem of data availability on birth gaps. Due to data constraints, birth spacing is often measured inappropriately (Powell/Steelman 1993; Petterson-Lidbom/Thoursie 2009) and is sometimes even replaced by the use of birth order or family size (Powell/Steelman 1993).

The few existing studies are mainly supporting the theoretical assumptions: For example, Powell/Steelman (1990, 1993) found negative effects of short birth gaps on verbal and math abilities, school grades, and high school completion, as well as attending post-secondary education, and closer birth spacing negatively affects the dilution of family resources, such as reading to children in preschool, verbal interaction with parents, and economic investments in children. Black et al. (2005) also identify a significant effect of birth spacing for earlier born children in families having lower educational outcomes when two

closely spaced younger siblings are present. Buckles/Munnich (2012) show positive effects of longer spacing on math and verbal test scores for older – but not for younger – siblings and find higher parental investment in older siblings when birth gaps are larger: The likelihood of daily reading to the older child at preschool age increases with longer spacing, whereas the older child's time spent watching television decreases with larger birth gaps. Furthermore, the likelihood of having more books in the household increases with longer spacing. Nguyen (2013)[2] shows positive as well as no effects of birth spacing for different stages in the life course considering various educational outcomes. In young adulthood, both younger and older siblings profit from longer spacing with regard to years of education; however, concerning the likelihood of college enrollment only younger siblings are found to benefit from larger gaps. No birth spacing effects could be identified for the groups of adolescents and young adults on test scores as well as for the group of adults on the outcomes of years of schooling, college degree, and labor earnings. These findings suggest that the effect of birth spacing on educational outcomes and family resources changes across the life course (Nguyen 2013).

## Extensions to the resource dilution model

Although the resource dilution hypothesis easily explains the mechanism of sibling structure on educational success, the theory's assumptions can be further extended, as they do not regard specifications such as interdependencies of sibling structure components, group effects or a longitudinal perspective.

### Interdependency of sibling structure components

First, the model does not consider the interdependency between sibling size, birth order, and birth spacing influencing the distribution of family resources and thus affecting children's educational outcomes. For example, Hanushek (1992) found no birth order effects for small families and a U-shaped effect for children in larger families, as first- or last-born children achieve a higher educational performance. Additionally, Härkönen (2014) and Hauser/Sewell (1985) found smaller birth order effects in larger families. These results indicate advantages for first-born children early on in life when living in a larger family and therefore receiving more attention – just as later-born children who enjoy these advantages later on in their life course (e.g., Hauser/Sewell 1985; Hanushek 1992; Härkönen 2014). However, Black et al. (2005), Conley/Glauber (2005), and Helbig (2013) could not identify sibship size effects when birth order is controlled for. In these studies, the sibling effect on educational outcomes refers back to having older siblings.

2 The author examined three different life stages, divided into adolescence (12 to 18 years), young adulthood (19 to 24 years), and adulthood (25 to 32 years). Depending on these life stages, different educational outcomes were being considered: test scores for the groups of adolescents and young adults, years of schooling for the groups of young adults and adults, or labor earnings for the group of adults.

Moreover, the interrelation of birth order and birth spacing can also be assumed to affect the distribution of family resources: Assuming that first-born children per se benefit of family resources until another newborn arrives, this positive effect should increase with wider age gap to the next sibling. Price (2008, 2010), for example, found a higher investment of parental time in first-born children when birth gaps are large, as differences for birth order additionally increase with wider age spacing. In contrast, even negative effects for first-born children are conceivable. For example, later-born children may profit from higher financial resources as family income increases with parents' age (e.g., Kalmijn/ Kraaykamp 2005; Jaeger 2007; Zerle et al. 2012), moreover so when birth spacing among children is larger (e.g. Behrman/Taubman 1986). As shown by Powell/Steelman (1995), lower financial investments are made for older siblings when children are closely spaced. The authors generally suggest that later-born children have advantages in terms of parental support, as they benefit from parents' later life cycle and furthermore from the self-reliance of their older siblings (e.g., moving out from the household).

Another assumption, which has been neglected in the resource dilution model, is the important role of older siblings, particularly those with larger birth gaps: older siblings can also function as role models and teachers, because with larger gaps the older siblings' competences and knowledge become more advanced – hence, turning into a resource per se, from which the younger sibling can benefit. For example, Helbig (2013) found that older children increase the competences of their younger siblings by teaching them, which becomes especially evident in single-parent households.

