Why Fertility Levels Vary between Urban and Rural Areas?

Hill Kulu

Why Fertility Levels Vary between Urban and Rural Areas?

Journal:	*Regional Studies*
Manuscript ID:	CRES-2010-0324.R1
Manuscript Type:	Main Section
JEL codes:	C41 - Duration Analysis < C4 - Econometric and Statistical Methods: Special Topics < C - Mathematical and Quantitative Methods, C39 - Other < C3 - Econometric Methods: Multiple/Simultaneous Equation Models < C - Mathematical and Quantitative Methods, J13 - Fertility|Family Planning|Child Care|Children|Youth < J1 - Demographic Economics < J - Labor and Demographic Economics
Keywords:	fertility, urban-rural, event history analysis, Europe, Finland

Why Fertility Levels Vary between Urban and Rural Areas?

Hill Kulu

School of Environmental Sciences, University of Liverpool, Roxby Building,

Liverpool, L69 7ZT, United Kingdom

E-mail: hill.kulu@liverpool.ac.uk

(Received October 2010: in revised form April 2011)

Abstract

In this study, we examine the causes of fertility variation across settlements. We use rich longitudinal data from Finland and apply event history analysis. Our analysis shows that fertility levels are the highest in small towns and rural areas and the lowest in the capital city, as expected. The socio-economic characteristics of women and selective migrations account for only a small portion of fertility variation across settlements. Housing conditions explain a significant portion of urban-rural fertility variation for first birth, but little variation for second and third birth. The analysis suggests that there are also significant contextual effects.

Keywords: fertility, urban, rural, event history analysis, Northern Europe, Finland

JEL codes: J13, C39, C41

Introduction

For a long time, spatial fertility variation was an under-researched topic in the literature on low fertility in industrialised countries. However, recent contributions to the literature are evidence of the growing interest in spatial aspects of fertility, including urban-rural fertility differences (HANK 2001; THYGESEN et al. 2005; DE BEER and DEERENBERG 2007; KULU et al. 2007). Studies show that urban-rural fertility variation has decreased over time, but significant differences between various settlements persist. Fertility levels are higher in rural areas and small towns and lower in large cities. This pattern has been observed for the US (HEATON et al. 1989; GLUSKER et al. 2000), England and Wales (TROMANS et al. 2008), France (FAGNANI 1991), the Netherlands (MULDER and WAGNER 2001; DE BEER and DEERENBERG 2007), Italy (BRUNETTA and ROTONDI 1991; MICHIELIN 2004), Germany and Austria (HANK 2001; KULU 2006), the Nordic countries (THYGESEN et al. 2005; KULU et al. 2007), the Czech Republic (BURCIN and KUČERA 2000), Poland and Estonia (VOJTĚCHOVSKÁ 2000; KULU 2005; 2006) and Russia (ZAKHAROV and IVANOVA 1996).

While studies on urban-rural fertility variation show broadly similar patterns (the larger the settlement, the lower the fertility levels are), it is far from clear why fertility levels are higher in smaller places and lower in larger settlements. Most research discusses two competing hypotheses regarding spatial fertility variation: the compositional and the contextual. The *compositional* hypothesis suggests that fertility levels vary between places simply because different people live in different settlements, whereas the *contextual* hypothesis suggests that factors related to immediate living environment are of critical importance. The role of *selective migrations* has also been discussed in the literature; couples with childbearing intentions may decide to move to smaller places that are better suited to childrearing, whereas those with no childbearing plans may migrate to larger settlements.

Although previous research has shed considerable light on spatial aspects of fertility, we argue that it suffers from important shortcomings. First, most studies have used aggregate data and respective indices (ASFR, TFR), which have been useful in outlining general patterns but less so for finding out the causes of urban-rural fertility variation. Second, urban-rural fertility variation has been a side-topic in most of those aforementioned studies that have examined disaggregated behavioural patterns using individual-level data. The causes of urban-rural fertility variation have been briefly discussed in these studies rather than being thoroughly analysed. Third, the role of *selective migrations* and *housing conditions* in urban-rural fertility variation has not been examined.

To investigate the causes of spatial fertility variation is important for demographic research. If the context turns out to be an important determinant of childbearing patterns, then research on urban-rural fertility variation will have the potential to significantly advance our understanding of the causes of fertility patterns and dynamics in Europe and North America. The issue of whether and how the social context influences fertility behaviour of individuals has been an ingredient part of ongoing discussion on the causes of fertility dynamics and patterns (BECKER 1991; MCDONALD 2000; LESTHAEGHE and NEELS 2002; NEYER and ANDERSSON 2008; THORNTON and PHILIPOV 2009). If the composition of a population plays a critical role, then spatial fertility patterns and their dynamics might still be of interest for researchers working on regional population projections (de Beer and DEERENBERG 2007; WILSON and REES 2005).

In this study, we examine the causes of urban-rural fertility variation. We go beyond the traditional urban-rural dichotomy and distinguish settlement groups by the size of settlement (KULU et al. 2007). We investigate to what extent the socio-economic characteristics of individuals, selective migrations and housing conditions explain fertility variation between various settlements and to what extent contextual factors play a role. Our contribution to the literature on urban-rural fertility variation is twofold. First, we examine the contribution of selective migrations to urban-rural fertility differences. While recent research has investigated the role of the individual-level characteristics in spatial fertility variation (KULU et al. 2007; KULU et al. 2009), no study has examined the contribution of selective migrations to urban-rural fertility differences (on the role of selective residential moves in high suburban fertility, see KULU and BOYLE 2009). Second, and even more importantly, we include in the analysis information on the housing characteristics of couples to investigate how much these account for fertility differences by settlement. This is an important step in the analysis that has not been executed in previous studies on urban-rural fertility variation. While some recent studies have examined childbearing patterns by housing type and size (KULU and VIKAT 2007; STRÖM 2010), none of these has explicitly focussed on urban-rural fertility variation. Further, to our knowledge, no recent study has modelled fertility and housing choices simultaneously to control for unobserved selectivity of individuals with different fertility plans into different housing types. This is a critical step for measuring the contribution of housing conditions to urban-rural fertility variation.

We use rich individual-level register data from Finland, a Northern European country, to examine patterns separately for first, second and third births. Parity-specific analysis allows us to gain a better understanding of the causes of urban-rural fertility variation than is possible via conventional studies based on aggregate data and indicators. We use data from Finland for two reasons. First, the Finnish register data contain a detailed information on the housing characteristics of individuals and couples. Second, information on residential and housing changes is provided to the accuracy of a month which is needed for a study of the effect of selective migrations and housing conditions on spatial fertility variation.

Competing views on the causes of urban-rural fertility variation

The idea of *compositional* factors suggests that fertility levels vary between places because different people live in different settlements. First, it is a well-known fact that the share of highly educated people is larger in cities than in small towns and rural areas. For many countries, fertility levels tend to differ by education level, with the lowest for university-educated individuals and the highest for individuals with only compulsory education (HOEM 2005; ANDERSSON et al. 2009). Therefore, lower fertility in larger places might simply be attributed to the higher proportion of highly educated people living there. Educational composition may thus be an important determinant of urban-rural fertility variation in many countries, particularly for spatial differences in childlessness. It is also likely that the role of education in urban-rural fertility differences varies between countries – it may be bigger in the countries where differences in fertility levels by education level are larger (e.g., Great Britain or Germany) and smaller in the countries where fertility levels vary little by level of education (e.g., the Nordic countries) (HOEM 2005; ANDERSSON et al. 2009). Second, fertility variation by residence may also result from the larger share of students in cities and towns than in small towns and rural areas (HANK 2001; KULU et al. 2007). Previous research shows that the likelihood of family formation is very small during the studies, even though some variation exists in Europe, particularly between the East and the West.

Third, the share of married people is larger in smaller places, and marriage is clearly related to childbearing. Thus, the over-representation of married people in small towns and rural areas may explain the higher fertility rates there and particularly the higher likelihood of family formation (HANK 2002). However, the direction of causality between marriage and childbearing is not as clear as it may appear to be at first glance. It might be argued that people often decide to marry because they wish to have children; the decision to begin childbearing could be seen as a reason to give a more "legal form" to a relationship (BAIZAN et al. 2004). This may be true even for the countries where childbearing in cohabitation is not rare (anymore). (For that reason marriage is left out from the models in this study.)

Selective migrations may also account for variations in spatial fertility. Couples who intend to have a child (or another child) may move from larger places to smaller ones because the latter are perceived as better suited to raising children. Indeed, recent studies show that selective moves take place between cities and neighbouring rural areas, many of which can be classified as suburbs of cities (HANK 2001; KULU and BOYLE 2009). However, the factor of selective migrations may be less relevant to explaining urban-rural fertility variation if the areas around cities and towns have been included in the analysis as part of the urban region. Previous studies have shown that there are families who move from cities and towns to small towns and rural areas over long distances, potentially with the intention of having another (or a third) child, but the share of such couples is not very large (KULU 2008).

