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Fertility Intentions and Residential Relocations

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Abstract: This research addresses the question of whether fertility intentions (before conception) are associated with residential relocations and the distance of the relocation. We empirically tested this using data from two birth cohorts (aged 24-28 and 34-38 in the first survey wave) of the German Family Panel (*pairfam*) and event history analysis. Bivariate analyses showed that coupled individuals relocated at a higher rate if they intended to have a(nother) child. We found substantial heterogeneity according to individuals' age and parental status, particularly for outside-town relocations. Childless individuals of average age at family formation – a highly mobile group – relocated at a lower rate if they intended to have a child. In contrast, older individuals who already had children – the least mobile group – relocated at a higher rate if they intended to have another child. Multivariate analyses showed that these associations are largely due to adjustments in housing and other living conditions. Our results suggest that anticipatory relocations (before conception) to adapt to growing household size are importantly nuanced by the opportunities and rationales of couples to adjust their living conditions over the life course. Our research contributes to the understanding of residential mobility as a by-product of fertility decisions, and more broadly, evidences that intentions matter and need to be considered in the analysis of family life courses.

Keywords: fertility intentions, spatial mobility, life course, pairfam, event history analysis

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Introduction

Growing evidence based on longitudinal data shows that the timing of residential relocations and childbearing are strongly interrelated. An explanation for this association suggests that if homes and neighborhoods are not perceived as adequate for childrearing, couples will *adjust* either their residential situation or their family plans, within the given financial resources of the household. This so-called *adjustment* perspective conceives relocations occurring around the time of childbearing events as anticipations to changes in family size – or adaptations if conception has already occurred. However, relying on evidence of the timing of *event* occurrences sheds only partial light on the associations between fertility and spatial mobility. While anticipatory moves may occur well in advance of child conception, fertility-*induced* relocation adjustments may also be delayed and occur long after the birth of the child when the household can finally afford the move, at about the time of a subsequent conception (Michielin et al. 2008, Clark and Davies Withers 2009). In addition, assumptions of research about the nature of the associations are deemed troublesome, since there is little explicit evidence on the decision-making processes or the relations between relocations and conceptions beyond the correlation between the timing of events (Courgeau 1990, Kulu and Steele 2013).

Building upon the existing body of research and following a life course approach combined with a decision-making perspective (Huinink and Kohli 2014), we focus on the under-researched subjective aspects of the association, and examine whether a relocation of a household might be an outcome of fertility planning, which eventually may condition childbearing. Complementing prior research, we shed more light on how relocations are related to fertility processes, in anticipating conceptions, by examining the association between fertility *intentions* and residential mobility. Significant associations can be related to the solutions households find to their needs to adjust where (i.e. housing conditions and residential environment), with whom (i.e. partnership circumstances) or how to raise children (i.e. accessibility to workplace or ties to friends and family). Further, due to increasing costs of both raising children and adequate housing, it is challenging for many, particularly young, households to adjust conditions through relocation in anticipation of the time when families are formed (Mulder 2006). In this study, we address these nuances in relocation behavior as anticipations to fertility events by examining the intersections of the association between relocations and fertility intentions with relevant indicators of family life course situation, such as individual's age and parental status.

For the empirical analysis, we use a longitudinal research design with rich data on intentions and realization of childbearing as well as residential mobility within towns and beyond, over short and long distances. Prior research has found relocation distance a relevant factor: fertility events are more likely to be observed around shorter than longer distance relocations because short distance relocations do not affect other daily activity patterns (Mulder and Hooimeijer 1999). We further distinguish between moves within or outside town. A common finding is that family formation, or the prospect of it, pushes couples to move short distances, outside town, towards less dense areas deemed appropriate to raise children (Kulu 2008). We conduct an analysis of event histories on monthly-detailed fertility (conception) and residential relocation episodes from six waves of the German Family Panel (pairfam). Results of this paper demonstrate that accounting for fertility decision-making or planning stages yields further evidence on the conditions under which relocations take place, and highlight both the importance of residential relocations in preparation for family events and the nuances of fertility-related relocations in relation to the family life stage situation. More generally, this research innovates by studying the associations between behavioral intentions in one life domain (fertility) and actual behavior in another one (spatial mobility). It evidences that intentions matter, and need to be addressed in studies on the intersections between family life courses and other life domains.

State of the Art

Extant literature offers important theoretical and empirical results about the interconnectedness of childbearing and residential transitions (for a recent review see Wagner and Mulder 2015). Earlier studies focused on the influence of local settings and spatial mobility on fertility behavior, as well as on the relevance of household and family changes as a main motivation for spatial mobility (Courgeau 1985; Hervitz 1985; Huinink and Wagner 1989; Rossi 1955). Using a life course approach and longitudinal data, the basic hypotheses postulated by the early studies have been re-examined and enriched by recent research that has considerably contributed to advancing our knowledge on the associations between residential relocations and childbirth events (e.g. Clark and Davies Withers 2007; De Jong and Roempke Graefe 2008; Kulu 2005; Kulu and Milewski 2007; Kulu and Washbrook 2014).

A wealth of studies have examined post-relocation fertility and find that childbirth rates increase significantly after short-distance relocations, and to a lesser extent after long-distance relocations. Often, the rationale behind these associations is the adjustment of living conditions (e.g. housing conditions or workplace accessibility), as a prerequisite for childbearing (Clark and Onaka 1983; Michielin and Mulder 2008; Wagner and Mulder 2015). This aligns well with the well-established *housing ladder* concept, which traces the tendency to move up to larger, owner-occupied and higher-status housing over the life course and along with increasing family size (Clark et al. 1984; Mulder 2013). Along these lines, research finds that the likelihood of a birth increases after moving into owner-occupancy (Michielin and Mulder 2008; Mulder and Wagner 2001), a single-family dwelling (Feijten and Mulder 2002; Kulu 2008; Kulu and Vikat 2008), and rural areas (Corgeau 1989; Kulu 2008; Lindgren 2003). Moves induced by changes in couple household arrangements are also relevant to fertility behavior. For instance, the wish to start a family is positively associated with partners who previously lived in separate households to move in together (Kulu 2008, Wagner and Mulder 2014). Studies have also considered associations of fertility and workplace accessibility. Although there are no differences in fertility intentions by length of commuting to the workplace (Huinink and Feldhaus 2012), women who commute over long distances are more likely to be childless and to delay fertility (Meil 2010; Rüger et al. 2012). Not all relocations, particularly those over longer distances, are directly related to fertility behavior. Yet, it has been shown that after a couple's long-distance relocation, often motivated by the job career of one partner, short-distance moves can follow to further improve the living conditions for eventual childrearing (Clark and Davies Withers 2007). In other cases, residential relocations (over short and long distances) are aimed at improving proximity to the extended family and previous places of residence where informal support for raising children is available (Hedman 2013; Michielin et al. 2008).

Several studies have also highlighted an immobilizing effect of families, since the likelihood of a residential relocation out of town or across metropolitan areas generally decreases after the birth of a child, and even more so with increasing family size, because families may want to stay close to relatives and friends (Clark 2013; Kulu 2008; Wagner 1989). Additionally, the high relocation rates towards urban areas among young adults sink after childbirth because housing conditions and residential environment are deemed less adequate for families with young children (Courgeau 1990; Kulu 2008; Kulu et al. 2009; Kulu and Boyle 2009; Lindgren 2003). In contrast, moves within cities have been found to increase right after childbirth because families adjust dwelling size to family size or enter owner-occupancy, if they have not already done this in anticipation (Clark et al. 1994; Clark and Huang 2003; Clark and Onaka 1983; Courgeau 1985).

Concurrent progresses in family life courses and housing ladders are often contested, though. Some research has highlighted tensions in the anticipated or adaptive home adjustments to childbirth. A tight housing market combined with insufficient financial resources constrains the ability of households to adapt their housing situation to a growing family (Clark and Huang 2003; Lersch 2014). This may explain why many households relocate from expensive urban areas to more affordable suburbs or rural areas when the family grows (Kulu 2008). Research evidence shows a negative association between house prices and fertility (Malmberg 2012). More generally, increasing costs of both, raising children and housing, have generated an endemic resource conflict that prevents many household from achieving their desired housing conditions, particularly homeownership, at the time they would like to have (more) children (Mulder 2006). Often, this results in delayed fertility, since housing security and housing stability remain important prerequisites for family formation (Kulu and Milewski 2007; Vignoli et al. 2013).

Evidence on substantive impacts of the housing and residential conditions on fertility behavior suggests that both directions of causality deserve attention. Using a Finnish Longitudinal Fertility Register, Kulu and Steele (2013) apply multiprocess multilevel event history models that control for unobserved factors commonly affecting both fertility and housing transitions. Findings of their analysis showed that childbirths increase the likelihood of home relocations, and relocations to single-family houses lead to higher rates of childbirth. Additionally, these associations were partly determined by unobserved factors, which call for caution when interpreting findings of previous analyses in light of potential selectivity.

In general, previous research shows that residential mobility and fertility (behavior) are strongly interrelated. Many studies focused on the realization of childbirth or pregnancy. Analytical attention has primarily been paid to *adjustment* mechanisms by which moves occurring around childbirth are meant to improve housing and spatial conditions. However, testing the adjustment mechanism based on the examination of the timing of events is contested, since fertility-induced relocations may occur well in advance or much later than the observed childbirth. Courgeau and Lelièvre (1988) suggest using fuzzy time approaches to address interdependence across life domains. Along these lines, Clark and Davies Withers (2009) use time windows before and after childbirth and migration in order to assess anticipatory relocations caused by forthcoming childbirth and relocations that occur afterwards. However, Courgeau (1990: 229) acknowledges deficits of this approach to identify the causal logic of the associations and advocates the utilization of complementary information on the decision-making process. Following Courgeau's suggestion, in this research we look into the possible associations between fertility intentions, the prior step in the family decision-making process, and residential mobility.

Theoretical Approach and Hypotheses

Our theoretical framework is based on the life course approach, supplemented with a fertility decision-making model (Huinink and Kohli 2014). From a life course perspective, individual life paths can be perceived as a sequence of individual actions and biographical transitions in different but interdependent life domains. Aiming to generate or maintain subjective well-being as efficiently as possible, individuals plan and decide on activities in these life domains based on a subjective evaluation of their living conditions as well as goal-related aspirations and expectations. Gainful employment, raising children according to one's standards or owning a house are typical and interrelated lifetime goals that contribute to the improvement of subjective well-being.