### Differential group effects

Additionally, the resource dilution model cannot successfully explain why the effect of sibship size on educational outcomes differs for various groups (e.g., high-income versus low-income families or different religious groups; Steelman et al. 2002) as evidenced by some studies. For example, Downey/Neubauer (1998) found a larger number of siblings to negatively affect educational success of children from high-income, but not from low-income families. This finding suggests that an increasing number of siblings especially affects surplus resources (e.g., resources for long-term opportunities, which are not necessary for survival), as parents invest in surplus resources only when the base resources (e.g., resources necessary for survival) are ensured (Downey 2001; Steelman et al. 2002). However, Iacovou (2001) showed the opposite effect, as children with non-manual family background face fewer disadvantages than children originating from families working in manual occupations or families with financial problems when the number of siblings increases. For birth order, Iacovou (2001) found no overall effect assuming that families with varying financial constraints are differently affected by the number of children, because families with a higher social background are better able to take out a loan for investments in their children.

Longitudinal perspective

A further point of critique of the resource dilution hypothesis concerns the lack of assumptions regarding children's development, and thus refrains from taking a life course perspective. For example, first-born children should profit of both longer birth spacing and an initial advantage, supposedly lasting for a lifetime, while the further skill development of siblings is assumed to run parallel. The same holds true for empirical work on sibling structure effects: although often panel data sets are used (e.g., National Longitudinal Survey of Youth 1979 (NLSY79), National Longitudinal Study of Adolescent Health (Add Health), Wisconsin Longitudinal Study (WLS)), it is cross-sectional methods that are mainly applied, studying educational outcomes at one point in time. Possible changes in the effects of sibling structure on educational outcomes or even on later life outcomes are therefore not being considered (e.g., Kantarevic/Mechoulan 2006; Buckles/Munnich 2012).

To our knowledge, only two studies exist that employ longitudinal analyses (Hanushek 1992; Iacovou 2001). Hanushek (1992) focused on vocabulary and reading competences from school grade two to six in the US, indicating that achievement growths weaken with a rising number of siblings. No effects on achievement outcomes were identified for birth order, spacing or age structure of the family when family size was controlled for. Hanushek (1992) concluded that achievement growth during school time particularly is ascribed to the number of (competing) siblings and the quality of parental time. Likewise, Iacovou (2001) analyzed the relationship between the number of siblings and birth order on mathematics and reading test scores at age 7, 11, and 16 for the UK. Overall, results show lower performance in mathematics and reading over time with increasing number of siblings and for later-born children.

To sum up, the theoretical assumption of the resource dilution hypothesis can substantively contribute to the explanation of sibling structure effects on educational outcome and is largely supported empirically. However, the model needs to be extended with respect to the interdependency of sibling structure effects, mechanisms leading to differential group effects, and assumptions concerning varying effects over the life course.

## 3. Research questions and hypotheses

Studying the role of sibship size, birth order position, and birth spacing for children's competence development, we pose the following questions:

*1. Does a larger number of siblings negatively affect educational achievement?*
In line with the resource dilution hypothesis, most studies on sibship size confirm a negative effect on educational outcomes with an increasing number of siblings (e.g., Downey 1995; Härkönen 2014), as family resources decrease with every additional child. Children from larger families receive less parental time (e.g., reading), fewer material investments

from their parents, or fewer cultural activities (e.g., Blake 1989; Powell/Steelman 1989, 1991, 1993) from which they can benefit. Therefore, we expect lower educational outcomes for children with a higher number of siblings.

2. *Do first-born children show better educational outcomes compared to later-born children?*

Consistent with the resource dilution hypothesis, most empirical findings on birth order show an educational advantage of being a first-born child (e.g., Behrman/Taubman 1986; Schulze/Preisendörfer 2013), as to be explained by the advantage of being an only child before a newborn arrives. In this phase, first-born children benefit from the undivided family resources in terms of parental time (e.g., reading to or playing with child) or having stronger endowment effects (e.g., Price 2008). Thus, we expect first-born children to reach higher achievement levels than later-borns.

3. *Do children's educational outcomes vary by the size of the age gap to their younger or older siblings?*

Beyond effects of sibship size and birth order, we are interested in whether or not differences in educational achievement are linked to birth spacing. As assumed by the resource dilution hypothesis and indicated by some previous research, educational outcome decreases with smaller birth gaps (e.g., Powell/Steelman 1990). Therefore, we expect longer birth spacing to have positive effects on children's achievement, as with larger birth gaps the available parental resources can be distributed more evenly between the children. In addition to this assumption of the resource dilution hypothesis, we further expect an interdependent sibling structure effect: For earlier born children, a small birth gap to a younger sibling may be of particular disadvantage, as the newborn demands special attention, which might be provided at the cost of the older child. As with regard to later-born children, a larger age gap to the older siblings could be particularly beneficial, because the latter could function as role models and teachers to the younger sibling and therefore become an additional family resource per se. Alternatively, older siblings do not need the same amount of parental attention (e.g., in doing homework) as do younger siblings because of their higher degree of self-reliance (e.g., Powell/Steelman 1995).