The *context* may influence fertility behaviour through economic opportunities and constraints or cultural factors. It is a well known fact that children are more expensive in cities than in rural areas (LIVI-BACCI and BRESCHI 1990; BECKER 1991). First, food, commodities and services are more expensive in larger than in smaller places (BECKER 1991). Secondly, we may also argue that children are expensive in cities because parents have to pay for each step of their children's education, be that sending the child to piano lessons after school or playing football in a sports club. Third, children in cities are more time-consuming for their parents than those in rural areas; parents not only need to pay (or pay more) for post-school activities but also organise their children's journeys to and from home. This may become an extremely difficult task for couples with many children, particularly if school, home and post-school activities are in different places, which is often the case in cities (FAGNANI 1991). The latter argument, however, is challenged by some recent studies, which argue that in a 'daily prism' of the same size, in fact, a greater variety of amenities can be reached in a city than in a rural area (DE MEESTER et al. 2007). Amenities are thus more concentrated in cities; therefore, children in cities are not necessarily more time-consuming than those in rural areas.

Finally, one could argue that urban environments as such encourage higher spending on children because of norms, proximity to shops (and other attractions) and a need to invest more in children through extra-curriculum activities (cf. BECKER 1991). All of these factors outweigh the (minor) difference in salaries between urban and rural areas. Life in small towns and rural areas is simpler in contrast to urban life: there are fewer attractions for children, and there is less normative pressure for parents; children may even contribute to the family economy, assisting their parents either in running a farm or in family-based tourism (CALDWELL 2005). Also, it is important to emphasise that a spacious child-friendly housing is affordable for many couples in rural areas and small towns, but for a fewer couples in large cities (see our further discussion below on the possible effect of housing.)

Opportunities costs are also higher in cities and towns than in small towns and rural areas (BECKER 1991; MICHIELIN 2004). Life in an urban context, particularly in large cities, offers various opportunities for work and leisure. For example, a teacher in a school may accept a job at other (and a better) school in the city; she may then become headteacher of the school and finally accept a managerial job at the department for education and children at the city government. Having children, however, means that the possibility of taking advantage of such opportunities is relatively small. In rural areas and small towns, in turn, where usually only one educational institution exists, fewer promotion opportunities exist for a school-teacher and the opportunities costs are thus significantly lower. There is also strong normative pressure to achieve in the work arena in cities, which may be further promoted by stronger competition in cities. Briefly, there is more to lose (and win) in cities than in small towns and rural areas, and this dynamic *per se* may constantly remind urban couples of the conflict between work and family.

The emphasis on economic factors should not necessarily imply that childbearing decisions are subject to purely individual rational calculation in its instrumental form (the maximisation of utility). Rather, economic factors may be the basis for a normative context for various decisions, including childbearing decisions; the context may discourage couples from having large families (in large cities) or encourage them to have many children (in rural areas).

Cultural factors may also explain urban-rural fertility variation. Research has shown that people in rural areas and small towns retain traditional attitudes and lifestyles, with a value orientation towards large families and a preference for extended families (TROVATO and GRINDSTAFF 1980; HEATON 1989; SNYDER et al. 2004; SNYDER 2006). A rural and small-town population can thus be considered a 'family-oriented' sub-culture within a country (cf. LESTHAEGHE and NEELS 2002; SOBOTKA and ADIGÜZEL 2002). The 'family-oriented' sub-culture forms a normative context for couples to draw upon when they make various decisions. Cities, in turn, are the places where the 'second' demographic transition began and spread, and they also remain a stronghold of 'post-modern' values (cf. LESTHAEGHE and NEELS 2002). Cities promote individual autonomy and self-actualisation – and, thus, individual choices, which (despite their variety) usually means fewer children. There is also more heterogeneity in cities: while a 'family-oriented' sub-culture may exist there, particularly in the suburbs, cities are also places that support (or at least tolerate) the 'culture of singlehood and childlessness'.

Finally, the physical and social dimensions of the residential environment should not be neglected. Life in rural areas and small towns involves living in the vicinity of nature. The lure of the rural and small town environment for many parents or prospective parents is related to the child-friendly environment they offer: green and quiet environment; a lot of open space. Rural and small town residents are also more likely to be surrounded by other families with children because of the higher fertility in these areas and possibly the migration of (some) families with small children from large cities to rural areas and small towns (COURGEAU 1985; MULDER and WAGNER 1998; KULU 2008).

While various compositional and contextual factors have received attention in the literature on spatial fertility variation, the role of *housing conditions* has been only briefly discussed. Housing type and size vary across residential contexts. Most people in rural areas and small towns live in detached or semi-detached houses, whereas in towns and large cities in particular, apartments are the dominant type of housing. Detached or semi-detached houses are usually larger than apartments and they also have a garden. Most importantly, fertility levels are higher in detached or semi-detached houses than in terraced houses or apartments (KULU and VIKAT 2007). However, studies show that selective residential moves on the part of couples intending to have a child (or another child) explain a significant portion of fertility differences between family houses and apartments, as expected (KULU and VIKAT 2007). Therefore moving from one type of housing to another type is not likely to cause a change in couple's fertility behaviour. An opportunity of making such a move or the lack of it, however, may shape couple's childbearing plans and patterns (cf. MULDER 2006). For example, fertility may be high in rural areas because the couples can move to larger housing (or a 'proper' housing) when planning to have a child (or another child); fertility in large cities, in contrast, may be low because of the lack of opportunities for many couples to improve housing conditions. The efforts required to obtain a 'proper' housing are much greater in large cities than in rural areas and small towns; a 'proper' housing (e.g. detached or semi-detached house, terraced house or large apartment) is a pre-condition of family formation in most industrialised societies (MULDER 2006; cf. BERNARDI et al. 2008). The spatially varying availability and affordability of housing may thus account for urban-rural fertility variation.

In this study, we examine the relative contributions of the socio-economic characteristics of a population, selective migrations, housing conditions and contextual factors to fertility differences between various settlements in Finland. We focus on the childbearing of partnered women. We do this for two reasons. First, childbearing outside a union is uncommon in the Nordic countries; if it occurs, it is mostly among teenagers who have unplanned pregnancies (cf. VIKAT 2004), and that phenomenon is not the focus of this study. Second, we investigate the contribution of housing conditions to spatial fertility variation. With a focus on childbearing in unions, we know with a relatively high level of precision what the housing conditions are at the moment when a couple decides to have a child. We disaggregate fertility patterns by separately analysing determinants of spatial variation in first, second and third birth. We use individual-level register data from Finland, which is necessary for examining the role of various factors in urban-rural fertility variation; our sample is also sufficiently large to obtain robust results.

Urban-rural fertility variation in Northern Europe

Before we proceed with a description of the hypotheses, a brief summary of the urban-rural fertility variation in Northern Europe is useful. Figures 1a to 1d present total fertility rate (TFR) across settlement groups for four Nordic countries: Denmark, Finland, Norway and Sweden in the 1990s and the early 2000s. We see that the TFR has varied significantly across settlements in all the four countries. Moreover, we observe a systematic inverse relationship between the fertility levels and the size of settlement – the larger the settlement is, the lower the fertility has been. Interestingly, the fertility variation has persisted over time and the differences between the countries have been minor. We also notice that in the beginning of the 21st century the TFR in rural settlements and small towns stayed close to replacement level, while the TFR in the capital city region remained at levels between 1.5 and 1.7 children per woman. The Finnish data thus provide us with a good opportunity to study the causes of urban-rural fertility variation in Northern Europe. Further, we are reassured that the findings of our study are valid for industrialised countries in more general.

FIGURES 1A, 1B, 1C AND 1D ABOUT HERE

Hypotheses on the relative contribution of various factors

First, we expect fertility levels to significantly vary by settlements, with the highest in small towns and rural areas and the lowest in large cities (see Figure 1b). We assume that we will observe differences for all three parity transitions (THYGESEN et al. 2005; KULU et al. 2007). Second, we expect the socio-economic characteristics of women to account for some fertility variation across settlements (HANK 2001; DE BEER and DEERENBERG 2007). However, socio-economic factors may play a smaller role in explaining spatial fertility variation as shown in previous studies: the focus of this study is the childbearing of women in unions, and there are fewer in cities and towns who are still in school at this stage of life compared to when they were single. Also, fertility levels vary relatively little by education in Finland (and in other Nordic countries), which is where our data set comes from (ANDERSSON et al. 2009). Third, we expect selective migrations to play little or no role in urban-rural fertility differences because we have controlled for the possible (confounding) effect of suburbanisation by including suburbs of cities and towns as a part of the urban region (cf. KULU and BOYLE 2009). Fourth, we expect housing conditions to explain some urban-rural fertility variation at least. The key question, however, is how much spatial fertility variation is attributed to housing conditions and how much to the remaining factors, and whether the patterns vary by parity. We assume that these remaining factors, if any, are related to the living environment for couples in both the economic and the cultural sense.

Data and definitions

Our data come from the Finnish Longitudinal Fertility Register. This is a database developed by Statistics Finland that contains linked individual-level information from different administrative registers (see VIKAT 2004). The extract we used in the analysis included women's full birth and educational histories. Data on partnership, residential and housing histories, and annual measurements of characteristics of women's activity and income were collected for the period from 1987 to 2000. The extract used is a ten-percent random sample stratified by single-year birth cohort and drawn from records of all women who had ever received a personal identification number in Finland and were in the age range of 16–49 during the period between 1988 and 2000 (this includes cohorts born between 1938 and 1983). We focused on childbearing among women who were in unions and included in the analysis all co-residential unions that were formed between 1988 and 2000. Foreign-born women (three percent) were excluded from the analysis.