We focus on fertility as a goal-seeking behavior over the life course. Successful parenthood is considered an ultimate goal by evolutionary scholars (Mace 2014). It can be also considered an intermediate goal to improve social well-being through affection, stimulation and social approval arising from close parent-child relationships (Huinink and Kohli 2014). In contrast, spatial mobility is more of an instrumental goal, i.e. a tool, for generating well-being in other life domains (Huinink et al. 2014; Kley 2011; Willekens 1991). Residential relocations are often motivated by (expected) changes in employment or family size and, more generally, by improvements in 'quality of life' (Geist and MacManus 2008).

Considering not only respective events and activities but also the decision-making process preceding them, the question arises whether goal-related intentions in one life domain impact behavior (and intentions) in another life domain. This idea is pivotal in recent studies that combine the life course approach with decision-making theories to improve the understanding of interconnected life domains. Huinink et al. (2014) used an enriched subjective expected utility model (SEU) to examine the effects of intended and manifest behavior between spatial mobility and job mobility. They found that the interdependence across life domains extended beyond associations among observed events, and also comprised the association between spatial mobility intentions and eventual job change.

Similarly, in this study we shed light on preferences, resources and subjective evaluations of available options with regard to family and place of residence. We postulate that residential mobility is instrumental to goal-seeking behavior such as fertility because it allows the adjustment to appropriate conditions for childrearing. When a pregnancy for a(nother) child is noticed, what we call an *adaptive relocation* – before or after the birth – is likely to occur in order to adjust conditions (see Figure 1). However, it has also been argued that already the intention of having a(nother) child (before conception) leads to the consideration of where, how and with whom to raise children and – given that housing attributes, residential environment and daily activity accessibility (e.g. distance to workplace or family) are perceived to be inappropriate – to an *anticipatory relocation* of the household.

– FIGURE 1 ABOUT HERE –

Against this backdrop, fertility intentions could translate into relocations, particularly over short distances or within town, as a response to an anticipated change in the demand for living conditions (e.g. home ownership, dwelling type/size, and residential area) appropriate for raising children. The motivation to marry and/or move together (when living-apart-together) in order to enjoy parenting in a common household might also underlie an association between fertility intentions and relocation of one or both partners. Additionally, the need to reduce commuting times in order to gain time resources for childcare or move to areas near relatives or childcare institutions could also support a significant association between fertility intentions and relocations, particularly over long distances. Adjustments in living conditions around the time of childbirth are well documented in the literature, conceptually and empirically, but the rationale of anticipatory relocations – when fertility is planned, before conception – as opposed to adaptive relocations – occurring during pregnancy or after childbirth – has not been clearly articulated. We argue that an anticipatory relocation is advantageous in that the "nest" is already well prepared before the demanding phase, in terms of both monetary and time resources, around the birth of the (next) child. Thus, a step-by-step strategy, where housing and location conditions are adjusted in advance of a(nother) child, supports couples by reducing stress due to the accumulation of partly competing tasks. Referring to this argumentation, our general hypothesis is that the intention to have a(nother) child has a positive association with residential relocations (fertility intentions hypothesis).

The associations between fertility intentions and relocations can be nuanced by combining the salience of the adjustments (i.e. how important and urgent are adjustments) and the availability of (economic) resources for relocation. For those intending to have a(nother) child, the salience of adjusting location is a function of the standards and adequacy of their current living conditions for childrearing. Despite the salience of an adjustment, relocations are expensive and require the availability of a certain level of resources. Couples with limited resources may have to postpone the relocation until either adjustments become more urgent or sufficient resources are accumulated. Thus, the fertility-related relocation may be delayed until conception occurs (adaptive relocation) or later (e.g. in anticipation of a subsequent child). Alternatively, the realization of fertility plans can be postponed until more resources have been accumulated.

Building upon the findings of previous literature, combinations of levels of the salience of adjustments and the resources available vary importantly across the life course. First, parental status can be expected to structure relocation patterns and adjustment rationales. For instance, the above-mentioned adjustments can be expected to be more relevant among childless couples planning to start a family, because of their salience in the family formation decision. Couples with children who plan to extend their families may have already sorted out some urgent matters in advance of or after the conception of the first child, such as moving together with the partner, or having access to formal or informal childcare. In addition, couples with children would be more likely to restrict mobility (particularly long-distance relocations) when planning to extend the family because of higher perceived costs of changing the socio-spatial context of the family (e.g. ties to other parents and school). However, couples may follow a step-by-step strategy, where relocations to owner-occupied, large houses in family-friendly areas might not necessarily occur about the time the first child is born, if resources were not available then, but as an anticipatory relocation in expectation of the next child. In fact, some research evidence suggests that couples who already have children move often to first-time homeownership (Clark et al. 1994).

Together with parental status, research also hints at the importance of individuals' age at (first) birth as a relevant life stage factor moderating the relationship between family events and residential relocations (e.g. Geist and McMannus 2008; Vidal and Lutz 2014). Shifts in contemporary fertility patterns due to extended periods of education, female labor force participation, and labor market insecurity have led to families being started at increasingly older ages, after partners have consolidated their careers and have accumulated sufficient resources to start a family (Lesthaeghe 2010). Additional economic uncertainties partly amplified by the recent global financial crisis translated into a stronger positive correlation between age at first birth and the socioeconomic situation of households (Kreyenfeld et al. 2012). Following this, recent evidence suggests that families experience increased uncertainty, economic hardship and disadvantage, particularly young families (Carlson 2012; Buhr and Huinink 2012). Young people spend longer periods in temporary living arrangements and take more time to move to homeownership or good-quality housing (Lennartz et al. 2015).

The arguments about the salience and disposable resources across age groups and parental status lead us to posit another hypothesis about fertility-related anticipatory relocations: <u>There is no general positive association between fertility intentions and residential relocations, but the association varies along with age and parental status of the individual</u> (family life stage hypothesis).

Method

Data

We use data from six waves of the German Family Panel (*pairfam*, 2008-2013). This is an interdisciplinary, longitudinal study of intimate relationships and family living arrangements in Germany collecting data on the same respondents every year, as well as additional information from their partners, parents and children (Huinink et al. 2011). The original sample of *pairfam* comprises 12,402 persons, and is representative of three birth cohort groups (1971-1973, 1981-1983, 1991-1993) in 2008.

The dataset is well-suited for our research because it contains rich information on the timing, the frequency and the distance of survey respondents' residential relocations in each wave, which allows analyzing the process of residential mobility. In addition, information on partnership and family dynamics, including partners' living arrangements, the intention to have a child as well as information regarding fecundity, pregnancy, childbearing and childbirth are available and collected over time. To our knowledge no large, national representative household panel survey contains the level of detail on residential and fertility histories as well as fertility decision processes as this study. Response rates and attrition levels in *pairfam* are similar to those of other large scientific surveys run in Germany (Brüderl et al. 2015).[1]

Sample

Our analytical sample comprises respondents in a stable heterosexual couple, either living together with the partner or living-apart-together, who are able to have children but did not have children with any previous partner, who participated in the survey beyond the first wave, and with complete information in key variables for the analyses.[2] We also restrict the sample to the two older cohorts of the study, aged 24-28 and 34-38 years at the time of the first interview in 2008-09. The median age at first childbirth in Germany was about 30 years for women and about 34 years for men of the birth cohort 1971-1973. Additionally, we find that most respondents of the youngest birth cohort (aged 15-17 in 2008-2009) did not intend to have children in the near future, which we attribute to dominant age norms on childbearing and the prioritization of education and career at this age. After exclusions, our sample consists of 1,442 respondents of the younger cohort (1981-1983), and 1,465 respondents of the older cohort (1971-1973).[3] We find differences across birth cohorts in parental status and number of children in wave one. Less than 20% of individuals of the younger cohort had children in the first wave, while more than 50% of individuals of the older cohort already had children by then. However, the majority of individuals with children of both cohorts had only one child in wave 1 (i.e. 75% and 69% of parents from the younger and older cohorts, respectively).

Measures

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[1] Response rate in wave one was 37%, which led to the realization of 12,402 interviews. Attrition in wave two was 22% of the original sample, but attrition rates felt thereafter. By wave four, the attrition rate was 11%, and the rate sank below 10% in wave six. Younger age groups, changes in union status/new unions, or living-apart-together situations are confirmed correlates of panel attrition in *pairfam* (Mueller and Castiglioni 2015).

[2] We exclude 634 individuals who stated they were infertile, 98 individuals in non-heterosexual unions, 880 individuals who had children with ex-partners by the start of the study as well as 1,752 individuals who only participated in the first survey wave and 240 individuals without response to the fertility intentions item in wave 1. We also exclude 900 individual who left the study by wave three, because retrospective information on residence started to be collected in wave three. After transforming the dataset into person months, we exclude person months in episodes of separation/divorce (but include living-apart-together situations). As with other surveys, line item non-response restricts the number of observations we use in our analysis. From the remaining 150,618 person month records, we exclude around 20% due to line item missing values. The investigation of missing data patterns concluded that exclusions were mostly due to lack of information on household income, room stress and lack of partner information such as education and employment status in some survey waves. A descriptive analysis of key variables showed that their distributions are not affected by missing data (See Table A1 in appendices). We have avoided multiple imputation strategies known to behave poorly, particularly for unbalanced longitudinal categorical data (Allison 2001).

[3] Since no oversampling was performed in pairfam, and variables that predict the probability of attrition are included in the multivariate analysis, we refrain from using weighting schemes that may lead to incorrect multivariate estimates. Descriptive analyses are also not weighed, and hence, are deemed sample summaries rather than population estimates.