4. *How does families' socioeconomic and cultural background influence sibling structure effects?*

As theoretically assumed, some studies show the independent relevance sibling structure exerts on children's educational outcomes above and beyond the families' socioeconomic status (e.g., Blake 1989; Iacovou 2001). Besides, studies revealed differential sibling structure effects with respect to family background. For example, interaction effects are found for families' social status and sibling size, indicating positive effects for higher status families with increasing number of siblings, whereas lower social status families evidence negative effects when having more children (e.g., Iacovou 2001). This suggests that families with different social backgrounds vary in their opportunities to compensate sibling structure effects. According to these results, we first assume sibling structure effects

to be relevant even when family background is held constant and second, as an extension of the resource dilution model, we expect an additional disadvantage of having a larger number of siblings, being a later-born child, and of close birth spacing for children from lower socioeconomic and cultural background.

5. *If there is evidence for sibling structure effects on educational outcomes, do they remain stable or vary across the two school years under study?*

Up to now, only little is known about any possible time-varying influences of sibling structure (Hanushek 1992; Iacovou 2001). Therefore, no general hypothesis is formulated in this regard. However, when looking at the specific educational stage under study – the end of primary education – this is well known to be an important time in children's educational career, as the transition to secondary school is most crucial in the German school system. It largely determines children's further educational opportunities, as the hierarchically organized secondary school types strongly vary in curricula and performance requirements. Hence, one could assume that family resources become increasingly relevant with the approaching transition to secondary school as the pressure on children's academic achievement rises. Thus, parental time and effort spent on the child may gain importance during this particular space of time, which could imply stronger effects of sibling structure. However, there is also reason to assume stability of sibling effects at the end of elementary school, as – for instance – the initial advantage of being a first-born (receiving undivided attention from the parents) should be established in early childhood and might constantly persist during the later course of childhood, as siblings' further development may run rather parallel.

## 4. Data and variables

To answer our research questions, we use data from the interdisciplinary longitudinal study BiKS ("Bildungsprozesse, Kompetenzentwicklung und Selektionsentscheidungen im Vorschul- und Schulalter [Educational processes, competence development and selection decisions in preschool- and school age]"). The BiKS study is composed of two longitudinal surveys running from 2006 to 2012: BiKS-3-10, following kindergarten children (from age 3 up to age 5) into elementary school (from age 6 up to age 10), and BiKS-8-14, following children from age 8 up to age 14 (von Maurice et al. 2007).

In our analysis, we concentrate on the first three waves of BiKS-8-14, which were conducted biannually when children attended third and fourth grade of elementary school in the years 2006 to 2007. The sample consists of overall 2,395 children distributed across 155 classes within 82 schools in two German federal states (51 schools in Bavaria, 31 schools in Hesse). Different research instruments were implemented: competence measurements, paper-and-pencil questionnaires for children as well as for teachers, and telephone interviews with the parents (von Maurice et al. 2007).

Besides the achievement measures of children's vocabulary competences repeated in all three waves, we use data from the parents' questionnaire providing information on the target child, the siblings, the family structure, and family resources. Thus, in comparison with many other data sources applied for sibling structure research, the BiKS study offers a wide range of research potential, as the longitudinal design allows analyzing children's competence developments over time and provides very specific information both on the target child and on all the siblings.

In the first wave, our analytical sample comprises 2,009 children after case-wise deletion of children with missing values on relevant indicators. Due to panel mortality, the sample has been reduced down to 1,807 at the second and to 1,607 at the third wave. We consider all children participating in at least one of the three waves, which results in a total case number of 2,098.

As we pursue to capture actual differences in achievement rather than performance subjectively affected by teachers' judgments (such as school grades), we focus on children's competence test scores in vocabulary. Children are found to vary in their vocabulary development during school time (e.g., Nagy/Herman 1987), also depending on their parents' educational and socioeconomic background (e.g., Chall et al. 1990; Chall/Jacobs 2003; Hart/Risley 1995, 2003). The German version of the vocabulary subtest of the culture fair intelligence test (CFT 20, WS; Weiß 1998) measures the vocabulary of the vernacular, comprising 30 words for which children have to select synonyms that are presented to them as predefined response options[3]. The mean test scores in the sample increase from 14.62 at wave one to 19.35 in wave three.