We studied the impact of settlement type on first, second and third births. We distinguished four types of settlements according to the size of the municipality of residence: 1) the capital city of Helsinki, with 500,000+ inhabitants; 2) other cities with a population of

50,000–250,000; 3) towns with 10,000–50,000 inhabitants; and 4) small towns and rural areas with less than 10,000 inhabitants. This was consistent with the fertility patterns we observed for various settlement groups at aggregate level (see Figure 1b). We also considered all cities and many towns to extend beyond their administrative borders and defined suburban municipalities (for cities and towns with more than 30,000 inhabitants) as part of the urban regions. We followed a definition developed by Statistics Finland and assigned a municipality to its respective urban region if at least 10% of its employed population commuted to work in the neighbouring city or town in 2000. Using commuting data to define labour-market regions is standard in migration and urbanisation research, although the threshold used varies across studies (see CHAMPION 2001; HUGO et al. 2003; KUPISZEWSKI et al. 2000).

Table 1 presents the distribution of person-years (exposure) and events (occurrences) across various settlement groups. The former shows how partnered women and their durations of residence were distributed across various settlements in the period when they were at risk for their first, second or third birth. Thirty four percent of all person-years for the first birth were lived in the capital city, 36% in other cities, 20% in towns and 9% in small towns and rural areas. The figures for the second birth were 30%, 37%, 21% and 11%, and those for the third birth 27%, 37%, 23% and 13%. There were 14,258 first births for 35,391 women, 12,097 second births for 23,154 women and 4,120 third births for 17,246 women in the data. Childless women who formed a union between 1988 and 2000 made up the population at risk for first births; the data set for second and third births also included women who had their first or second conception (that led to a birth) in 1988 or later but before union formation and women who had their first or second conception (that led to a birth) before 1988 but formed another union in 1988 or later.

TABLE 1 ABOUT HERE

We controlled for a set of demographic and socio-economic variables when examining fertility variation across settlements. Our demographic controls included union duration, the woman's age, and time since previous birth (if there were any births). The socio-economic controls included the woman's language (Finnish or Swedish), educational enrolment (enrolled or not enrolled), education level (lower secondary, upper secondary, vocational, lower tertiary or upper tertiary) and annual earnings (none, low, medium, high or very high)[1]. We also controlled for calendar time. In addition, we included in the analysis a variable showing whether a couple had changed its settlement of residence to control for the possible effect of selective migrations. During its first (common) residential episode, a couple was treated as a non-migrant couple (whatever the migration history of the partners before their marriage or cohabitation); they became a migrant couple after they had changed (together) their settlement of residence (i.e. crossed the border of a labour-market area). If a child was born after the migration, the couple was again treated as a non-migrant couple. For second and third births, therefore, we only considered migrations that had taken place after the birth of first or second child, respectively. This strategy (i.e. include only migrations before the current childbirth) was considered the best to capture the effect of selective moves; in our further analysis (results not shown), we also used different definitions for the migration variable (e.g. no return to 'non-migrant' category after the birth of a child / another child). Finally, we included housing type in the analysis, distinguishing between detached (and semi-detached) houses, terraced houses, and apartments. A dwelling for one or two families is defined as *detached house* (or 'single-family house'). *Terraced house* (or 'rowhouse') is a dwelling with three or more houses in a row of houses and sharing a wall with its adjacent neighbour. *Apartments* ('flats') are housing units in a dwelling that have three or more residential units, with at least one unit being on top of another.

Methods and modelling strategy

We used an event-history analysis (HOEM 1987; 1993; BLOSSFELD and ROHWER 1995), fitting a series of regression models for the hazard of first, second, and third births. We modelled the time to conception (subsequently leading to a birth) to measure the effect of the settlement of residence on childbearing decisions as precisely as possible. The basic model can be formalised as follows:

$$\ln \mu_i(t) = y(t) + \sum_k z_k(u_{ik} + t) + \sum_j \alpha_j x_{ij} + \sum_l \beta_l w_{il}(t), \qquad (1)$$

where $\mu_i(t)$ denotes the hazard of the first, second or third conception for individual i and $y(t)$ denotes a piecewise linear spline that captures the baseline log-hazard (union duration for first birth or time since previous birth for the second and third births). We used a piecewise linear spline specification instead of the widely used piecewise constant approach to pick up the baseline log-hazard and the effect of (other) time-varying variables that change continuously. Parameter estimates are thus the slopes for linear splines over user-defined time periods. With sufficient nodes (bend points), a piecewise linear-specification can capture any log-hazard pattern in the data (for further details, see LILLARD and PANIS 2003)[2]. $z_k(u_{ik} + t)$ denotes the spline representation of the effect of a time-varying variable that is a continuous function of t with origin u_{ik} (the woman's age, calendar time and union duration for the second and third births). x_{ij} represents the values for a time-constant variable (language), and

$w_{il}(t)$ represents a time-varying variable whose values can change only at discrete times (place of residence and all other variables).

In our modelling strategy, we first investigated first, second and third birth risk by settlement type controlling for basic demographic characteristics (union duration, woman's age and time since previous birth, if any). We then also controlled for socio-economic characteristics of women to explore how much these characteristics explained urban-rural fertility variation. In the third model, we also included migrant status to examine whether selective migrations played any role in spatial fertility variation. Finally, we included housing type in the analysis to further explain fertility variation across settlements. The aim of stepwise modelling was to examine the relative contribution of socio-economic characteristics, selective migrations, housing conditions and contextual (or remaining) factors to urban-rural fertility variation.

Housing type was an endogeneous variable in the fertility equations; childbearing plans of women (or couples) were likely to influence their housing choices. To identify and control for endogeneity of housing type in the fertility process we built a simultaneous-equations model to estimate jointly three equations for fertility and another three equations for housing choices according to the type of destination housing. The model can be formalised as follows:

$$\begin{aligned}
\ln \mu_i^{B1}(t) &= y^{B1}(t) + \sum_k z_k^{B1}(u_{ik} + t) + \sum_j \alpha_j^{B1} x_{ij} + \sum_l \beta_l^{B1} w_{il}(t) + \varepsilon_i^B \\
\ln \mu_i^{B2}(t) &= y^{B2}(t) + \sum_k z_k^{B2}(u_{ik} + t) + \sum_j \alpha_j^{B2} x_{ij} + \sum_l \beta_l^{B2} w_{il}(t) + \varepsilon_i^B \\
\ln \mu_i^{B3}(t) &= y^{B3}(t) + \sum_k z_k^{B3}(u_{ik} + t) + \sum_j \alpha_j^{B3} x_{ij} + \sum_l \beta_l^{B3} w_{il}(t) + \varepsilon_i^B \\
\ln \mu_{im}^{D}(t) &= y^{D}(t) + \sum_k z_k^{D}(u_{imk} + t) + \sum_j \alpha_j^{D} x_{imj} + \sum_l \beta_l^{D} w_{iml}(t) + \varepsilon_i^D , \\
\ln \mu_{im}^{T}(t) &= y^{T}(t) + \sum_k z_k^{T}(u_{imk} + t) + \sum_j \alpha_j^{T} x_{imj} + \sum_l \beta_l^{T} w_{iml}(t) + \varepsilon_i^T \\
\ln \mu_{im}^{A}(t) &= y^{A}(t) + \sum_k z_k^{A}(u_{imk} + t) + \sum_j \alpha_j^{A} x_{imj} + \sum_l \beta_l^{A} w_{iml}(t) + \varepsilon_i^A
\end{aligned} \qquad (2)$$

where $\mu_i^{B1}(t)$, $\mu_i^{B2}(t)$, $\mu_i^{B3}(t)$ denote the hazard of the first, second and third birth of individual i, respectively, and $\mu_{im}^{D}(t)$, $\mu_{im}^{T}(t)$, $\mu_{im}^{A}(t)$ represent the risk of mth move of individual i to detached housing, terraced housing and apartment in the competing risk framework. ε_i^B, ε_i^D, ε_i^T and ε_i^A are person-specific time-invariant residuals for the fertility, moving to detached housing, terraced housing and apartment equations, respectively. The residuals are assumed to follow a multivariate normal distribution with correlations ρ^{BD}, ρ^{BT}, ρ^{BA}, ρ^{DT}, ρ^{DA} and ρ^{TA}. A positive value of ρ^{BD} suggests that women with an above-average risk of having a child (or another child), net of their observed characteristics, have also an above-average propensity of moving to detached or semi-detached housing. The same logic applies for ρ^{BT} and ρ^{BA}, which denote correlations between the residuals of the birth and terraced housing equations and the birth and apartment equations, correspondingly. The identification of the model was attained through within-person replication (see LILLARD 1993; LILLARD et al.1995; KULU 2005; 2006; STEELE et al. 2006). Many women gave several births, and some women made several moves to the same housing type. We also tested robustness of the results by including and excluding various socio-economic variables from the equations of the two processes; the results were robust to different specification. The model was estimated via maximum likelihood using aML (LILLARD and PANIS 2003)[3].

The model thus controlled for woman-level unobserved characteristics, which influenced both her fertility and housing choices by destination. These unmeasured characteristics were assumed to be constant during a woman's reproductive ages. The model did not control for potential time-varying unobserved characteristics, which were birth- or move-specific.

The competing risks framework assumes that the risks of moving to different housing types are independent of each other (HACHEN 1988; HILL et al 1993). The assumption of Independence of Irrelevant Alternatives (IIA) is obviously not valid here: it is likely that the risks of moving to various housing types are related; more specifically, the residuals of the three housing equations are correlated. Our simultaneous-equations model offers (some) protection against the IIA assumption, however; by allowing the correlation of women-specific residuals of the three housing choice equations we control for the (unmeasured) similarity of alternative housing types.