We consider three types of residential relocation events: (i) *within-town* relocations, (ii) outside-town, *short-distance* relocations (if moves are under 50km), and (iii) outside-town, *long-distance* relocations (if moves are equal to or above 50km, as in e.g. Limmer and Schneider 2008). The data on residential relocations between towns is extracted from a retrospective questionnaire that was administered from wave two onwards. Detailed information on the month of relocation, the place of origin and destination allows us to construct measures of respondents' residential relocations in monthly time intervals (coded 1 if relocation occurs; coded 0 otherwise), as well as the duration of residence. Within-town relocations are asked between waves two and six, but no detailed information on the month of the relocation is available. Random imputation of the month of within-town relocation occurrence (between the previous and the current survey wave) was performed using a uniform distribution.

The *pairfam* survey question on fertility intentions is asked annually to respondents who are self-rated fertile. The question item reads "Do you intend to become a mother or father (again) over the next two years?"[4] We collapse the response categories "yes, definitely" and "yes, maybe" into a positive response of an indicator variable (coded 1), and the response categories "no, rather not", "no, certainly not" and "I have not had any thoughts about it" into a negative response (coded 0).[5] The fertility intentions indicator is time varying and switches in the month when data is collected – if the respondent answers differently than in her/his latest survey participation – or in the month a pregnancy is observed. Since the question refers to a specific, relatively short period of time (i.e. two years), we expect that eventual relocations of those who intend to have (more) children might also be strongly related to fertility decisions.[6] To control for fertility decisions, we use an indicator of *pregnancy status* leading to childbirth (coded 1 for monthly intervals starting nine months before childbirth until the month when childbirth occurs; coded 0 otherwise). To empirically address the family life stage hypothesis, we use an indicator for *parental status* (coded 1 if the respondent already has a child/children, coded 0 if the respondent is childless), and for *age group* (coded 1 if the respondent was born in 1971-

[4] Translated from the original question in German: "Haben Sie vor, in den nächsten zwei Jahren (erneut) Mutter bzw. Vater zu werden?"

[5] It is fair to assume that those who have not had any thoughts about becoming a father or mother have no fertility intention because a fertility intention should require having thought about having a(nother) child.

[6] For respondents who are pregnant or whose partner is pregnant at the time of the interview, the question refers to a subsequent parity. Since we consider intentions and pregnancies as two mutually exclusive states of fertility decision-making in the analysis, we switch the fertility intentions indicator to 0 during the pregnancy stage, but we re-switch the indicator after the birth of the child.

1973, coded 0 if the respondent was born in 1981-1983), which distinguishes respondents in their mid- to late 30s from those in their mid- to late 20s in the first wave of the study.

For the multivariate models, we use a number of measures of covariates that are known to be associated with fertility (intentions) and residential relocations. These include time-varying housing and residential conditions such as *housing density* (ratio between the number of people living in the household and the number of rooms), whether the respondent is living in *owner-occupancy* (indicator coded 1, otherwise 0), and settlement structure (two indicators for urban core or *inner city*, and sparsely populated or *rural areas*; *ref.* surrounding metropolitan areas or *suburbs*). We also include time-varying variables of accessibility conditions such as *commuting time* to work (two indicators for 30-50min one way, >59min one way; *ref.* <30 min one way / no commute), and *distance to parents* (indicator coded 1 if one-way drive to mother's or father's place of residence is more than 59 min one way; coded 0 otherwise). To control for characteristics of union and household formation, we include time-varying indicators of *marital status* (coded 1 if married, coded 0 otherwise), *co-residence status* (coded 1 if living-apart-together, coded 0 otherwise) and partnership order within study window (coded 1 if in second- or higher-order partnership, coded 0 otherwise). Resources and resource conflicts are accounted for in time-varying covariates such as *level of education* (indicator coded 1 for higher education; coded 0 otherwise), employment status (two indicators for part-time work and non-employment situations; *ref.* full-time work), partner's level of education (indicator coded 1 for higher education; coded 0 otherwise) and employment status (indicator coded 1 for full-time or part-time work; coded 0 otherwise); household income (log-transformed annual income weighted by household size using an OECD equivalence scale); number of children (two or more children). We derive other control variables from the literature including time-constant covariates such as respondent's *sex* (indicator coded 1 if female, coded 0 if male) or ethnic background (indicator coded 1 if at least one parent born abroad, coded 0 otherwise). We also derive a time-varying variable for whether the respondent resides in East Germany (coded 1 if applies, coded 0 otherwise).[7] Summary statistics for model covariates (also broken down by fertility intentions and pregnancy status) can be consulted in Table A2 in the appendix.

[7] For marital status, cohabitation, living-apart-together situations, individual's labour market status and educational level the transition month is known. For other time-varying covariates where the exact month of change in not known, response values switch in the month when data is collected – if the respondent answers differently than in her/his latest survey participation. If a response is missing in a given wave, the inter-wave observations are excluded (see above sample exclusions). Additionally, for time-varying covariates referring to type of dwelling, residence location, distance to parents and commuting response values change in the relocation month using information from the subsequent survey wave.

Statistical Model

We use discrete-time event history analysis (EHA) to examine durations of partnered respondents' residence leading to (i) within-town, (ii) short- or (iii) long-distance relocations. The method is well-suited to our research, as it allows estimating the associations with triggering factors that can be constant, status changing or time-dependent on the occurrence of an event of interest that is observed within monthly time intervals (Blossfeld and Rohwer 1995). The model can be written as

$$\log\left(\frac{\mathrm{h}_{\mathrm{ij}}^{R}}{h_{ij}^{0}}\right) = \alpha^{R}\,(\mathrm{t}) + \beta^{R}\,x_{ij}^{R}(t) + \mathrm{u}_{\mathrm{i}} \qquad (1)$$

where h^{R} is the discrete-time transition rate to a residential relocation of *R* type (R=1,2,3), referring to within-town, short-distance, and long-distance relocations. The reference outcome category is *no relocation*. The discrete-time hazard is defined as a multinomial response *Y* (coded 1 to 3 if a relocation of type R is observed and coded 0 if no relocation is observed) for each discrete time interval *t* given that no prior event within residential episode *j* and respondent *i* has been observed. The term $\alpha^{R}\,(t)$ captures the duration of residence of a partnered respondent with the same partner in months since the start of a residential episode. We specify a piecewise linear transformation of the duration function that estimates the slope *effect* of residence duration for the following time intervals since the last relocation: 0 to 12 months, 13 to 36 months, and 37 months onwards. Models including the piecewise specification of the duration function performed better (i.e. model fit) than those including linear or polynomial specifications of the duration variable. Additionally, the piecewise linear specification revealed nuances in the duration patterns across relocation types. An indicator for higher than first order relocation episodes was also included to capture average differences across episodes. Additionally, we include time-constant and time-varying covariates that capture the anticipated demands for housing and other living conditions in fully-specified models. In accordance with the adjustment perspective, we expect anticipatory relocations will reflect household adjustment needs, so adding these covariates in the models will capture (at least part of) the association between fertility intentions and residential relocations. Time-constant and time-varying covariates and their coefficients are specified in $\beta_{i}^{R}x_{ij}^{R}(t)$. Last, u_{i} is a random term capturing correlations with time-constant respondent-specific unmeasured characteristics.

Sensitivity tests

It has been suggested that the *causal* association could also work in the reverse direction (Myers 2001). For instance, subjective housing security and feelings of stress associated with residential relocations are known to negatively impact women's fertility plans (Kulu and Milewski 2007; Vignoli et al. 2013). To address the potential selectivity of fertility decisions across those who relocate, we followed a strategy similar to Kulu and Steele (2013) and we jointly estimated event history models for time to relocation and for time to conception leading to childbirth. Results of the sensitivity tests show that fertility intentions and pregnancy status coefficients of models that do not account for selectivity remain unchanged after controlling for time-constant unobserved factors that affect the timing of fertility and relocations. However, other sources of selectivity, such as time-varying unobserved factors affecting the association may still be at play, which prevent us from making causal assessments about the associations under analysis. Further details on the analytical model and results of the sensitivity test can be found in appendix B.

Results

Bivariate results

Table 1 displays occurrences and rates of within-town (WT), short-distance (SD), and long-distance (LD) relocations across stages of fertility decision-making, i.e. no intentions (*reference*), fertility intentions, and pregnancy. We present unadjusted monthly rates in Table 1 as per thousands. Consistent with the literature, individuals relocate more often within town than leaving town, and individuals also relocate more often over short distances than over long distances when leaving town. Relocations within town or over short distances are most frequent during pregnancy, and these also occur more often among those who intend to have a(nother) child than among those who do not. Long-distance relocations, in contrast, are not significantly more frequent during a pregnancy, but are marginally more frequent when intending to have a(nother) child than when not intending to have a(nother) child.

– TABLE 1 ABOUT HERE –

Table 1 also portrays relevant differences in relocation patterns by an individual's age and parental status. The younger age group (birth cohort 1981-1983, aged 24-28 at wave one) displays higher overall relocation rates than the older age group (birth cohort 1971-1973, aged 34-38 at wave one) if no fertility intentions are reported. Interestingly, differences in the relocation rates between those who report no fertility intentions, fertility intentions, and pregnancies are more marked for the older age group, whose incumbents are at a late childbearing stage, than for the younger age group. The intention to have the first child spurs long-distance relocations for respondents at late family formation age (*older age group*), but deters short-distance and long-distance relocations for respondents at young family formation age (*younger age group*). After a conception leading to the birth of the first child, short-distance relocations occur at a higher rate for both, younger and older individuals. The intention to have another child spurs relocations over any distance among older respondents, while this is not the case for respondents of the younger age group. After a conception leading to the birth of another child, within-town and long-distance relocation rates are significantly higher for respondents of the older age group, while no significant association is to be found for respondents of the younger age group.

Overall, unadjusted rates show that relocations occur at a higher rate during both fertility intentions (anticipatory relocations) and pregnancy stages (adaptive relocations), but the associations are uneven across individuals' age and parental status.

Multivariate results

Table 2 presents results for within-town (WT), short-distance (SD), and long-distance (LD) relocation discrete-time hazard rates, respectively, which have been jointly modeled as competing risks. In Model 1 (our baseline model) of Table 2 we first address the association of relocations with fertility intentions and pregnancy status adjusting only for respondent's age and parental status as well as the baseline durations, the relocation episode indicator, and one random variance term commonly specified for the three outcomes. Results of Model 1 show that after controlling for respondent's age and parental status, the associations between fertility intentions and within-town, short-distance and long-distance relocations are not statistically significant. In contrast, we find that pregnancies are positively associated with short-distance relocations. Already having children (ref. *childless couples*) is significantly and negatively associated with relocations outside town, but not significantly related to within-town relocations. Being a member of the older age group is negatively associated with all types of relocations over shorter distances, and the associations are highly significant.