Sibling structure is measured as follows[4]:

The number of siblings is given by the absolute number of a child's siblings including biological, adopted, foster, and stepchildren. The number of the target child's siblings ranges from 0 to 10, with a mean of 1.31.

Birth order was generated by the birth dates of all children in the family. As most of the children are either first- (47%) or second-born (37%), with only 13% being third-born and 3% fourth- or later-born children, we coded the birth order as a dummy variable: 0 for first-born and 1 for later-born target children.

Birth spacing is defined as the difference in age of the target child in relation to the next older and next younger child in years. We categorized birth spacing into small birth gaps (range: 0 to 2 years), middle range birth gaps (range: more than 2 up to 6 years) and large birth gaps (range: more than 6 years). The intermediate category is chosen as refer-

3 Note that the processing time for vocabulary measure was 10 minutes in the first wave and 8 minutes in the second and third wave; however, this should not affect our results concerning sibling-structure effects in any substantial way.

4 Changes in sibling structure across waves occurred in only about 1% of all families in the sample and are therefore neglected.

ence. Furthermore, we operationalized two dummy variables, indicating whether or not any older or younger siblings are present (0 = an older or younger sibling is present and 1 = no older or younger sibling is present). In total, 54% of the target children have older siblings with a mean birth gap of 2.33 years, and 45% have younger siblings with a mean gap of 1.49 years.

Family resources were measured by the following indicators:

First, the highest ISEI (International Socio-Economic Index of Occupational Status) score in the household (Ganzeboom et al. 1992) represents the families' socioeconomic resources. On average, parents hold a score of 50.75 in the sample.

Second, families' human capital is measured by parents' highest educational level (1 for high educational level = at least higher secondary educational degree "Abitur" and 0 for lower educational level = intermediate secondary educational degree "Mittlere Reife" or less). Overall, 43% of all children are from families with a high educational level.

Third, cultural capital in the family is captured by parents' activities with the target child. The main caregivers were asked "In the past year, how many times did you visit the following places together with [target child]?", containing the following five options of "museum", "library", "children's theater", "children's concert", and "zoo or wildlife park". Parents could respond with "at least once a week", "at least once a month", "several times a year", "less than several times a year", "never". The items are considered as a composite measure derived from factor analysis with an alpha of .55.

Additionally, the age of the main caregiver at the target child's birth is considered (in years) with a mean age of 29.48 in the sample. In 92% of the cases, the main caregivers are mothers.

In all models, the following control variables are considered:

A dummy variable indicating whether the target person is an only child, the child's age, gender, and whether he/she has a migration background.

Table 1 provides a descriptive overview of the indicators used.

*Table 1*: Description of variables

| Variable | Description of variable | N | Mean | Std. dev. | Min. | Max. |
|---|---|---|---|---|---|---|
| | **Dependent Variable** | | | | | |
| Vocabulary | CFT 20, WS, range 0-30<br>Wave 1 (2nd semester grade 3) | 2009 | 14.62 | 4.93 | 0 | 29 |
| | CFT 20, WS, range 0-30<br>Wave 2 (1st semester grade 4) | 1807 | 17.38 | 4.60 | 3 | 28 |
| | CFT 20, WS, range 0-30<br>Wave 3 (2nd semester grade 4) | 1607 | 19.35 | 4.55 | 2 | 29 |

| Variable | Description of variable | N | Mean | Std. dev. | Min. | Max. |
|---|---|---|---|---|---|---|
| | | **Sibling structure** | | | | |
| Number of siblings | Total no. of target child's siblings | 2098 | 1.31 | .99 | 0 | 10 |
| Birth order | First-born = 0; later-born = 1 | 2098 | .53 | – | – | – |
| Birth spacing to younger siblings | Age gap to next younger sibling; up to 2 years | 2098 | .66 | – | – | – |
| | Age gap to next younger sibling; more than 2 up to 6 years | 2098 | .29 | – | – | – |
| | Age gap to next younger sibling; more than 6 years | 2098 | .05 | – | – | – |
| No younger siblings | 0 = having younger siblings; 1 = no younger siblings | 2098 | .55 | – | – | – |
| Birth spacing to older siblings | Age gap to next older sibling; up to 2 years | 2098 | .58 | – | – | – |
| | Age gap to next older sibling; more than 2 up to 6 years | 2098 | .31 | – | – | – |
| | Age gap to next older sibling; more than 6 years | 2098 | .11 | – | – | – |
| No older siblings | 0 = having older siblings; 1 = no older siblings | 2098 | .47 | – | – | – |
| | | **Family resources** | | | | |
| HISEI | Highest ISEI score in the household, range 16-90 | 2098 | 50.75 | 16.28 | 16 | 90 |
| Highest education | Highest educational level in the household,0 = low; 1 = high | 2098 | .43 | – | – | – |
| Cultural capital | Factor score of parents' activities with the target child | 2098 | .00 | .1.01 | -2.03 | 3.74 |
| Age at child birth | Main caregiver's age at target child's birth in years | 2098 | 29.48 | 5.23 | 15 | 58 |
| | | **Control variables** | | | | |
| Only child | 0 = siblings present; 1 = only child | 2098 | .15 | – | – | – |
| Age | Target child's age in years at wave 1 | 2098 | 9.50 | .58 | 8 | 12 |
| Gender | Target child's gender, 0 = male; 1 = female | 2098 | .48 | – | – | – |
| Migration back-ground | 0 = target child's parents born in Germany; 1 = at least one parent born abroad | 2098 | .22 | – | – | – |