Parity-specific fertility across settlements

First birth

In the first model, we only controlled for union duration and the woman's age. Couples living in the capital city of Helsinki had the lowest risk of a first birth, while couples in rural areas and small towns had the highest risk (Table 2 and 3). In the second model, we also controlled for the socio-economic characteristics of women. The differences between settlements largely persisted. In the third model, we also included migrant status to control for the effect of selective migrations. Couples who had changed their settlement of residence had a higher risk of a first birth than did couples who had not moved, suggesting that selective migration was indeed in operation (Table 3). The patterns did not change, however, because of the small share of selective migrants. This was expected because we had included suburban municipalities as part of the urban regions.

TABLES 2 AND 3 ABOUT HERE

Next, we also controlled for housing type. The differences in the first birth levels diminished considerably and disappeared between rural areas (and small towns) and urban areas. The high risk of first birth in rural areas and small towns was thus largely attributed to the fact that detached / semi-detached and terraced houses are dominant housing type there, while in urban areas in Finland (and other Nordic countries), most people live in apartments. Still, interestingly, women living in the capital city had a significantly lower risk of first birth than did those living in other settlements, even after controlling for housing conditions, suggesting that socio-economic factors and housing conditions did not explain all spatial variation in levels of first births and that there were other factors, possibly contextual ones, at play.

Second birth

Women living in rural areas and small towns had a significantly higher risk of a second birth than did those in cities and towns, but the risk of a second birth was not lower for women living in Helsinki (Table 4 and 5). In the second and third model, we controlled for the socio-economic characteristics of women and migrant status. The initial differences between the settlements persisted, suggesting that compositional factors and selective migrations played no role in spatial variation in the risk of a second birth. In the fourth model, we also controlled for housing type. The differences between urban and rural areas decreased somewhat, but the birth levels remained higher in rural areas.

TABLES 4 AND 5 ABOUT HERE

Third birth

The patterns for third births were also interesting. Couples living in Helsinki had the lowest risk of a third birth, while couples in rural areas and small towns had the highest risk (Table 6 and 7). This was similar to what we observed for the first birth. Next, we controlled for the socio-economic characteristics of women and migrant status. Couples who had changed their settlement of residence had a higher risk of a birth than did couples who had not moved, showing that selective migration was in operation for third births as well. However, the patterns did not change because of the small share of (selective) migrants. In the fourth model, we controlled for housing type. Spatial fertility variation decreased only slightly (if at all). The levels of third births remained significantly higher in rural areas and small towns than in urban areas, clearly indicating that other factors, possibly contextual ones, were responsible for the high risk of third births in smaller settlements.

TABLES 6 AND 7 ABOUT HERE

The results of the analysis supported that housing was an endogeneous variable in the fertility process; the correlations between the residuals of the respective equations were significantly different from zero (Table 8). Positive values suggested that women who were more likely to have a child (or another child), *ceteris paribus*, were also more likely to change housing, whatever the type of destination housing. Migration was also endogeneous in the fertility process, as expected; its 'effect' ceased in a joint model of the two processes (compare the results of Model 3 and 4 in Table 3, 5 and 7.)

TABLE 8 ABOUT HERE

Summary and discussion

The aim of this study was to investigate the causes of urban-rural fertility variation. Using rich longitudinal register data from Finland, we examined the relative contribution of socio-economic characteristics of population, selective migrations, housing conditions and contextual factors to fertility variation across settlements. While research had investigated the role of the individual-level characteristics in spatial fertility variation, no previous study had examined the contribution of selective migrations and housing characteristics to urban-rural fertility differences. Further, we modelled fertility decisions and housing choices jointly, which was necessary to measure the net contribution of housing conditions to urban-rural fertility variation.

Our study showed, first, that fertility levels varied significantly across settlements for all three parity transitions. The levels were the highest in small towns and rural areas and the lowest in the capital city of Helsinki. Second, the study showed that the socio-economic characteristics of women accounted for only a small portion of fertility variation across settlements. Third, we discovered that selective migrations did not explain any of the variation in spatial fertility: couples who had changed their settlement of residence had higher birth rates, but the share of internal migrants was small. Fourth, housing conditions accounted for a significant portion of variation in first birth levels across settlements. Fifth, we observed significant fertility variation across settlements after controlling for compositional characteristics, selective migration and housing conditions, which suggested that there were also contextual effects. First-birth levels were relatively low in the capital city of Helsinki; the second and, especially, third-birth rates were high in rural areas and small towns.

Why were the first-birth levels low in large cities? It could be argued that omitted individual or couple characteristics are the reason; these characteristics might include marital status and partner's education and income, for example. The share of married people was smaller in the capital city, and this explained the lower first-birth rates there. However, the direction of causality between marriage and childbearing is far from clear, as we discussed earlier. People may simply decide to marry when they wish to have children, thus making marriage a consequence (or a part) of family formation rather than its cause (BAIZAN et al. 2004). Also, we controlled for marriage in our further analysis, but significant differences in first-birth rates persisted between the settlements (results not shown). The inclusion of information on partner's education and income would have not changed the patterns either. Previous studies on the Nordic countries have shown that in the context of relatively high educational homogamy and given the prevalence of dual-earner couples, woman's educational and labour market characteristics are good proxies for a household's labour market performance and income and its association with childbearing (cf. ANDERSSON and SCOTT 2007). We are thus confident that contextual factors contributed to low fertility rates in the capital city. However, the question remains of which of those factors were critical.

To begin with economic factors, one might argue that some couples are unable to afford a child in large cities because of the high costs of child-rearing. However, while this may be true in some contexts, it is unlikely the case for Finland and other Nordic countries, where generous welfare provisions by the state ensure that couples enjoy sufficient security when raising a child. We may continue by considering the argument that higher opportunity costs account for lower first-birth rates in large cities. Again, it is unlikely that this is a critical factor in the Nordic context. Generous maternity leave, the availability of high-quality childcare and flexible work arrangement for parents (in the public sector) should minimise opportunity costs for parents, particularly if they (only) raise one child. Difficulties associated with reconciling work with childcare in a large city because of time and space constraints (potentially including long journeys to and from home) are also unlikely to lead a couple to decide not to have any children (cf. FAGNANI 1991).

Significantly lower first-birth levels in large cities may thus be related to cultural-normative factors: for example, to voluntary childlessness. Recent studies reveal the spread of voluntary childlessness in European countries (GOLDSTEIN et al. 2003), and it could be argued that large cities are the places where such behaviour emerged and spread first. A large city environment is a source of heterogeneity in behavioural patterns and supports the existence of various sub-cultures, including that of singles and couples who have decided not to have any children; in smaller places, in contrast, union formation (marriage) and childbearing are still expected to be closely connected (HEATON et al. 1989; SNYDER 2006). It is also possible that people with different family plans move to different environments at some stage in their lives (e.g., those who plan to remain childless leave rural areas for cities after leaving high school) or stay where they are (e.g. those who plan to have children stay in rural areas), but research in other European countries has found no support for this argument (KULU 2005; 2006).

We have deemphasised the role of economic opportunities and constraints in explaining low first-birth levels in large cities and emphasised the importance of cultural-normative factors instead. This view, however, is challenged by the fact that housing conditions explained a significant amount of spatial variation in the first-birth levels. Lower first-birth rates in urban areas were related to the fact that people in cities mostly live in apartments; higher first-birth levels in rural areas and small towns were associated with living in detached or semi-detached houses, which were larger than apartments. Living in spacious housing *per se* does not lead to birth of a (first) child. However, an opportunity of moving to a larger housing or the lack of it may shape couple's childbearing plans and patterns. The results thus suggest that the limited availability (or, more precisely, affordability) of a 'proper' housing is a factor in lower first-birth rates in urban areas, particularly in large cities. Access to 'proper' housing is a pre-condition of family formation in most industrialised societies (MULDER 2006). This is a requirement that is more difficult to fulfil in large cities than in towns and rural areas. Postponement of childbearing, in turn, increases the chances that some women will end up having fecundity problems (MULDER 2006).

It seems reasonable to assume that economic opportunities and constraints play an important role in explaining spatial variation in higher-order childbearing. Raising a second and especially a third child is costly in cities, even in the context of the Nordic welfare state. Further, despite generous policies that aim for the reconciliation of parenthood with employment, having a large family limits a woman's career opportunities, especially in a competitive city environment. It also takes a great deal of time and effort to organise the everyday activities of a large family in a city context (although some studies disagree with this argument). If these factors are pertinent to our study, however, we should expect levels of second and third births to be particularly low in the large cities where the constraints are the greatest. However, the main fertility differences that we observed occurred between urban areas, including both large cities and medium-sized towns, and between rural areas. Furthermore, while housing explained a significant portion of spatial variation in first-birth rates, it did account for less urban-rural variation in the levels of second births and little variation for third births; one would have expected the opposite if opportunities and constraints had been critical factors.