The non-significant associations between fertility intentions and relocations in Model 1 of Table 2 contrast with the significant bivariate associations (Table 1), and suggest that anticipatory relocations (before conception) are a function of different rationales, needs and resources at different life stages. Additional models (not shown) with fewer covariates (i.e. only fertility intentions, pregnancy status, baseline duration, relocation episode indicator, and the random variance term) resulted in significant coefficients for fertility intentions and pregnancy status, confirming that the inclusion of respondent's age group and parental status yielded insignificant fertility intentions and pregnancy status coefficients in the models presented in Table 2.

Model 2 (our fully-specified model) in Table 2 added a number of covariates for living conditions that are known predictors of both relocations and fertility decisions to Model 1. In brief, results show that when allowing for changes in living conditions neither the direction nor the significance of the covariates indicating the association between fertility intentions and relocations change. Instead, the coefficients of pregnancy status and family couple turn positive and significant for within-town relocations, the negative coefficient of family couple turns non-significant for short-distance relocations, and the negative coefficients of couple with children and older age group turn non-significant for long-distance relocations.

All in all, adjusted results for living conditions featured in the model covariates indicate that couples with children and older respondents relocate less because most adjustments may have already been made. Fertility intentions remain not significantly related to relocations. Interestingly, pregnancy status is positively related with within-town and short-distance relocations, revealing that further factors are associated with adjustment relocations of shorter distance. Additionally, the result also may point at the higher urgency for adjustment after conception (adaptive relocations) than before, during the planning stage (anticipatory relocations).

– TABLE 2 ABOUT HERE –

We briefly comment on selected coefficients in Model 2 of Table 2 that rendered interesting results. As expected, homeownership is one major deterrent of residential relocations, particularly outside town. Housing density (i.e. household size divided by number of rooms) is only significantly associated with within-town relocations. Interestingly, those living in the inner city are less likely to relocate outside town, over short distances. We find that a number of aspects of accessibility such as lengthy commuting or distance to parents are associated with long-distance relocations. Respondents in a living-apart-together couple arrangement also relocate more often outside town, both over short and long distances. In line with results of the couple migration literature, the education and employment status of the respondent and his/her partner are relevant to predict relocations over long distances.

We further assess whether respondents' age and parental status moderate the associations between fertility intentions and relocations. In Figure 2, we present selected results of a model equivalent to the ones presented in Model 1 (baseline model) and Model 2 (fully-specified model) of Table 2 with additional two-way interaction terms for fertility intentions and age group, fertility intentions and parental status, age group and parental status, and a three-way interaction term for the three variables. Equivalent interaction terms have been modeled for pregnancies with age group and parental status. Figure 2 shows results for full interactions of those not intending to have a(nother) child, those intending to have a(nother) child, and those who are (or whose partner is) pregnant in four situations: younger age group – childless, older age group – childless, younger age group with child(ren), and older age group with child(ren). The dots represent the discrete hazard rate of each group for each relocation type, and the spikes around the dot are the 95 percent confidence interval (ref. cat. younger age group, childless, and not intending to have a child). Results of the interaction terms' coefficients can be consulted in Table A3 in the online appendix.

– FIGURE 2 ABOUT HERE –

Despite a few significant coefficients for the interaction terms in multivariate models (see Table A3 in online appendix), a graphical representation of the associations presented in Figure 2 shows some variation within and between groups in relocation rates among those not intending to have a(nother) child, those intending to or those who are pregnant. In the baseline model, which only adjusts for residence duration and episode, we observe several statistically significant differences. In the full model, which additionally adjusts for a number of home and living conditions, we observe hardly- to non-statistically significant differences. This confirms that after controlling for key predictors of residential relocation and fertility, variations in relocation rates by fertility intentions or pregnancy status over the life course are less marked, which evidences that anticipatory relocations are due to adjustments in housing and other living conditions.

Additional findings are worth considering. First, younger respondents intending to have a first child display a lower likelihood of outside-town relocations in the baseline model. That is, the 95 percent confidence interval of the coefficients for fertility intentions in Figure 2 (baseline model) does not cross the horizontal solid line. The significant difference vanished in the full model. Interestingly, for this group outside-town relocations over short distances displayed a higher likelihood during pregnancy. This is suggestive of couples moving to (more affordable) suburbs outside the city as a reaction to – and not in anticipation of – the first child's conception. Coefficients of younger respondents with children show no significant differences in relocation rates among those reporting no fertility intentions, fertility intentions, and being pregnant with another child

Second, older childless respondents intending to have a(nother) child display a higher likelihood of long-distance relocations in the baseline model. That is, the 95 percent confidence intervals of the coefficients for fertility intentions do not cross the 95 percent confidence intervals of the coefficients for *no* fertility intentions within the individual's age and parental status group. Among older respondents with children, fertility intentions also spur higher short-distance relocations. Additionally, older respondents with children move more often within-town or outside-town over long distances if a pregnancy is reported. Statistically significant differences in relocation rates among those reporting no fertility intentions (reference), fertility intentions, and being pregnant for a(nother) child vanish in the full models. The only exception is among respondents in a reported pregnancy stage, where higher likelihood of within-town relocations is at least marginally significant ($p<.1$).

Third, the comparison of coefficients shows interesting differences in relocation likelihoods across respondents of different age and parental status. If no fertility intention is reported, the relocation rates of older individuals are in many cases significantly lower than those of younger individuals. That is, among no fertility intention coefficients the 95 percent confidence intervals for old age group are lower and do not cross the ones for young age groups. Interestingly, differences in relocation rates across age groups are smaller among those who report fertility intentions or pregnancies. The coefficients for long-distance relocations even reverse, where older individuals display some slightly higher (but mostly non-significant) rates than younger individuals when reporting fertility intentions or pregnancies. Significant differences found in baseline models are again largely weaker in the full models. It is worth to note, that despite controlling for a number of relevant covariates, fertility intentions and pregnancies among the older respondents with children relate to (marginally) significant higher within-town or long-distance relocation likelihoods than those of younger, childless respondents not intending to have children, which is a typical highly mobile group. This result again suggests that fertility-related adjustments might be partly postponed (or more salient) at later times, when families grow.[8]

Conclusions

The interdependencies between spatial mobility and fertility are complex. In this research we have shed more light on this by examining the associations between fertility intentions and residential relocations within town, or leaving town over short and long distances. Conceptually, we argued that the interdependence across life domains extends beyond associations among observed events, and acknowledged the relevance of preceding decision-making stages. We posed that relocations as solutions that households find to their needs for adjustment of where, with whom, or how to raise children can already be performed before an intended conception (anticipatory adjustment) and not only after conception (adaptive adjustment). Relocations in anticipation to changes in family size are deemed advantageous in that these support couples by reducing stress associated with the demanding phase around the birth of a child. We also acknowledged that associations between fertility intentions and relocations could be nuanced by the salience of the adjustments (i.e. how important and urgent they are), and the availability of (economic) resources for relocation. We expected these nuances to be relevant across family life stages (as a function of respondents' age and parental status). We used longitudinal data from the German Family Panel (*pairfam*) and event history models to test the associations.

[8] The nuanced associations between the fertility intentions and residential relocations may hide finer moderated associations with available resources or specific resource-intensive adjustments than the associations presented here with family life stages. We addressed this question in further analyses including interactions of fertility intentions and pregnancies with indicators of couples' resources (i.e. income, education, employment) and housing conditions (i.e. homeownership) but new interactions were not statistically significant, and other results remained unchanged (results available on request).

Some key findings arise from our study. First, unadjusted results show that respondents who reported an intention to have a(nother) child relocated at a higher rate than those who did not. However, these associations mask compositional (family life course) differences between groups. Second, we find important heterogeneity, and even reversals, in the association between fertility intentions and relocation when respondents' age and parental status are considered. This is particularly true for outside-town relocations, over short or long distances. Third, these associations emerged partly because of the diverse needs to adjust housing and other living conditions to changes in family size among groups of respondents.

With regard to the previous literature, a number of studies have claimed that residential relocations are a means to adjust housing and other living conditions in anticipation of (as well as in adaptation to) increases in family size. Our findings support these claims, with some evidence for vanishing differences in the relocation propensities of those who intend to have a(nother) child and those who do not intend to after controlling for a number of housing and other living conditions in the multivariate models (full models). However, we did not find that relocations in anticipation to changes in family size extend to all situations as suggested in our general *fertility intentions hypothesis*. In fact, the unadjusted positive correlations between fertility intentions and relocations vanished after adjusting only for respondent's compositions of age and parental status (baseline models; i.e. not adjusted for housing and living conditions). Instead, consistent with research that demonstrates how economic uncertainties among young adults inhibit concurrent progress in family and housing life courses, our results (baseline models) showed that fertility intentions matter differently for relocations at various life stages, as suggested by the *family life stage hypothesis*. On the one hand, childless individuals around average age at family formation – an overall highly mobile group – relocate less often outside town if they intend to have a child. On the other hand, older individuals, particularly those who already have children – the least mobile group – relocate more often outside town if they intend to have another child. In line with the adjustment perspective, these differences vanished after controlling for housing and other living conditions (full models). Differences in relocation rates according to fertility intentions were already less relevant for within-town relocations before controlling for covariates other than respondent's age and parental status.

The salience of and resources available for adjustments of homes and residential environments to new or growing families vary importantly across the life course. Particularly, our research confirms that young adults may be facing far more difficulties in advancing in family careers and housing ladders synchronously. Those who have children at a younger age may relocate at a later time when the salience of adjusting living conditions is greater or when sufficient resources have been accumulated. That we find positive associations between relocations and the pregnancy status confirms that many couples react to instead of anticipate an intended conception. The relocation adjustment can also be postponed to the time the next child is planned. This could be inferred in our results (baseline models) from the fact that older respondents who are in a family couple display higher relocation rates when intending to have another child, but also during the pregnancy. The rationale of reacting to conception or postponing a fertility-related home adjustments can be one of the reasons why a life course gradient partly remains in some pregnancy coefficients after controlling for relevant explanatory factors such as individual and partner's resources, distance to work or family ties, home and residential conditions, or the partner's living arrangements. All in all, our evidence for a life course gradient in anticipatory and adaptive adjustment relocations calls for a more nuanced understanding of the association between fertility and residential mobility over the life course.