## 5 Methodological approach

In order to study sibling effects across three waves including possible changes over time, we apply linear latent growth curve models (LGMs). The average competence level of the three waves is taken as a dependent variable, and an overall pattern of change over time can be investigated alongside effects of explanatory variables on the temporal pattern.

Stepwise, we include additional indicators in altogether 14 models (with control variables considered in all models to hold differences occurring to these attributes constant). To examine the overall effect of all sibling features, we estimate separate models for the three components of sibling structure (number of siblings, birth order, and birth spacing) with and without controlling for family resources. Furthermore, significant interaction terms are presented testing for differential group effects, and slope effects are estimated separately for each sibling indicator to capture respective changes across waves.

*Table 2*: Linear latent growth curve models (LGMs) on vocabulary test scores (wave 1-3): Number of siblings and birth order

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| **Wave** | 2.44** | 2.27** | 2.31** | 2.20** | 2.27** | 2.31** | 2.22** |
| **Sibling structure** | | | | | | | |
| Number of siblings | -.72** | -.68** | -.78** | -.73** | -.62** | -.62** | -.70** |
| Birth order | | | | | -.43* | -.48+ | -.34 |
| **Family resources** | | | | | | | |
| HISEI | | .03** | | .03** | .03** | | .03** |
| Highest education | | 1.41** | 1.81** | 1.41** | 1.39** | 1.95** | 1.39** |
| Cultural capital | | .23* | | .23* | .21* | | .21* |
| Age at child birth | | .06** | | .06** | .07** | | .07** |
| **Interaction terms** | | | | | | | |
| Number of siblings* highest education | | | .34+ | | | | |
| Birth order*highest education | | | | | | .55+ | |
| **Slope effects** | | | | | | | |
| Number of siblings*time | | | | .05 | | | .07 |
| Birth order*time | | | | | | | -.08 |
| **Control variables** | | | | | | | |
| Only child | -.25 | -.33 | -.20 | -.34 | -.50 | -.33 | -.50 |
| Age | -.40* | -.06 | -.14 | -.06 | -.06 | -.14 | -.06 |
| Gender | -.29 | -.31 | -.29 | -.31 | -.30 | -.28 | -.30 |
| Migration background | -1.54** | -1.26** | -1.56** | -1.26** | -1.28** | -1.59** | -1.28** |
| **Constant** | 20.02** | 12.59** | 16.60** | 12.66** | 12.53** | 16.75** | 12.58** |
| **Random part** | | | | | | | |
| Slope variance | .99 | 1.00 | .99 | .99 | .99 | .99 | .99 |
| Intercept variance | 18.26 | 16.69 | 17.04 | 16.69 | 16.68 | 17.01 | 16.67 |
| Intercept/slope covariance | -1.50 | -1.51 | -1.50 | -1.51 | -1.52 | -1.49 | -1.52 |
| Wave: variance | 4.77 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 |

Source: BiKS 8-14, wave 1-3, + p<0.10, * p<0.05, ** p<0.01, n(observations): 5423, n(children): 2098, linear regression models with random intercept and random slope (robust standard errors), ICC of null model at 2nd level: .83