What then (or what else) explains high third-birth levels in rural areas and small towns? Daily support is particularly important for parents with large families, and grandparents are a primary source in this respect. It is thus possible that higher third-birth rates in rural areas and small towns can be attributed to the better availability of grandparental support. Interestingly, however, recent studies in the Nordic context have shown that there is not much of difference between the urban and rural areas in this respect; grandparents are (almost) equally available (or not available) in cities and rural areas (cf. MALMBERG and PETTERSSON 2007). It might also be argued that the inter-generational transmission of fertility explains high third-birth levels in rural areas and small towns: many rural and small-town residents come from families with three children. Again, however, previous studies based on survey data have shown that significant spatial variation in third-birth levels remains after controlling for the number of siblings (KULU 2005; 2006). We also controlled for the effect of unmeasured characteristics of women in our further analysis, but this did not change the results (see Model 4 in Table 7). It is thus likely that cultural-normative (contextual) factors account for particularly high third-birth levels in rural areas and small towns as compared to the levels in towns and cities. Rural and small town populations continue to constitute a subculture with a value orientation towards large families.

To sum up, there is evidence that the desired family size in small towns and rural areas is larger than that in urban areas. Further, the rural and small town environment provides opportunities that allow the couples to reach their desired family size in the reality. In urban areas, in turn, the desired family size is smaller and, in large cities in particular, some couples never reach their desired family size because of the inability to afford (at right time) a ‘proper’ housing (and status) required for forming a family.

This study has shown significant fertility variation across settlements in a Northern European country. Its novelty lies in its decomposition of urban-rural fertility variation, which revealed that a substantial portion of spatial fertility variation could be attributed to housing conditions and contextual factors. This is a first study to show the importance of housing conditions in urban-rural fertility differences. The role of contextual factors in explaining urban-rural fertility variation needs further investigation. A conventional way to examine contextual effects on fertility behaviour is to apply multilevel models to data on individuals and their regions of residence (HANK 2002). However, while this is an appropriate way to explore spatial fertility variation to its full extent and with all its nuances, it may not be the best way to examine urban-rural fertility variation, which is of a persistent nature and is difficult to explain using conventional contextual characteristics. Another (and perhaps more fruitful way to proceed) would be to interview a sample of (similar) couples living in various settlements to ascertain the socio-spatial context of their childbearing decisions.

Most recent research in the low-fertility contexts examines childbearing dynamics in a country or compares fertility trends in a number of countries (MCDONALD 2000; KOHLER et al. 2002; MORGAN 2003; NEYER and ANDERSSON 2008; FREJKA et al. 2008; GOLDSTEIN et al. 2009; THORNTON and PHILIPOV 2009). This study suggests that more attention should be paid to family and fertility dynamics in sub-national units, particularly in large cities were low fertility emerged a few decades ago and has dominated since then (cf. BECKER 1991; LESTHAEGHE and NEELS 2002). Research on childbearing dynamics in large cities would deepen our understanding of the determinants of low fertility in Europe and other industrial countries. Research on fertility dynamics in smaller places, in turn, may lead us to a better understanding of the factors that promote a relatively high fertility in the low-fertility settings. While most researchers assume that selective migrations explain much spatial fertility variation within countries, this study showed that this is not the case. Clearly, residential context matters.

Acknowledgements

I am grateful to two anonymous referees for their valuable comments and suggestion on a previous version of this paper. I would also like to thank Statistics Finland for providing me with the register data used in this study, and Marianne Johnson for valuable suggestions when preparing the data order. The analyses of this study are based on the Statistics Finland Register Data at the Max Planck Institute for Demographic Research (TK-53-1662-05).

References

ANDERSSON G., RØNSEN M., KNUDSEN L., LAPPEGÅRD T., NEYER G., SKREDE K., TESCHNER K. and VIKAT A. (2009) Cohort fertility patterns in the Nordic countries, Demographic Research 20(14), 313–352.

ANDERSSON G. and SCOTT K. (2007) Childbearing dynamics of couples in a universalistic welfare state: The role of labor-market status, country of origin, and gender, Demographic Research 17(30), 897–938.

BAIZAN P., AASSVE A. and BILLARI F. C. (2004) The interrelations between cohabitation, marriage and first birth in Germany and Sweden, Population and Environment 25(6), 531–561.

BECKER G. S. (1991) A Treatise on the Family. Second Edition. Harvard University Press, Cambridge.

BERNARDI L., KLARNER A. and VON DER LIPPE H. (2008) Job insecurity and the timing of parenthood: a comparison between eastern and western Germany, European Journal of Population 24(3), 287–313.

BLOSSFELD H.-P. and ROHWER G. (1995) Techniques of Event History Modeling: New Approaches to Causal Analysis. Lawrence Erlbaum Associates, Mahwah, NJ.

BRUNETTA G. and ROTONDI G. (1991) Urban and rural fertility in Italy: regional and temporal changes, in BÄHR J. AND GANS P. (Eds) The Geographical Approach to Fertility. Kieler Geographische Schriften 78, pp. 203–217. Geographisches Institut der Universität Kiel, Kiel.

BURCIN B. and KUČERA T. (2000) Changes in fertility and mortality in the Czech Republic: an attempt of regional demographic analysis, in KUČERA T., KUČEROVĂ O., OPARA O. and SCHAICH E. (Eds) New Demographic Faces of Europe, pp. 371–417. Springer, Berlin.

CALDWELL J. C. (2005) On net intergenerational wealth flows: an update, Population and Development Review 31(4), 721–740.

CHAMPION A. G. (2001) Urbanization, sub-urbanization, counterurbanization, and reurbanization, in PADDISON R. (Ed), Handbook of Urban Studies, pp. 143–161. Sage, London.

COURGEAU D. (1985) Interaction between spatial mobility, family and career life-cycle: a French survey, European Sociological Review 1(2), 139–162.

DE BEER J. and DEERENBERG I. (2007) An explanatory model for projecting regional fertility differences in the Netherlands, Population Research and Policy Review 26, 511–528.

DE MEESTER E., MULDER C. H. and DROOGLEEVER FORTUIJN J. (2007) Time spent in paid work by women and men in urban and less urban contexts in the Netherlands, Tijdschrift voor Economische en Sociale Geografie 98(5), 585–602.

FAGNANI J. (1991) Fertility in France: the influence of urbanization, in BÄHR J. and GANS P. (Eds) The Geographical Approach to Fertility. Kieler Geographische Schriften 78, pp. 165–173. Geographisches Institut der Universität Kiel, Kiel.

FREJKA T., SOBOTKA T., HOEM J. M. and TOULEMON L. (2008) Childbearing Trends and Policies in Europe, Demographic Research, Special Collection 7. Max Planck Institute for Demographic Research, Rostock.

GLUSKER A. I., DOBIE S. A., MADIGAN D., ROSENBLATT R. A. and LARSON E. H. (2000) Differences in fertility patterns between urban and rural women in Washington State, 1983–1984 to 1993–1994, Women & Health 31(1), 55–70.

GOLDSTEIN J. R., LUTZ W. and TESTA M.-R. (2003) The emergence of sub-replacement fertility ideals in Europe, Population Research and Policy Review 22(5–6), 479–496.

GOLDSTEIN J. R., SOBOTKA T. and JASILIONIENE A. (2009) The end of lowest-low fertility?, Population and Development Review 35(4), 663–700.

HACHEN D. S. (1988) The competing risks model: a method for analyzing processes with multiple types of events, Sociological Methods & Research 17(1), 21–54.

HANK K. (2001) Regional fertility differences in Western Germany: an overview of the literature and recent descriptive findings, International Journal of Population Geography 7(4), 243–257.

HANK K. (2002) Regional social contexts and individual fertility decisions: a multilevel analysis of first and second births in Western Germany, European Journal of Population 18, 281–99.

HEATON T. B., LICHTER D. T. and AMOATENG A. (1989) The timing of family formation: rural-urban differentials in first intercourse, childbirth, and marriage, Rural Sociology 54(1), 1–16.

HILL D. H., AXINN W. G. and THORNTON A. (1993) Competing hazards with shared unmeasured risk factors, Sociological Methodology 23, 245–277.

HOEM J. M. (1987) Statistical analysis of a multiplicative model and its application to the standardization of vital rates: a review, International Statistical Review 55(2), 119–152.

HOEM J. M. (1993) Classical demographic models of analysis and modern event-history techniques, IUSSP: 22nd International Population Conference, Montreal, Canada, Volume 3, 281–291.

HOEM J. M. (2005) Why does Sweden have such high fertility?, Demographic Research 13(22), 559–572.

HUGO G., CHAMPION A. and LATTES A. (2003) Toward a new conceptualization of settlements for demography, Population and Development Review 29(2), 277–297.

KOHLER H.-P., BILLARI F. C. and ORTEGA J. A. (2002) The emergence of lowest-low fertility in Europe during the 1990s, Population and Development Review 28(4), 641–680.

KULU H. (2005) Migration and fertility: competing hypotheses re-examined, European Journal of Population 21(1), 51–87.

KULU H. (2006) Fertility of internal migrants: comparison between Austria and Poland, Population, Space and Place 12(3), 147–170.

KULU H. (2008) Fertility and spatial mobility in the life-course: evidence from Austria, Environment and Planning A 40(3), 632–652.

KULU H. and BOYLE P. J. (2009) High fertility in city suburbs: compositional or contextual effects? European Journal of Population 25(2), 157–174.

KULU H., BOYLE P. J. and ANDERSSON G. (2009) High fertility in city suburbs: evidence from four Northern European countries. Demographic Research 21(31), 915–944.

KULU H. and VIKAT A. (2007) Fertility differences by housing type: the effect of housing conditions or of selective moves?, Demographic Research 17(26), 775–802.