Our research contributes to the literature in a number of ways. First, by addressing the association between fertility intentions and relocation behavior we improve the understanding of interdependent developments across different domains of life, i.e. family and residence. We have postulated and empirically tested for the first time that fertility intentions can trigger residential mobility. Our results complement previous studies that have relied on fuzzy time approaches (i.e. observation of event occurrences within a time window) to assess the relationships between fertility and relocation events. Since under certain conditions fertility intentions matter for couples' relocation behavior, further studies may need to consider that the impact of fertility on relocations starts before the conception of a child, already when families are planned. We not only examined differences in relocations over short and long distances, but we also examined differences in relocations within and outside town. Our results contribute to the literature in finding that couples relocate more often within- than outside-town when intending to have a(nother) child. Additionally, we were able to provide more accurate evidence by using longitudinal data with detailed information on partnership dynamics (including living-apart-together situations), fertility decision-making stages, and residential histories.

Despite its contributions, our research could be improved in a number of ways. In a sensitivity test, we established that our results remained unchanged after adjusting for time-constant unobserved heterogeneity that commonly affect fertility and residential mobility. Nevertheless, we cannot rule out that other sources of selection, e.g. due to time-varying unobserved heterogeneity, bias our results. Additionally, data limitations restricted the analysis to information mostly from one individual (i.e. main survey respondent) in each couple, despite growing recognition that partner's intentions and characteristics have to be taken into account in equal measure to understand household decisions (Balbo et al. 2013). To further assess the interdependence of fertility and residential mobility, information on intentions to relocate should be considered, as well. Future work should look at differences by gender in the associations between fertility intentions and spatial mobility. An incipient but growing literature on residential mobility to start co-residence with the significant other has found marked gendered patterns (Brandén and Haandrikman 2013).

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Figure 1. Fertility process and adjustment relocations

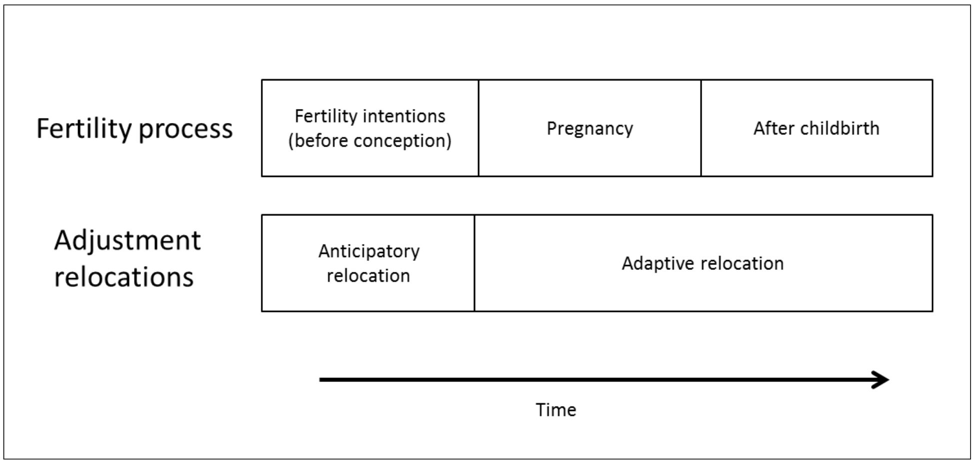


Table 1. Within-town, short-distance and long-distance relocation rates (per thousand respondent months) by fertility decision-making stage and family life stage.

	No fertility intention	Fertility Intention		Pregnancy		*Relocation events (N)*
All couples						
Within-town relocation	5.40	7.23	*	8.03	*	*741*
Short-distance relocation	2.23	3.08	*	5.19	*	*321*
Long-distance relocation	1.32	1.94	*	2.05		*187*
Respondent months (N)	*84,257*	*32,523*		*6,353*		
Childless couples						
Younger age group						
Within-town relocation	7.53	8.57		8.10		*284*
Short-distance relocation	5.95	4.11	*	9.45	*	*187*
Long-distance relocation	4.13	1.99	*	2.25		*106*
Respondent months (N)	*16,463*	*16,564*		*2,221*		
Older age group						
Within-town relocation	4.63	4.22		1.70		*103*
Short-distance relocation	1.48	1.41		5.09	*	*36*
Long-distance relocation	0.53	1.76	*	1.70		*20*
Respondent months (N)	*16,841*	*5,692*		*589*		
Family couples						
Younger age group						
Within-town relocation	8.01	6.17		8.07		*147*
Short-distance relocation	3.63	2.64		3.77		*66*
Long-distance relocation	1.40	1.23		1.61		*27*
Respondent months (N)	*12,114*	*5,672*		*1,858*		
Older age group						
Within-town relocation	4.02	7.40	*	10.09	*	*207*
Short-distance relocation	0.54	1.96	*	1.19		*32*
Long-distance relocation	0.44	2.83	*	2.37	*	*34*
Respondent months (N)	*38,839*	*4,595*		*1,685*		

Note: Rates are multiplied by 1,000 and are based on exposures and occurrences measured in monthly time intervals. Members of the younger age group were born in 1981-1983 and were aged 24-28 in wave one. Members of the older age group were born in 1971-1973 and were aged 34-38 in wave one.
*p<0.05 for two-tailed t-test (ref: no fertility intention).

Table 2. Discrete hazard rates (log-odds) of within-town, short-distance and long-distance relocations

	Within town		Short distance		Long distance	
Models	1	2	1	2	1	2
	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)
Fertility intentions	0.121	0.054	-0.235	-0.240	-0.004	-0.011
	(0.090)	*(0.092)*	*(0.135)*	*(0.143)*	*(0.151)*	*(0.183)*
Pregnancy	0.246	0.323 *	0.464 *	0.577 **	0.154	0.538
	(0.149)	*(0.155)*	*(0.199)*	*(0.224)*	*(0.285)*	*(0.341)*
Family couple	-0.045	0.295 *	-0.620 ***	-0.101	-0.524 ***	0.598
(ref. childless couple)	*(0.085)*	*(0.135)*	*(0.132)*	*(0.222)*	*(0.155)*	*(0.364)*
Older age group	-0.704 ***	-0.351 ***	-1.492 ***	-0.845 ***	-0.858 ***	-0.058
(ref. younger age group)	*(0.092)*	*(0.100)*	*(0.156)*	*(0.183)*	*(0.171)*	*(0.239)*
Other variables						
Sex (female)		-0.269 **		0.033		0.142
		(0.092)		*(0.132)*		*(0.188)*
Duration of residence (linear spline)						
Up to 12 months	0.190 ***	0.188 ***	0.073 *	0.069	-0.133 ***	-0.135 ***
	(0.045)	*(0.047)*	*(0.037)*	*(0.040)*	*(0.038)*	*(0.041)*
12 to 36 months	0.024 **	0.020 *	0.012	0.012	0.048 **	0.051 **
	(0.009)	*(0.009)*	*(0.012)*	*(0.012)*	*(0.015)*	*(0.015)*
Over 36 months	0.001	0.000	0.000	0.000	-0.002 *	-0.001
	(0.000)	*(0.000)*	*(0.000)*	*(0.001)*	*(0.001)*	*(0.001)*
Residence episode	0.131	-0.030	0.024	-0.118	0.434	0.306
(2nd or higher order)	*(0.144)*	*(0.155)*	*(0.189)*	*(0.208)*	*(0.237)*	*(0.262)*
Ethnic background		-0.047		-0.145		-0.399
		(0.104)		*(0.171)*		*(0.226)*
Residence in Eastern Germany		-0.166		-0.420 *		0.014
		(0.109)		*(0.174)*		*(0.212)*
Homeownership		-0.806 ***		-1.878 ***		-1.927 ***
		(0.102)		*(0.230)*		*(0.348)*
Housing density		0.386 ***		0.277		0.192
		(0.094)		*(0.159)*		*(0.281)*
Settlement structure (Suburbs)						
Inner city		0.121		-0.483 **		-0.098
		(0.100)		*(0.147)*		*(0.212)*
Rural areas		-0.037		-0.027		0.046
		(0.107)		*(0.156)*		*(0.261)*
Union situation (ref. cohabiting - 1st observed union)						
Living-Apart-Together		0.103		0.898 ***		1.037 ***
		(0.158)		*(0.167)*		*(0.231)*
Married		0.054		-0.099		-0.079
		(0.106)		*(0.168)*		*(0.257)*