*Table 3*: Linear latent growth curve models (LGMs) on vocabulary test scores (Wave 1-3): Birth spacing

| | Model 8 | Model 9 | Model 10 | Model 11 | Model 12 | Model 13 | Model 14 |
|---|---|---|---|---|---|---|---|
| **Wave** | 2.48 ** | 2.44 ** | 2.26 ** | 2.22 ** | 2.45 ** | 2.27 ** | 2.09 ** |
| **Sibling structure** | | | | | | | |
| Number of siblings | | -.72 ** | -.70 ** | -.74 ** | -.66 * | -.63 ** | -.70 ** |
| *Birth spacing to younger siblings:* | | | | | | | |
| <= 2 years | -.60 + | -.35 | -.41 | -.37 | | | |
| > 6 years | -.17 | -.08 | .16 | .03 | | | |
| No younger siblings | .34 | .01 | .01 | .01 | | | |
| *Birth spacing to older siblings:* | | | | | | | |
| <= 2 years | | | | | .22 | .36 | .21 |
| > 6 years | | | | | .84 * | .84 * | .73 + |
| No older siblings | | | | | .39 | .30 | .30 |
| **Family resources** | | | | | | | |
| HISEI | | | .03 ** | .03 ** | | .03 ** | .03 ** |
| Highest education | | | 1.38 ** | 1.38 ** | | 1.42 ** | 1.42 ** |
| Cultural capital | | | .21 * | .21 * | .20 * | .20 * | |
| Age at child birth | | | .07 ** | .07 ** | | .07 ** | .07 ** |
| **Slope effects** | | | | | | | |
| Number of siblings*time | | | | .05 | | | .07 |
| *Birth spacing to younger siblings*time:* | | | | | | | |
| <= 2 years*time | | | | -.04 | | | |
| > 6 years*time | | | | .11 | | | |
| *Birth spacing to older siblings*time:* | | | | | | | |
| <= 2 years*time | | | | | | | .14 |
| > 6 years*time | | | | | | | .11 |
| **Control variables** | | | | | | | |
| Only child | .89 ** | -.12 | -.17 | -.17 | -.41 | -.50 | -.51 |
| Age | -.48 ** | -.40 * | -.05 | -.05 | -.41 * | -.07 | -.07 |
| Gender | -.24 | -.27 | -.29 | -.29 | -.27 | -.29 | -.29 |
| Migration background | -1.67 ** | -1.56 ** | -1.28 ** | -1.28 ** | -1.59 ** | -1.31 ** | -1.31 ** |
| **Constant** | 19.87 ** | 20.16 ** | 12.47 ** | 12.51 ** | 19.69 ** | 12.08 ** | 12.26 ** |
| **Random part** | | | | | | | |
| Slope variance | 1.00 | .99 | 1.00 | .99 | .99 | .99 | .98 |
| Intercept variance | 18.64 | 18.24 | 16.67 | 16.66 | 18.20 | 16.63 | 16.62 |
| Intercept/slope covariance | -1.53 | -1.50 | -1.53 | -1.53 | -1.51 | -1.53 | -1.52 |
| Wave: variance | 4.76 | 4.77 | 4.76 | 4.76 | 4.77 | 4.76 | 4.77 |

Source: BiKS 8-14, wave 1-3, + p<0.10, * p<0.05, ** p<0.01, n(observations): 5423, n(children): 2098, linear regression models with random intercept and random slope (robust standard errors), ICC of null model at 2nd level: .83

As children in the BiKS sample are clustered in school classes, we review whether the consideration of a third-level – the level of school classes – is necessary. However, only about 4% of variance in vocabulary competences is due to differences between school classes. Therefore, a two-level random intercept, random slope model is applied to analyze individual change in vocabulary competences over time. In order to capture the clustering of children in school classes sufficiently, robust standard errors are estimated.