KULU H., VIKAT A. and ANDERSSON G. (2007) Settlement size and fertility in the Nordic countries, Population Studies 51(3), 265–285.

KUPISZEWSKI M., HEIKKILA E., NIEMINEN M., DURHAM H., REES P. and KUPISZEWSKA D. (2000) Internal migration and regional population dynamics in Europe: Finland case study, Working Paper 00/07. The University of Leeds, School of Geography, Leeds.

LESTHAEGHE R. and NEELS K. (2002) From the first to the second demographic transition: an interpretation of the spatial continuity of demographic innovation in France, Belgium and Switzerland, European Journal of Population 18(4), 325–360.

LILLARD L. A. (1993) Simultaneous equations for hazards: marriage duration and fertility timing, Journal of Econometrics 56, 189–217.

LILLARD L. A., BRIEN M. J. and WAITE L. J. (1995) Premarital cohabitation and subsequent marital dissolution: A matter of self-selection?, Demography 32, 437–57.

LILLARD L. A. and PANIS C. W. A. (2003) aML Multilevel Multiprocess Statistical Software, Version 2.0. EconWare, Los Angeles.

LIVI-BACCI M. L. and BRESCHI M. (1990) Italian fertility: an historical account, Journal of Family History 15(4), 385–408.

MALMBERG G. and PETTERSSON A. (2007) Distance to elderly parents: analyses of Swedish register data, Demographic Research 17(23), 679–704.

MCDONALD P. (2000) Gender equity in theories of fertility transition. Population and Development Review 26(3), 427–439.

MICHIELIN F. (2004) Lowest low fertility in an urban context: the role of migration in Turin, Italy, Population, Space and Place 10(4), 331–347.

MORGAN S. P. (2003) Is low fertility a twenty-first-century demographic crisis?, Demography 40(4), 589–603.

MULDER C. H. (2006) Population and housing: a two-sided relationship, Demographic Research 15(13), 401–412.

MULDER C. H. and WAGNER M. (1998) First-time home-ownership in the family life course: a West German–Dutch comparison, Urban Studies 35(4), 687–713.

MULDER C. and WAGNER M. (2001) The connection between family formation and first-time home ownership in the context of West Germany and the Netherlands, European Journal of Population 17(2), 137–164.

NEYER G. R. and ANDERSSON G. (2008) Consequences of family policies on childbearing behaviour: effects or artifacts? Population and Development Review 34(4), 699–724.

SNYDER A. R. 2006. The role of contemporary family behaviors in nonmarital conception outcomes of nonmetro women: comments on Albrecht and Albrecht (2004), Rural Sociology 71(1), 155–163.

SNYDER A. R., BROWN S. L. and CONDO E. P. (2004) Residential differences in family formation: the significance of cohabitation, Rural Sociology 69(2), 235–260.

SOBOTKA T. and ADIGÜZEL F. (2002) Religiosity and spatial depographic differences in the Netherlands, SOM Research Report 02F65. University of Groningen, Groningen.

STRÖM S. (2010) Housing and first births in Sweden, 1972–2005, Housing Studies 25(4), 509–526.

THORNTON, A. and PHILIPOV D. (2009) Sweeping changes in marriage, cohabitation and childbearing in Central and Eastern Europe: new insights from the developmental idealism framework, European Journal of Population 25(2), 123–156.

THYGESEN L. C., KNUDSEN L. B. and KEIDING N. (2005) Modelling regional variation of first-time births in Denmark 1980–1994 by an age-period-cohort model, Demographic Research 13(23), 573–596.

TROMANS N., NATAMBA E. and JEFFERIES J. (2009) Have women born outside the UK driven the rise in UK births since 2001?, Population Trends 136, 28–42.

TROVATO F. and GRINDSTAFF C. F. (1980) Decomposing the urban-rural fertility differential: Canada, 1971, Rural Sociology 45(3), 448–468.

VIKAT A. (2004) Women's labor force attachment and childbearing in Finland, Demographic Research S3(8), 177–212.

WILSON T. and REES P. (2005) Recent developments in population projection methodology: a review, Population, Space and Place 11(5), 337–360.

VOJTĚCHOVSKÁ P. (2000) Population development in Poland, in KUČERA T., KUČEROVÁ O., OPARA O. and SCHAICH E. (Eds), New Demographic Faces of Europe, pp. 247–266. Springer, Berlin.

ZAKHAROV S. V. and IVANOVA E. I. (1996) Regional fertility differentiation in Russia: 1959–1994, Studies on Russian Economic Development 7(4), 354–368.

[1] We thank Andres Vikat for preparing a command file for calculation of earnings in the Finnish context.

[2] The value of the linear spline function between the points (t_n, y_n) and (t_{n+1}, y_{n+1}) is computed as follows: $y(t) = y_n + s_{n+1}(t - t_n)$ for n = 0, 1, 2 ..., where s_{n+1} is the slope of the linear spline over the interval [t_n, t_{n+1}]. To compute the linear spline function we thus need to define nodes and estimate from the data constant y_0 and slope parameters s_1, s_2, ...

[3] Another possibility to address the issue of endogeneity of housing in the fertility process is to include housing conditions in the analysis as a regional-level variable. This would require of setting up a multilevel model where individuals are nested within regions. However, this specification would allow us to include in the analysis a variable showing the size of settlement / region, but not simultaneously dummies for settlements (or a dummy for the capital city region) and a variable showing housing conditions in the region. For that reason, we decided to conduct a simultaneous analysis of fertility behaviour and housing choices.

Table 1: Person-years and Births by Place of Residence.

	Person-years Number	Percent	Births Number	Percent
First birth				
Capital city	33716.34	34	4494	32
Other cities	35395.34	36	5228	37
Towns	19849.82	20	2998	21
Rural areas and small towns	8980.05	9	1538	11
Total	97941.56	100	14258	100
Second birth				
Capital city	15324.76	30	3446	28
Other cities	18705.52	37	4447	37
Towns	10706.93	21	2648	22
Rural areas and small towns	5561.81	11	1556	13
Total	50299.01	100	12097	100
Third birth				
Capital city	13760.01	27	957	23
Other cities	18694.41	37	1476	36
Towns	11451.49	23	970	24
Rural areas and small towns	6779.79	13	717	17
Total	50685.70	100	4120	100

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.

Table 2: Relative Risks of Conception Leading to First Birth.

Place of residence	Model 1		Model 2		Model 3		Model 4	
Capital city	0.88	***	0.86	***	0.86	***	0.89	***
Other cities	1		1		1		1	
Towns	1.04	*	1.02		1.02		0.99	
Rural areas and small towns	1.18	***	1.14	***	1.14	***	1.02	

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.
Model 1: controlled for union duration and the woman's age.
Model 2: additionally controlled for language, educational level and enrolment, earnings and calendar time.
Model 3: additionally controlled for migration.
Model 4: additionally controlled for housing type.

Table 3: Log-risks of Conception Leading to First Birth.

Variable	Model 1		Model 2		Model 3		Model 4	
Place of residence								
Capital city	-0.126	***	-0.151	***	-0.150	***	-0.120	***
Other cities	0		0		0		0	
Towns	0.042	*	0.024		0.021		-0.007	
Rural areas and small towns	0.167	***	0.133	***	0.128	***	0.018	
Demographic variables								
Union duration (baseline)								
Constant	-2.506	***	-0.555	**	-0.544	**	-0.902	***
0-1 years (slope)	-0.165	***	-0.172	***	-0.175	***	-0.153	***
1-3 years (slope)	0.069	***	0.079	***	0.078	***	0.094	***
3-5 years (slope)	-0.005		0.002		0.001		0.024	
5+ years (slope)	-0.137	***	-0.125	***	-0.125	***	-0.110	***
Age								
-24 years (slope)	0.086	***	0.050	***	0.050	***	0.054	***
25-29 years (slope)	0.072	***	0.045	***	0.045	***	0.051	***
30-34 years (slope)	-0.072	***	-0.069	***	-0.069	***	-0.072	***
35+ years (slope)	-0.270	***	-0.274	***	-0.273	***	-0.288	***
Socio-economic variables								
Year								
1988-2000 (slope)			-0.017	***	-0.017	***	-0.015	***
Language								
Finnish			0		0		0	
Swedish			0.103	**	0.104	**	0.095	**
Educational enrolment								
Not enrolled			0		0		0	
Enrolled			-0.568	***	-0.568	***	-0.570	***
Educational level								
Lower secondary			0.109	***	0.110	***	0.140	***
Upper secondary			0		0		0	
Vocational			0.093	***	0.092	***	0.088	***
Lower tertiary			0.283	***	0.281	***	0.297	***
Upper tertiary			0.253	***	0.249	***	0.270	***
Earnings								
None			-0.394	***	-0.395	***	-0.384	***
Low			-0.020		-0.022		-0.008	
Medium			0		0		0	
High			0.067	***	0.067	***	0.051	**
Very high			0.106		0.106		0.072	
Migrations								
No migrations					0		0	
One or two migrations					0.090	**	0.014	
Housing conditions								
Housing type								
Detached house							0.377	***
Terraced house							0.237	***
Apartment							0	

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.
Notes: For linear splines we present slope estimates which show how the log-hazard increases or decreases over a certain duration;
Likelihood ratio test statistic (LR)
Model 2 versus Model 1: LR = 871.8, df = 11, $p < 0.001$; Model 3 versus Model 2: LR = 5.1, df = 1, $p < 0.05$;
Model 4 versus Model 3: LR = 440.9, df = 10, $p < 0.001$; the likelihood of a simultaneous-equations model was compared to a sum of the likelihoods of models for births and those for housing changes by type.