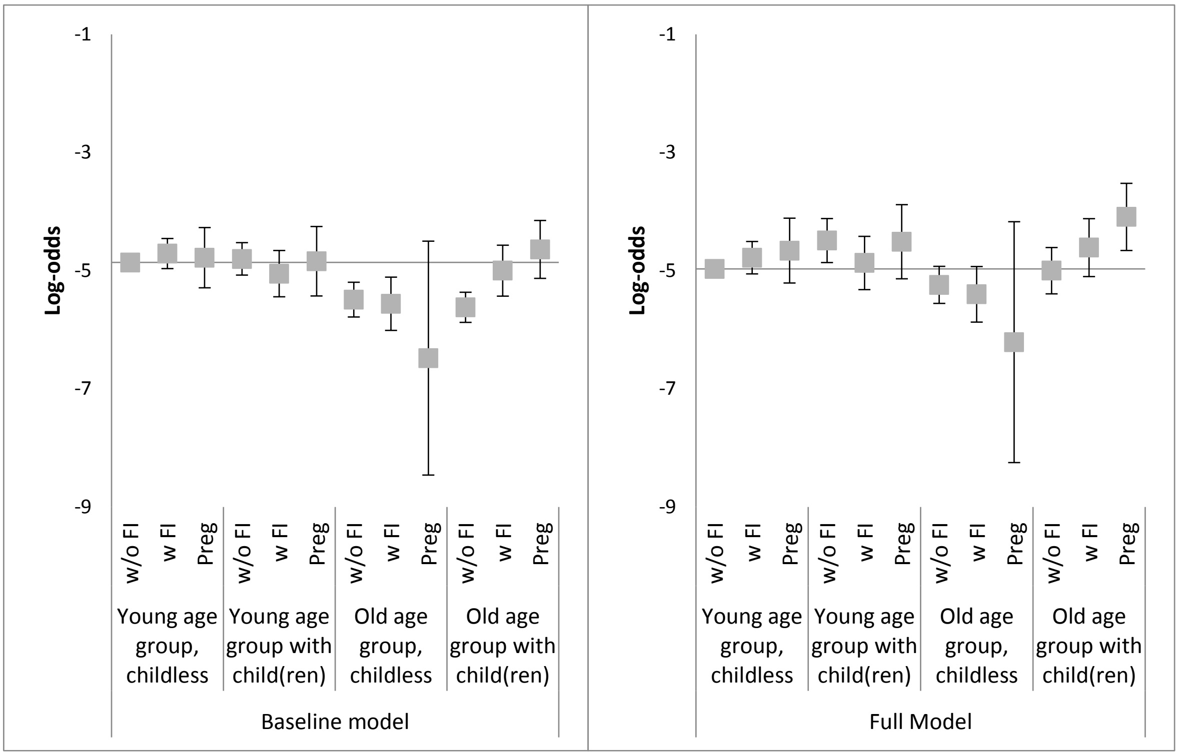
Union order (2nd or higher order)		0.492 **		0.489 *		0.368
		(0.156)		*(0.200)*		*(0.263)*
Two or more children		-0.197 **		-0.061		-0.377 *
		(0.071)		*(0.118)*		*(0.171)*
Log household income		0.004		0.226		-0.041
		(0.101)		*(0.132)*		*(0.161)*
Higher education		0.063		0.150		0.696 **
		(0.098)		*(0.143)*		*(0.212)*
Employment status (ref. Full-time employed)						
Part-time employed		0.222 *		-0.429 *		-0.641 *
		(0.102)		*(0.199)*		*(0.279)*
Non-employment situations		-0.255 *		-0.002		0.439 *
		(0.107)		*(0.174)*		*(0.198)*
Higher education (partner)		-0.049		-0.043		0.517 *
		(0.098)		*(0.151)*		*(0.206)*
Partner employed		-0.041		0.090		-0.389 *
		(0.092)		*(0.144)*		*(0.190)*
Commuting time (from home to work) one-way (ref. <30min or no commuting)						
30-59 min		-0.117		0.181		-0.573
		(0.104)		*(0.155)*		*(0.297)*
>=60 min		-0.313		0.062		0.801 **
		(0.196)		*(0.272)*		*(0.263)*
Distance to parents (>60 min one way)		-0.025		0.040		0.745 ***
		(0.092)		*(0.128)*		*(0.171)*
Random variance (σ)	0.575 ***	0.466 ***	0.575 ***	0.466 ***	0.575 ***	0.466 ***
	(0.079)	*(0.115)*	*(0.079)*	*(0.115)*	*(0.079)*	*(0.115)*
N (observations)	118,788	118,788	118,788	118,788	118,788	118,788
n (individuals)	2,861	2,861	2,861	2,861	2,861	2,861
Log-likelihood	-7,503.43	-7222.21	-7,503.43	-7222.22	-7,503.43	-7,222.23

* = p<0.05, ** = p<0.01, ***= p<0.001

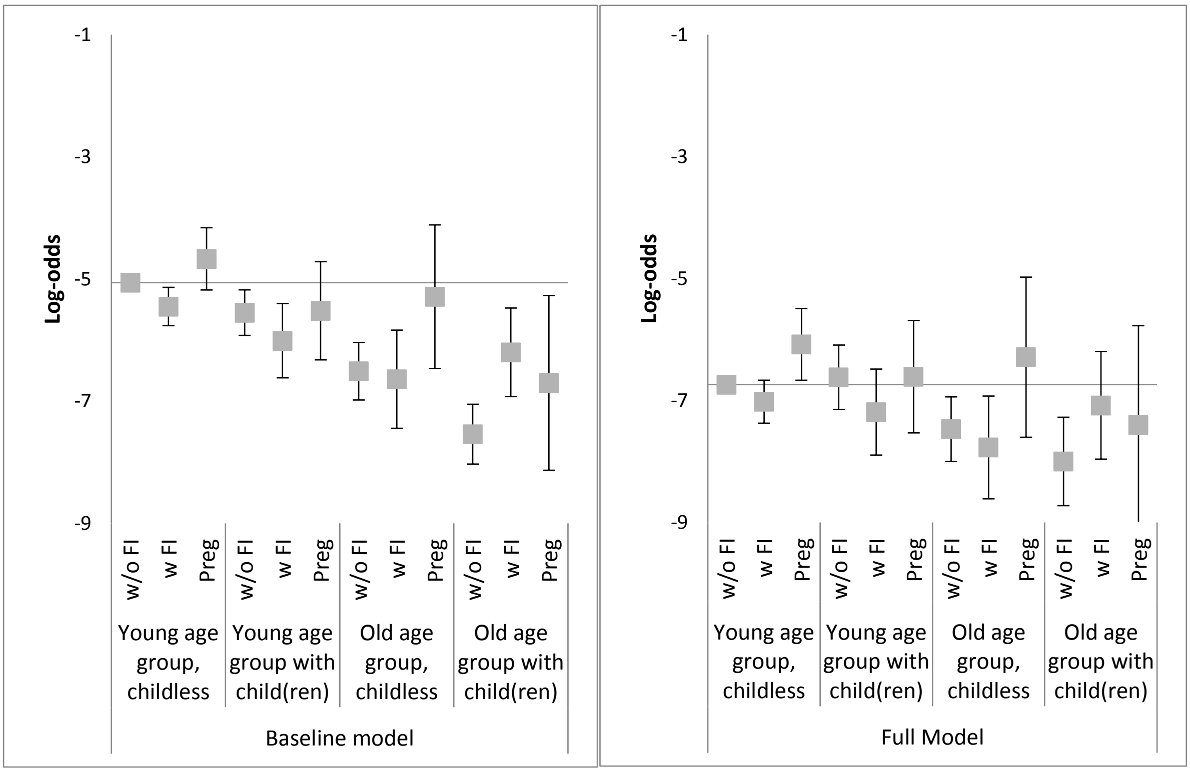
Notes: Competing risk discrete-time event history analyses (random effects multinomial logit). The reference category is *no relocation*. Duration of residence is a linear specification of months since last relocation. β estimates are discrete log-hazards or log-odds. Standard errors in parentheses. Members of the younger age group were born in 1981-1983 and aged 24-28 in wave one. Members of the older age group were born in 1971-1973 and aged 34-38 in wave one.

Figure 2. Model-based relocation rates of respondents not intending to have a(nother) child, intending to have a(nother) child, and (whose partner is) pregnant by family life stage (log-odds and 95 percent confidence interval)

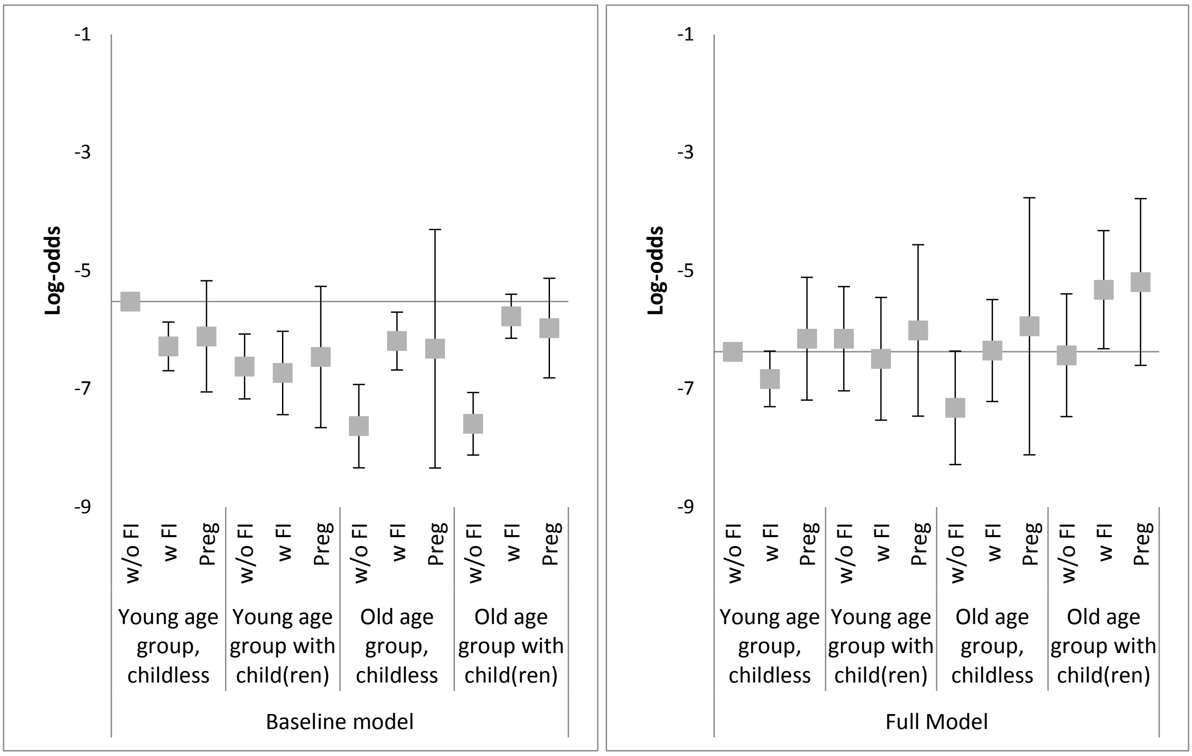
(i) Within-town relocations



(ii) Short-distance relocations



(iii) Long-distance relocations



Notes: Rates calculated from competing risk discrete-time event history analyses presented in Table A3, and graphically representing results of two-way and three-way interaction terms between fertility intentions/pregnancy, older age group, and couple with children status. Spikes around the squares are 95 percent confidence interval. Baseline model coefficients are adjusted by control variables included in Model 1 in Table 2. Full model coefficients are adjusted by control variables included in Model 2 in Table 2.
w/o FI = no fertility intentions/no pregnancy; w FI = Fertility intentions; Preg= pregnancy. Younger age group – childless refers to childless respondents born in 1981-1983 and aged 24-28 in wave one. Younger age group with child(ren) refers to respondents in a couple with children born in 1981-1983 and aged 24-28 in wave one. Older age group –childless refers to childless respondents born in 1971-1973 and aged 34-38 in wave one. Older age group with child(ren) refers to respondents in a couple with children born in 1971-1973 and aged 34-38 in wave one. Ref. category= Younger age group, childless with no fertility intentions/pregnancy.