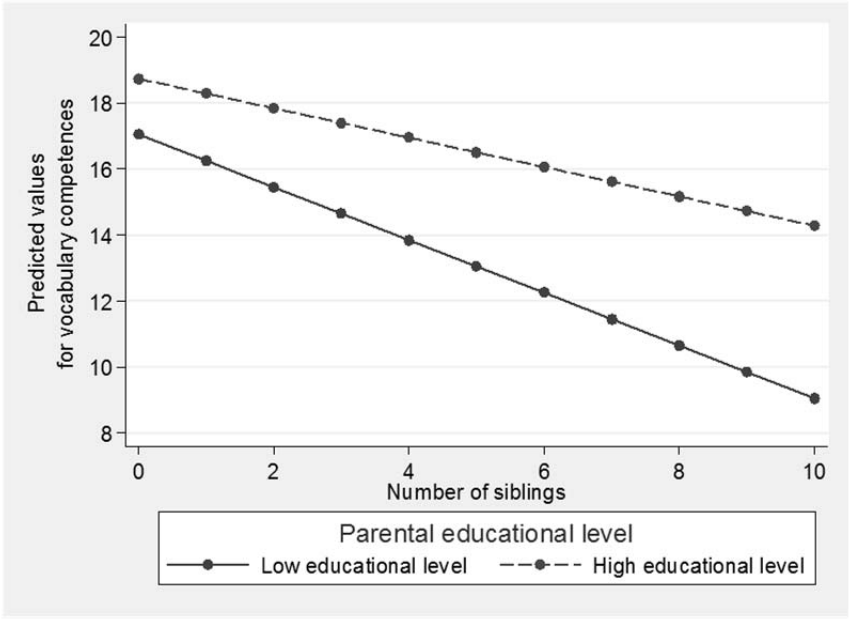
## 6 Results

The multivariate regression results are displayed in Table 2 and 3. In a first step, the number of siblings is introduced in addition to the control variables (model 1). As expected from the theoretical and empirical literature, it can be confirmed that, on average, more siblings mean lower vocabulary competences. In a next step, it is the independent effect of sibship size on families' socioeconomic, cultural resources and the parent's age at child birth that is particularly being considered (model 2): the negative effect of the number of siblings decreases only slightly from -.72 to -.68 and remains highly significant. Thus – in line with our hypothesis – sibling size substantially affects competences beyond family resources. However, as suggested from prior research, family resources may be diluted differently, depending on the families' social status. Therefore, we are not only interested in the overall net effect of sibling indicators, but also in possible differential effects by parents' resources. Consequently, all theoretically relevant interaction terms were tested, resulting in one significant effect concerning the number of siblings reported in model 3 and illustrated in figure 1: Particularly when children originate from families with lower educational background, a higher number of siblings mean a widening additional disadvantage for children's vocabulary competences. This confirms the assumption that families with a higher educational level can better compensate for this negative effect, because their children are able to benefit more from the culture capital that rests within the family. This is particularly relevant, as lower educated parents on average have more children (2.36) than higher educated ones (2.25). Concerning changes over time, we modeled the slope effect for number of siblings in model 4, which does not reveal a significant result. Thus, the children's number of siblings has a stable influence during third and fourth grade of elementary school.

Models 5 to 7 investigate the significance of birth order controlling for family size. The theoretically expected negative effect of being a later-born child becomes evident before (not shown) and after controlling for family resources (model 5). Thus, it can be concluded that, on average, birth order has an impact on the dilution of resources, as children do benefit from being a first-born with respect to their vocabulary competences. When testing for interaction terms, a differential educational background effect becomes visible once again (model 6 and figure 2): Whereas in highly educated families, birth order appears to be quite irrelevant to children's vocabulary, being a second- or later-born child implies an additional disadvantage in lower educated families. This means that later-born

children in less educated families perform worse than first-borns, even when the number of siblings is held constant. Therefore, the resource dilution argumentation on birth order seems to be relevant only when cultural resources are limited, as less educated families cannot compensate for effects of birth order position. In model 7, the insignificant slope effect of birth order once again indicates a high stability across waves.

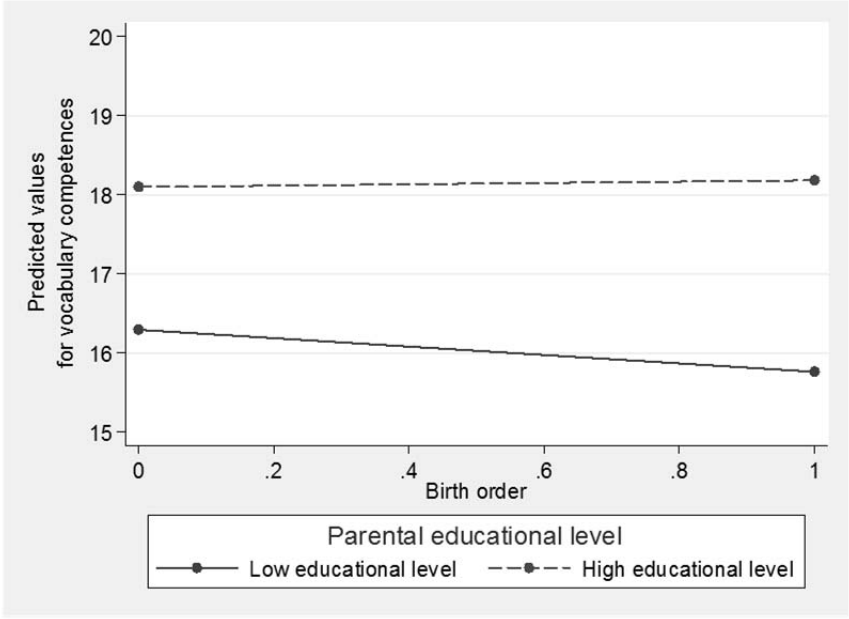
*Figure 1*: Interaction effect of number of siblings and families' educational level




Source: BiKS 8-14, wave 1-3, model 3, n(observations): 5423, n(children): 2098, controlled for wave, only child, age, gender, migration background

In models 8 to 14 (table 3), we turn to the analysis of birth spacing. We estimate the effects of having younger and older siblings separately. Model 8 shows that the size of birth gap in relation to younger siblings only is relevant when birth gaps are small, while longer gaps do not significantly affect the child's vocabulary competences. This result supports our hypothesis that particularly a shortly spaced newborn means a disadvantage to the older child. However, including the number of siblings (model 9) and family resources (model 10), this negative effect for birth gaps up to two years disappears. Besides missing independent effects of birth gaps to younger siblings, also no differential group effects (not shown) as well as slope effects (model 11) can be identified.