Table 4: Relative Risks of Conception Leading to Second Birth.

Place of residence	Model 1		Model 2		Model 3		Model 4	
Capital city	0.98		0.98		0.98		1.00	
Other cities	1		1		1		1	
Towns	1.02		1.02		1.02		1.00	
Rural areas and small towns	1.15	***	1.15	***	1.14	***	1.09	***

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.
Model 1: controlled for the age of the first child, union duration and the woman's age.
Model 2: additionally controlled for language, educational level and enrolment, earnings and calendar time.
Model 3: additionally controlled for migration.
Model 4: additionally controlled for housing type.

Table 5: Log-risks of Conception Leading to Second Birth.

Variable	Model 1		Model 2		Model 3		Model 4	
Place of residence								
Capital city	-0.020		-0.020		-0.019		-0.002	
Other cities	0		0		0		0	
Towns	0.024		0.022		0.019		-0.005	
Rural areas and small towns	0.143	***	0.137	***	0.134	***	0.088	***
Demographic variables								
Time since first birth (baseline)								
Constant	-3.130	***	-1.968	***	-1.945	***	-1.976	***
0-1 years (slope)	2.493	***	2.563	***	2.561	***	2.651	***
1-3 years (slope)	-0.160	***	-0.110	***	-0.113	***	-0.016	
3-5 years (slope)	-0.298	***	-0.298	***	-0.299	***	-0.292	***
5+ years (slope)	-0.089	***	-0.081	***	-0.081	***	-0.089	***
Union duration (baseline)								
0-1 years (slope)	-0.108	*	-0.106	*	-0.111	*	-0.031	
1-3 years (slope)	-0.024		-0.028		-0.029		-0.078	***
3-5 years (slope)	-0.015		-0.020		-0.020		-0.009	
5+ years (slope)	-0.049	***	-0.048	***	-0.048	***	-0.030	**
Age								
-24 years (slope)	0.029	***	-0.008		-0.008		-0.017	*
25-29 years (slope)	-0.004		-0.024	***	-0.024	***	-0.022	***
30-34 years (slope)	-0.054	***	-0.061	***	-0.061	***	-0.063	***
35+ years (slope)	-0.218	***	-0.219	***	-0.219	***	-0.234	***
Socio-economic variables								
Year								
1988-2000 (slope)			-0.009	***	-0.010	***	-0.012	***
Language								
Finnish			0		0		0	
Swedish			-0.029		-0.029		-0.051	
Educational enrolment								
Not enrolled			0		0		0	
Enrolled			-0.357	***	-0.361	***	-0.384	***
Educational level								
Lower secondary			-0.218	***	-0.217	***	-0.206	***
Upper secondary			0		0		0	
Vocational			0.152	***	0.151	***	0.164	***
Lower tertiary			0.247	***	0.245	***	0.262	***
Upper tertiary			0.236	***	0.231	***	0.249	***
Earnings								
None			-0.338	***	-0.339	***	-0.334	***
Low			0.041	*	0.040	*	0.050	**
Medium			0		0		0	
High			0.029		0.031		0.019	
Very high			0.175	**	0.175	**	0.151	
Migrations								
No migrations					0		0	
One or two migrations					0.082	**	0.010	

Variable	Model 1	Model 2	Model 3	Model 4	
Housing conditions					
Housing type					
Detached house				0.265	***
Terraced house				0.101	***
Apartment				0	

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.
Notes: Likelihood ratio test statistic (LR)
Model 2 versus Model 1: LR = 387.3, df = 11, $p < 0.001$; Model 3 versus Model 2: LR = 4.4, df = 1, $p < 0.05$;
Model 4 versus Model 3: LR = 440.9, df = 10, $p < 0.001$; the likelihood of a simultaneous-equations model was compared to a sum of the likelihoods of models for births and those for housing changes by type.

Table 6: Relative Risks of Conception Leading to Third Birth.

Place of residence	Model 1		Model 2		Model 3		Model 4	
Capital city	0.92	**	0.93	*	0.93	*	0.95	
Other cities	1		1		1		1	
Towns	1.05		1.06		1.05		1.04	
Rural areas and small towns	1.22	***	1.22	***	1.21	***	1.19	***

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.
Model 1: controlled for the age of the second child, union duration and the woman's age.
Model 2: additionally controlled for language, educational level and enrolment, earnings and calendar time.
Model 3: additionally controlled for migration.
Model 4: additionally controlled for housing type.

Table 7: Log-risks of Conception Leading to Third Birth.

Variable	Model 1		Model 2		Model 3		Model 4	
Place of residence								
Capital city	-0.085	**	-0.077	*	-0.072	*	-0.054	
Other cities	0		0		0		0	
Towns	0.047		0.054		0.049		0.039	
Rural areas and small towns	0.201	***	0.199	***	0.191	***	0.174	***
Demographic variables								
Time since second birth (baseline)								
Constant	-2.498	***	-2.676	***	-2.620	***	-2.664	***
0-1 years (slope)	1.928	***	1.977	***	1.965	***	2.019	***
1-3 years (slope)	-0.084	***	-0.044		-0.049		-0.013	
3-5 years (slope)	0.009		0.004		0.003		0.019	
5+ years (slope)	-0.066	***	-0.059	***	-0.059	***	-0.054	***
Union duration (baseline)								
0-1 years (slope)	-0.246	**	-0.249	**	-0.262	**	-0.187	*
1-3 years (slope)	-0.068	*	-0.074	*	-0.078	**	-0.124	***
3-5 years (slope)	-0.168	***	-0.178	***	-0.177	***	-0.207	***
5+ years (slope)	-0.060	***	-0.062	***	-0.061	***	-0.056	***
Age								
-24 years (slope)	-0.058	**	-0.067	**	-0.068	**	-0.064	**
25-29 years (slope)	-0.045	***	-0.059	***	-0.058	***	-0.053	***
30-34 years (slope)	-0.037	***	-0.042	***	-0.041	***	-0.041	***
35+ years (slope)	-0.247	***	-0.252	***	-0.251	***	-0.262	***
Socio-economic variables								
Year								
1988-2000 (slope)			0.002		0.002		-0.002	
Language								
Finnish			0		0		0	
Swedish			-0.106		-0.101		-0.110	
Educational enrolment								
Not enrolled			0		0		0	
Enrolled			-0.289	***	-0.299	***	-0.301	***
Educational level								
Lower secondary			-0.123	***	-0.123	***	-0.085	*
Upper secondary			0		0		0	
Vocational			0.053		0.052		0.050	
Lower tertiary			0.310	***	0.306	***	0.322	***
Upper tertiary			0.145	**	0.136	**	0.150	**
Earnings								
None			-0.159	***	-0.163	***	-0.150	**
Low			0.150	***	0.146	***	0.149	***
Medium			0		0		0	
High			-0.008		-0.010		-0.028	
Very high			0.257	**	0.255	**	0.234	*
Migrations								
No migrations					0		0	
One or two migrations					0.223	***	0.140	**

Variable	Model 1	Model 2	Model 3	Model 4	
Housing conditions					
Housing type					
Detached house				0.215	***
Terraced house				-0.019	
Apartment				0	

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.
Notes: Likelihood ratio test statistic (LR)
Model 2 versus Model 1: LR = 79.1, df = 11, $p < 0.001$; Model 3 versus Model 2: LR = 12.0, df = 1, $p < 0.001$;
Model 4 versus Model 3: LR = 440.9, df = 10, $p < 0.001$; the likelihood of a simultaneous-equations model was compared to a sum of the likelihoods of models for births and those for housing changes by type.

Table 8: Standard Deviations and Correlations Between Person-specific Residuals (Model 4).

Standard deviations		
Fertility	0.463	***
Move to detached housing	0.590	***
Move to terraced housing	0.371	***
Move to apartment	0.324	***
Correlations		
Fertility and move to detached housing	0.339	***
Fertility and move to terraced housing	0.716	***
Fertility and move to apartment	0.536	***
Move to detached housing and move to terraced housing	0.652	***
Move to detached housing and move to apartment	0.400	***
Move to terraced housing and move to apartment	0.486	***

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.