Online appendices

Appendix A

Table A1. Summary statistics of selected variables by line item missing value status.

	Cases with missing values		Complete cases	
	mean	st. dev.	mean	st. dev.
Within-town relocation	0.006	0.076	0.006	0.076
Short-distance relocation	0.005	0.069	0.003	0.051
Long-distance relocation	0.003	0.055	0.002	0.038
Fertility intentions	0.245	0.431	0.265	0.441
Pregnancy	0.036	0.187	0.053	0.224
N	31,780		118,838	

Note: mean differences across groups are not statistically significant at the 5 percent level.

Table A2. Summary statistics

	Complete sample				Fertility Intention	Pregnancy
	Mean	SD	Min.	Max.	Mean	Mean
Birth parity						
Parity 0	0.465	0.499	0	1	0.679	0.443
Parity 1	0.351	0.477	0	1	0.240	0.375
Parity 2 or higher	0.184	0.388	0	1	0.080	0.182
Age at birth (older group)	0.564	0.496	0	1	0.318	0.366
Duration of residence (months)	125.769	138.957	1	1017	94.788	96.915
Residence episode (2nd or higher order)	0.265	0.441	0	1	0.351	0.333
Logged household income	7.340	0.492	2.485	10.414	7.404	7.411
Higher education	0.475	0.499	0	1	0.547	0.519
Employment status						
Full-time employed	0.569	0.495	0	1	0.668	0.605
Part-time employed	0.246	0.431	0	1	0.158	0.163
Non-employment situations	0.281	0.450	0	1	0.235	0.297
Higher education (partner)	0.380	0.485	0	1	0.436	0.432
Partner employed	0.664	0.472	0	1	0.678	0.667
Union situation						
Living-apart-together	0.060	0.237	0	1	0.078	0.023
Married	0.698	0.459	0	1	0.548	0.730
Union order (2nd or higher)	0.053	0.224	0	1	0.082	0.062
Commuting time (from home to work) one way						
<30 min	0.463	0.499	0	1	0.473	0.487
30-59 min	0.193	0.395	0	1	0.203	0.188
>=60 min	0.060	0.237	0	1	0.082	0.049
Distance to parents (>1 hour one way)	0.305	0.460	0	1	0.320	0.301
Homeownership	0.441	0.496	0	1	0.280	0.355
Housing density	0.820	0.341	0.091	7	0.758	0.780
Settlement structure						
Inner city	0.365	0.482	0	1	0.429	0.375
Suburbs	0.359	0.480	0	1	0.306	0.343
Rural areas	0.276	0.447	0	1	0.265	0.281
Sex (female)	0.573	0.495	0	1	0.550	0.526
Ethnic background	0.212	0.408	0	1	0.211	0.219
Residence in Eastern Germany	0.204	0.403	0	1	0.211	0.195

Table A3. Discrete hazard rates (log-odds) of within-town, short-distance and long-distance relocations. Models with interaction terms of fertility intentions/pregnancy, age group and parental status.

	Within town		Short distance		Long distance	
Models	1	2	1	2	1	2
	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)
Intercept	-4.86 ***	-4.97 ***	-5.08 ***	-6.74 ***	-5.52 ***	-6.37 ***
	(0.11)	*(0.75)*	*(0.13)*	*(1.00)*	*(0.17)*	*(1.30)*
Family couple (ref. childless couple)	0.06	0.47 *	-0.47 *	0.16	-1.09 ***	0.22
	(0.14)	*(0.19)*	*(0.19)*	*(0.27)*	*(0.28)*	*(0.45)*
Old age group (ref. young age group)	-0.64 ***	-0.27	-1.42 ***	-0.71 **	-2.09 ***	-0.94
	(0.15)	*(0.16)*	*(0.24)*	*(0.27)*	*(0.36)*	*(0.49)*
Family couple * Old age group	-0.19	-0.24	-0.57	-0.67	1.12 *	0.67
	(0.20)	*(0.21)*	*(0.36)*	*(0.39)*	*(0.50)*	*(0.61)*
Fertility intentions	0.14	0.19	-0.36 *	-0.25	-0.75 ***	-0.46
	(0.13)	*(0.14)*	*(0.16)*	*(0.18)*	*(0.21)*	*(0.24)*
* Family couple	-0.40	-0.57 *	-0.10	-0.33	0.64	0.13
	(0.25)	*(0.25)*	*(0.38)*	*(0.40)*	*(0.47)*	*(0.56)*
* Old age group	-0.21	-0.35	0.21	-0.07	2.17 ***	1.42 *
	(0.28)	*(0.28)*	*(0.47)*	*(0.50)*	*(0.47)*	*(0.61)*
*Family couple * Old age group	1.08 **	1.13 **	1.59 *	1.55 *	-0.24	0.02
	(0.40)	*(0.41)*	*(0.71)*	*(0.74)*	*(0.69)*	*(0.88)*
Pregnancy	0.06	0.29	0.45	0.73 *	-0.59	0.22
	(0.26)	*(0.28)*	*(0.26)*	*(0.30)*	*(0.48)*	*(0.53)*
* Family couple	-0.10	-0.31	-0.42	-0.72	0.75	-0.08
	(0.39)	*(0.41)*	*(0.53)*	*(0.56)*	*(0.81)*	*(0.87)*
* Old age group	-1.08	-1.28	0.74	0.42	1.79	1.09
	(1.05)	*(1.07)*	*(0.68)*	*(0.75)*	*(1.17)*	*(1.30)*
*Family couple * Old age group	2.10	2.21	0.07	0.16	-0.33	0.00
	(1.12)	*(1.14)*	*(1.11)*	*(1.18)*	*(1.42)*	*(1.63)*
N (observations)	118,788	118,788	118,788	118,788	118,788	118,788
n (individuals)	2,861	2,861	2,861	2,861	2,861	2,861
Log-likelihood	-7507.2	-7240.4	-7507.2	-7240.4	-7507.2	-7240.4

* = p<0.05, ** = p<0.01.

Notes: Competing risk discrete-time event history analyses. β estimates are discrete log-hazards. Standard errors in parentheses. Covariates in Model 1 include duration of residence and residence episode order. Covariates in Model 2 include sex, duration of residence, residence episode order, ethnic background, residence in Eastern Germany, calendar period, homeownership, housing density, settlement structure, married, number of children (2+), living-apart-together, union episode order, respondent's level of education, respondent's employment status, partner's level of education, partner's employment status, logged household income, commuting time, distance to parents, and a normally distributed individual level random term. Members of the younger age group were born in 1981-1983 and aged 24-28 in wave one. Members of the older age group were born in 1971-1973 and aged 34-38 in wave one.

Appendix B

To address the potential selectivity of fertility decisions across those who relocate, we follow a strategy similar to Kulu and Steele (2013) and we jointly estimate event history models for time to relocation and for time to conception leading to childbirth (Eq. 1).

$$\begin{cases} \log\left(\frac{\mathrm{h}_{\mathrm{ij}}^{R}}{h_{ij}^{0}}\right) = \alpha^{R}\,(\mathrm{t}) + \beta^{R}\,x_{ij}^{R}(t) + \mathrm{u}_{\mathrm{i}}^{R} \\ \log\left(\frac{\mathrm{h}_{\mathrm{ij}}^{F}}{1-h_{ij}^{F}}\right) = \alpha^{F}\,(\mathrm{t}) + \beta^{F}\,x_{ij}^{F}(t) + \mathrm{u}_{\mathrm{i}}^{F} \end{cases} \qquad (1)$$

The event history model for time to relocation estimates the discrete-time hazard rate of a residential relocation h^R of R type (R=1,2,3), referring to within-town, short-distance, and long-distance relocations. The reference outcome category is *no relocation*. The discrete-time hazard is defined as a multinomial response Y (coded 1 to 3 if a relocation of type R is observed and coded 0 if no relocation is observed) for each discrete time interval t given that no prior event within residential episode j and individual i has been observed. The term $\alpha^R\,(t)$ captures the duration of residence and is specified as a linear function of months since the start of a residential episode. Time-constant and time-varying covariates and their coefficients are specified in $\beta_i^R x_{ij}^R(t)$. Last, u_i is a random term capturing the effect of unmeasured individual characteristics that are fixed across residential episodes of each respondent. The event history model for time to conception leading to childbirth estimates the discrete-time hazard rate of a conception of parity order F (F=1,…, N). h^F is the discrete-time transition rate to a conception. The term α^F (t) captures the duration of a conception episode (since last childbirth, or since age 16 if childless). Covariates included in $\beta^F\,x_{ij}^F(t)$ are analogous to those of the relocation equation, and $\mathrm{u}_{\mathrm{i}}^{F}$ is a random term that captures the unobserved heterogeneity among conception episodes of the same individual. The random terms $\mathrm{u}_{\mathrm{i}}^{R}$ and $\mathrm{u}_{\mathrm{i}}^{F}$ are assumed to follow a joint bivariate normal distribution with mean 0 and variances and covariance to be estimated (Eq. 2).

$$\begin{pmatrix} \mathrm{u}^R \\ \mathrm{u}^F \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{u^R}^2 & \rho_{u^R u^F} \\ \rho_{u^F u^R} & \sigma_{u^F}^2 \end{pmatrix}\right) \qquad (2)$$

A significant non-zero covariance term ρ will be taken as evidence of common unobserved heterogeneity affecting both fertility and relocation decisions. That is, childbearing events and relocation events are predicted by factors that are not controlled for in the model (e.g. preference for family life over employment career), and thus, the relevant unobserved variation remains in the covariance term. After controlling for common unobserved heterogeneity, the coefficients of model covariates are adjusted associations to time-constant unobserved mediating or confounding factors. Nevertheless, other sources of heterogeneity (e.g. time-varying unobserved heterogeneity) may still prevent us from making causal statements about the associations.