*Figure 2*: Interaction effect of birth order and families' educational level




Source: BiKS 8-14, wave 1-3, model 6, n(observations): 5423, n(children): 2098, controlled for wave, number of siblings, only child, age, gender, migration background

Regarding birth spacing in relation to older siblings, our analysis reveals a significant positive effect for larger birth gaps (of more than 6 years), also when the number of sibling is considered (model 12). Although slightly weakened, this independent effect remains when controlling for occupational status, education, cultural capital and the parent's age at child birth (model 13). Again, no differential group effects (not shown) and slope effects (model 14) can be identified for birth spacing to older siblings. Overall, the results confirm our assumption on the role of birth spacing, as children with longer spaced older siblings are suggested to benefit twice: First, they benefit from a larger amount of family resources, because the older children require less of their parents' time as they are more self-reliant. And second, they seem to gain an advantage by learning from the older sibling. This is an important result, because this clearly shows that studies replacing birth spacing by birth order or neglecting the role of birth spacing altogether are missing an important part of the picture and might thus be misled in their substantive interpretation of sibling structure effects.

As for none of the sibling indicators, a slope effect could be revealed, and thus a stable influence is observed, the expectation of their rising relevance before the transition to secondary school cannot be confirmed. However, what must be conceded is that the time

period under study is rather short (1.5 years). Instead, any possible long-term effects may become discernible if the observation window were to be extended.

## 7 Conclusion

The aim of this study has been to analyze the role of sibling structure components on educational achievement. This was motivated by a lack of German research in this field, whereas especially U.S. American research could show that – apart from the effects of social background characteristics and other influences of the familial learning environment – sibling structure plays an additional role in the acquisition of education. Although the impact of sibship size can be widely confirmed, findings on birth order, and in particular on birth spacing, are rather mixed.

Regarding our theoretical approach, we have concentrated on the argumentation of the resource dilution hypothesis, which assumes that differences between siblings occur, because they have to share family resources (e.g., parental time, parental investments, or cultural activities). Having a larger number of siblings, being a later-born child, as well as narrow gaps in relation to the other siblings can affect the parental resources available for each child – which may thus negatively affect educational outcome.

As for sibship size, the hypothesis can be clearly confirmed with our analysis. Additionally, we have been able to show that especially children from lower educated families are negatively affected by a larger number of siblings. Thus, families with better resources can better compensate for negative effects of sibling group size.

Also, the hypothesis on birth order effects can be confirmed: Being a later-born child does denote a disadvantage with regard to the acquisition of competences, particularly it is children in lower educated families that are affected by this mechanism. Families with a higher educational level are thought to have better options to support each child equally; whereas in lower educated families, first-borns benefit more from family resources than do later-born children, as they do not have to share them with other siblings for quite some time. Therefore, the assumption that parental time resources (e.g., reading to the child) should be the driving factor of birth order effects falls too short. In line with our findings on sibship size, it rather seems to be the quality of parents' cultural resources and input that compensate for negative birth order effects.

Beyond effects of sibship size and birth order, we assumed effects of birth spacing to be relevant, as with larger birth gaps the available parental resources can be distributed more evenly between the children. It could be shown that having a shortly spaced younger sibling means a disadvantage to the child's competences, as more parental attention is required for the newborn and thus restricts family resources at the cost of the older child. Therefore, it is not surprising that this effect disappears, once family resources and the number of siblings are controlled for. Having largely spaced older siblings appeared to be particularly beneficial, because they can function as role models and teachers to the

younger sibling and therefore become an additional family resource from which the younger sibling can benefit.

Additionally, we have been interested in the question whether the effects of sibling structure vary across time. It can be clearly shown that the effects remain very stable during the last 1.5 years of elementary school. With regard to future research, it would be particularly interesting to investigate whether changing effects could rather be identified in a long-term perspective. As our study has concentrated exclusively on vocabulary competences, future analyses in this field should be extended to other educational outcomes at different stages in the life course. In particular for the German context, there is still much room and a great necessity to carry out research on sibling effects in general – but in particular with regard to education.

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