Further, within-person replication, or repeated events (of relocations and conceptions) by some respondents would allow the identification of the model (Lillard and Waite 1993). Within the study period, 248 respondents relocate more than once, but only in 68 respondents do we observe conceptions leading to live births. In the fully-specified models, the variance of the residual term of the fertility equation was close to zero, which led to model estimation convergence issues. This is due to low number of respondents with repeated pregnancies in the study observation window, and hence, residual variation was very low after including relevant predictors of fertility realization (e.g. fertility intentions). In order to estimate the correlation between (residuals of the two) equations of fully-specified models, we evaluated different plausible constant values of the residual variance in the fertility equation. We present in Table B1 and B2 the results for the fertility intentions (and interactions in Table B2) estimates, the random part (i.e. variances and correlation) and the model log-likelihood for models setting the random variance of the fertility equation at several fixed values. Results in Tables B1 and B2 show high levels of correlations across equations, which suggests that unobserved factors commonly affect fertility and relocations. Given that we controlled for a number of known observable predictors of the timing of relocations and fertility, the remaining, unobserved factors affecting synchronicity in the timing of fertility and relocations might be perceptions, values and personality traits for which we had no control variables in the models. Our sample features partnered respondents of two childbearing age groups, and thus, intersections between perceptions/values about family events and the conditions for raising children can be expected. After controlling for cross-equation correlation, the associations between fertility intentions and relocations remained unchanged, though.

Table B1. Discrete hazard rates of within-town, short-distance, long-distance relocations, and conceptions from simultaneous equation estimation. (Selected results)

	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)
Fertility intentions											
Within-town relocation	0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.01	-0.01
	(0.09)	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*
Short-distance relocation	-0.26	-0.28	-0.28	-0.28	-0.28	-0.29	-0.29	-0.29	-0.29	-0.29	-0.28
	(0.14)	*(0.14)*	*(0.14)*	*(0.14)*	*(0.14)*	*(0.15)*	*(0.15)*	*(0.15)*	*(0.15)*	*(0.15)*	*(0.14)*
Long-distance relocation	-0.08	-0.06	-0.06	-0.06	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.06
	(0.18)	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*
Random part											
Variance relocations	0.44 ***	0.46 ***	0.46 ***	0.46 ***	0.46 ***	0.44 ***	0.44 ***	0.43 ***	0.41 ***	0.38 ***	0.34 ***
	(0.13)	*(0.13)*	*(0.13)*	*(0.13)*	*(0.12)*	*(0.12)*	*(0.11)*	*(0.10)*	*(0.10)*	*(0.09)*	*(0.09)*
Variance fertility (fixed)	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
Correlation	0.93 *	0.93 **	0.79 **	0.74 ***	0.73 ***	0.73 ***	0.72 ***	0.72 ***	0.72 ***	0.72 ***	0.72 ***
	(0.40)	*(0.31)*	*(0.26)*	*(0.22)*	*(0.19)*	*(0.15)*	*(0.13)*	*(0.11)*	*(0.09)*	*(0.07)*	*(0.07)*
ln-L	-11028.5	-11044.8	-11068.4	-11094.9	-11122.5	-11149.9	-11177.0	-11203.6	-11230.3	-11256.8	-11280.2

* = p<0.05, ** = p<0.01, *** = p<0.001.

Notes: Within-town, short-distance, long-distance relocations are competing risk discrete-time event history analyses. Fertility equation is a discrete-time event history analysis. β estimates are discrete log-hazards. Standard errors in parentheses. Model covariates: sex, duration of residence (duration since last childbirth or since age 16 in fertility equation), residence episode order, ethnic background, residence in Eastern Germany, calendar period, homeownership, housing density, settlement structure, married, living-apart-together, union episode order, respondent's level of education, respondent's employment status, partner's level of education, partner's employment status, logged household income, commuting time, distance to parents.

Table B2. Discrete hazard rates of within-town, short-distance, long-distance relocations, and conceptions from simultaneous equation estimation. Models with interaction terms. (Selected results)

	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)	β/(St.Err.)
Within-town relocation											
Fertility intentions	0.18	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15
	(0.13)	*(0.13)*	*(0.13)*	*(0.13)*	-0.13	*(0.13)*	*(0.13)*	*(0.13)*	*(0.13)*	*(0.13)*	*(0.13)*
* Family couple	-0.64 *	-0.62 *	-0.62 *	-0.62 *	-0.62 *	-0.63 *	-0.63 *	-0.62 *	-0.62 *	-0.61 *	-0.61 *
	(0.25)	*(0.25)*	*(0.25)*	*(0.25)*	-0.25	*(0.25)*	*(0.25)*	*(0.25)*	*(0.25)*	*(0.25)*	*(0.25)*
* Older age group	-0.35	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.33	-0.33
	(0.28)	*(0.28)*	*(0.28)*	*(0.28)*	-0.28	*(0.28)*	*(0.28)*	*(0.28)*	*(0.28)*	*(0.28)*	*(0.28)*
*Family couple * Older age group	0.99 *	0.99 *	0.98 *	0.97 *	0.96 *	0.95 *	0.94 *	0.94 *	0.93 *	0.93 *	0.94 *
	(0.41)	*(0.41)*	*(0.41)*	*(0.41)*	-0.41	*(0.41)*	*(0.41)*	*(0.41)*	*(0.41)*	*(0.41)*	*(0.41)*
Short-distance relocation											
Fertility intentions	-0.29	-0.30	-0.30	-0.30	-0.3	-0.31	-0.31	-0.31	-0.31	-0.31	-0.30
	(0.18)	*(0.18)*	*(0.18)*	*(0.18)*	-0.18	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*	*(0.18)*
* Family couple	-0.27	-0.30	-0.30	-0.30	-0.3	-0.31	-0.31	-0.31	-0.30	-0.30	-0.29
	(0.38)	*(0.38)*	*(0.38)*	*(0.38)*	-0.38	*(0.38)*	*(0.38)*	*(0.38)*	*(0.38)*	*(0.38)*	*(0.38)*
* Older age group	-0.13	-0.10	-0.10	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.10	-0.10
	(0.49)	*(0.49)*	*(0.49)*	*(0.49)*	-0.49	*(0.49)*	*(0.49)*	*(0.49)*	*(0.49)*	*(0.49)*	*(0.49)*
*Family couple * Older age group	1.51 *	1.47 *	1.47 *	1.46 *	1.45 *	1.44 *	1.43 *	1.43 *	1.43 *	1.43 *	1.43 *
	(0.73)	*(0.73)*	*(0.73)*	*(0.73)*	*(0.73)*	*(0.73)*	*(0.73)*	*(0.73)*	*(0.73)*	*(0.73)*	*(0.73)*
Long-distance relocation											
Fertility intentions	-0.47	-0.43	-0.43	-0.43	-0.44	-0.45	-0.45	-0.45	-0.44	-0.44	-0.43
	(0.24)	*(0.24)*	*(0.24)*	*(0.24)*	*(0.24)*	*(0.24)*	*(0.24)*	*(0.24)*	*(0.24)*	*(0.24)*	*(0.24)*
* Family couple	0.16	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.05	0.06
	(0.55)	*(0.55)*	*(0.55)*	*(0.55)*	*(0.55)*	*(0.55)*	*(0.55)*	*(0.55)*	*(0.55)*	*(0.55)*	*(0.55)*
* Older age group	1.37 *	1.30 *	1.30 *	1.30 *	1.31 *	1.33 *	1.33 *	1.32 *	1.31 *	1.31 *	1.31 *
	(0.60)	*(0.60)*	*(0.60)*	*(0.60)*	*(0.60)*	*(0.60)*	*(0.60)*	*(0.60)*	*(0.60)*	*(0.60)*	*(0.60)*

*Family couple * Older age group	-0.29	-0.11	-0.11	-0.12	-0.13	-0.16	-0.16	-0.16	-0.16	-0.16	-0.17
	(0.90)	*(0.89)*	*(0.89)*	*(0.89)*	*(0.89)*	*(0.89)*	*(0.89)*	*(0.89)*	*(0.88)*	*(0.88)*	*(0.88)*
Random part											
Variance relocations	0.44 ***	0.47 ***	0.47 ***	0.46 ***	0.47 ***	0.46 ***	0.45 ***	0.44 ***	0.42 ***	0.40 ***	0.35 ***
	(0.13)	*(0.13)*	*(0.13)*	*(0.12)*	*(0.12)*	*(0.11)*	*(0.11)*	*(0.11)*	*(0.10)*	*(0.10)*	*(0.10)*
Variance fertility (fixed)	0.50	0.75	1.00	1.25	1.5	1.75	2.00	2.25	2.50	2.75	3.00
Correlation	0.93 *	0.96 **	0.80 **	0.75 ***	0.73 ***	0.73 ***	0.72 ***	0.72 ***	0.72 ***	0.72 ***	0.72 ***
	(0.40)	*(0.32)*	*(0.26)*	*(0.22)*	*-0.18*	*(0.15)*	*(0.13)*	*(0.11)*	*(0.09)*	*(0.07)*	*(0.07)*
ln-L	-11012.4	-11028.0	-11051.6	-11078.1	-11105.8	-11133.4	-11160.3	-11186.9	-11213.6	-11240.1	-11263.4

* = p<0.05, ** = p<0.01, *** = p<0.001.

Notes: Within-town, short-distance, long-distance relocations are competing risk discrete-time event history analyses. Fertility equation is a discrete-time event history analysis. β estimates are discrete log-hazards. Standard errors in parentheses. Model covariates: sex, duration of residence (duration since last childbirth or since age 16 in fertility equation), residence episode order, ethnic background, residence in Eastern Germany, calendar period, homeownership, housing density, settlement structure, married, living-apart-together, union episode order, respondent's level of education, respondent's employment status, partner's level of education, partner's employment status, logged household income, commuting time, distance to parents. Additional covariates in relocation equations: interaction term of older age group and family couple.