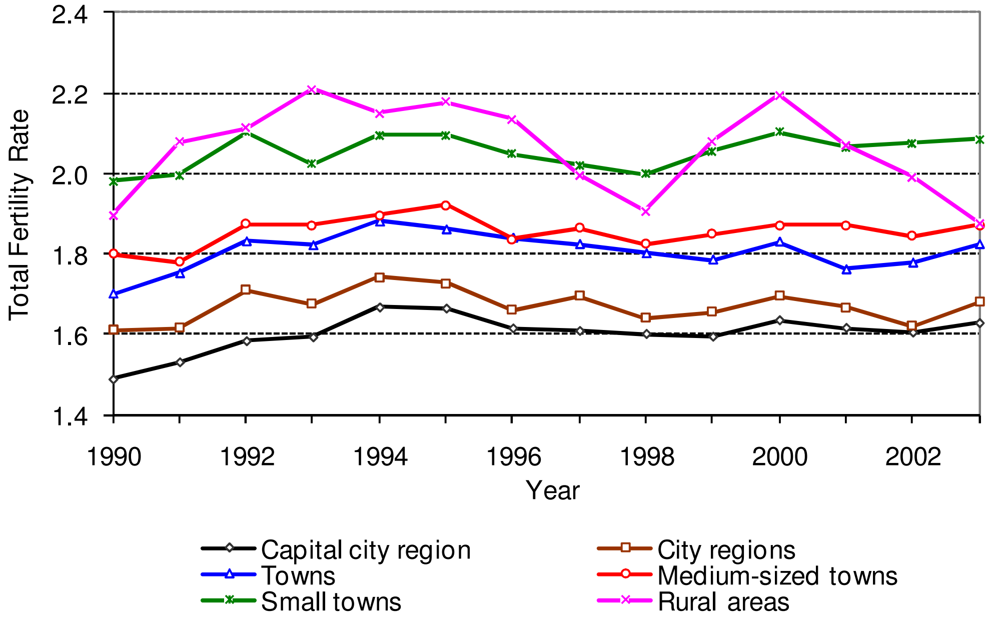

Figure 1a. TFR by Settlement Type in Denmark, 1990–2003.

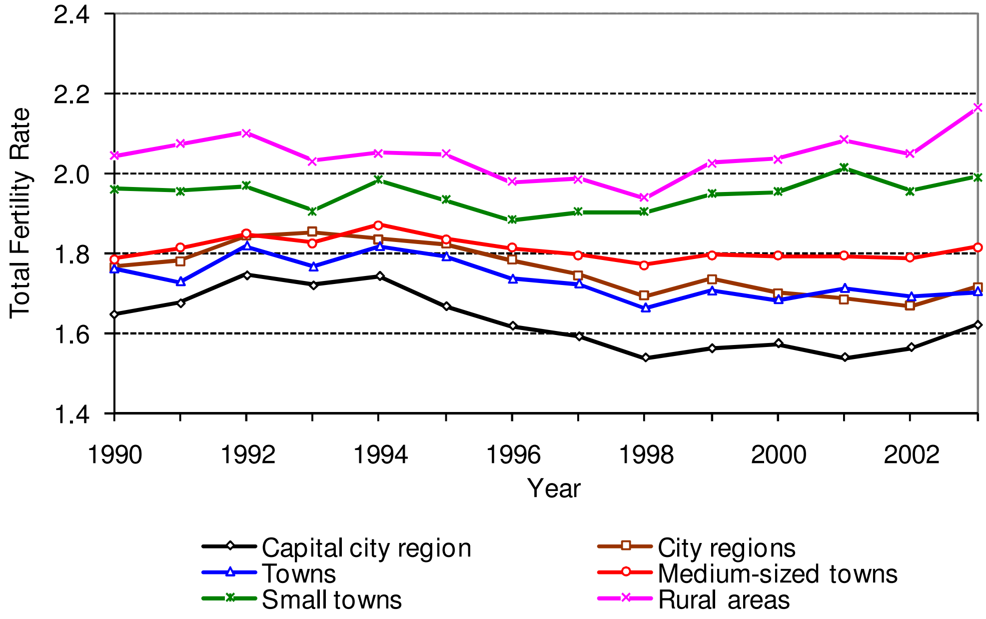

Figure 1b. TFR by Settlement Type in Finland, 1990–2003.

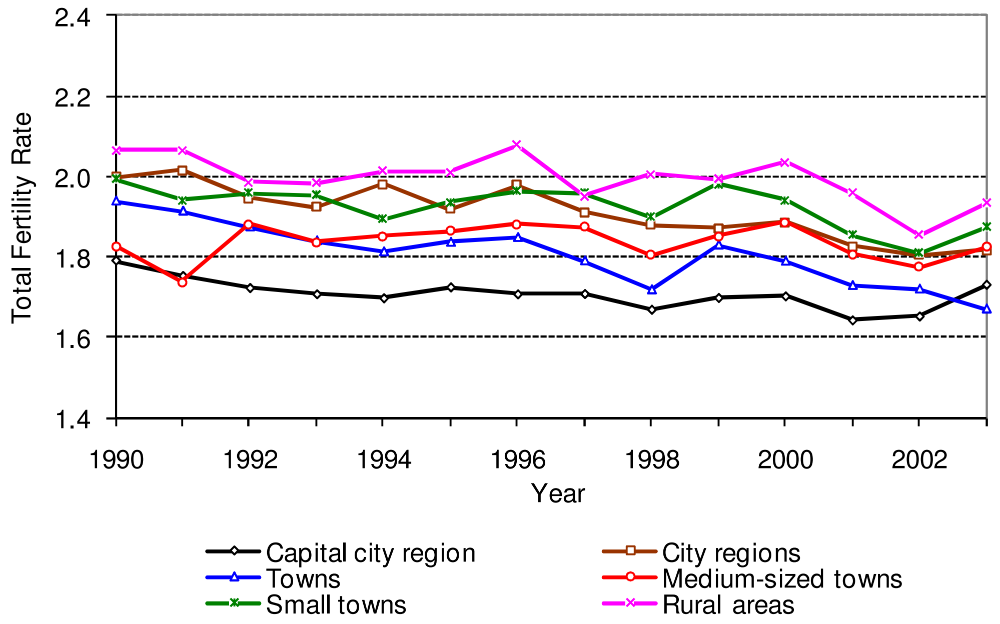

Figure 1c. TFR by Settlement Type in Norway, 1990–2003.

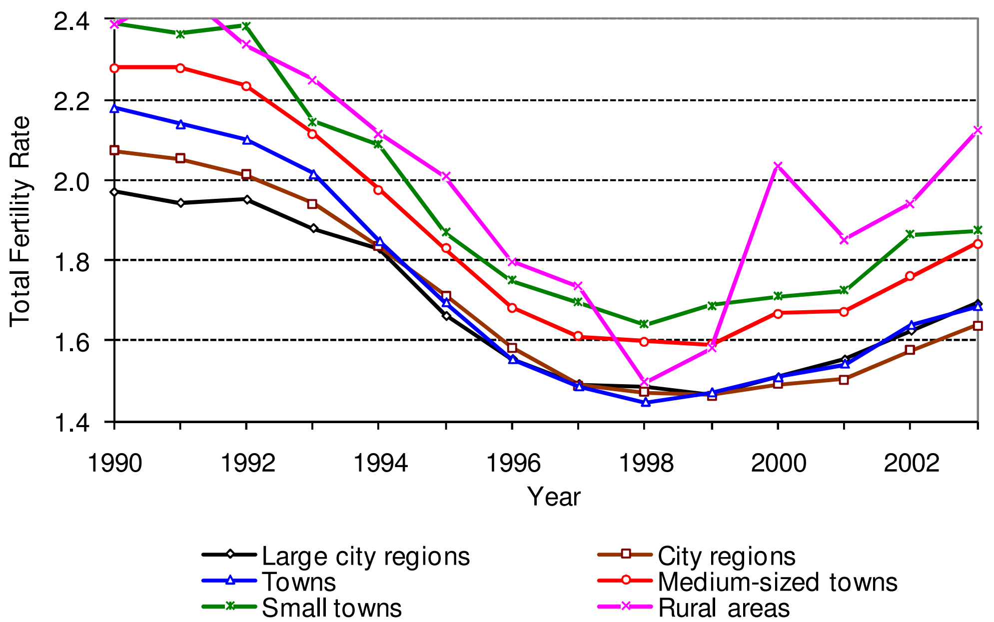

Figure 1d. TFR by Settlement Type in Sweden, 1990–2003.

Note: the category of large city regions includes Stockholm and Gothenburg.

Source: Calculations based on the population registers of Denmark, Finland, Norway, and Sweden.

Appendix 1: Log-risks of Residential Moves by Destination Housing (Model 4).

Variable	Detached house		Terraced house		Apartment	
Demographic variables						
Union duration (baseline)						
Constant	-9.157	***	-7.903	***	-4.518	***
0-1 years (slope)	0.602	***	0.724	***	0.615	***
1-3 years (slope)	0.017		-0.083	***	-0.183	***
3-5 years (slope)	0.019		-0.071	***	-0.082	***
5+ years (slope)	-0.043	***	-0.074	***	-0.111	***
Marriage						
Cohabitation	0		0		0	
Marriage	0.311	***	0.179	***	0.176	***
Time since previous move						
No moves	0		0		0	
One or more moves (constant)	-0.779	***	-0.682	***	-0.685	***
0-1 years (slope)	0.644	***	0.501	***	0.604	***
1-3 years (slope)	-0.078	***	0.062	**	0.010	
3-5 years (slope)	0.100	***	0.002		0.068	**
5+ years (slope)	0.016		0.062		0.093	**
Moves						
One move	0		0		0	
Two or more moves	0.022		0.200	***	0.307	***
Age						
-24 years (slope)	-0.008		-0.041	***	-0.049	***
25-29 years (slope)	-0.017	**	-0.052	***	-0.055	***
30-34 years (slope)	-0.040	***	-0.063	***	-0.046	***
35+ years (slope)	-0.071	***	-0.063	***	-0.026	***
Birth parity						
No children	0		0		0	
First pregnancy	0.411	***	0.615	***	0.424	***
First birth	0.371	***	0.387	***	0.116	***
Second pregnancy	0.574	***	0.516	***	0.286	***
Second birth	0.538	***	0.253	***	-0.010	
Third pregnancy	0.617	***	0.271	***	0.170	**
Third birth	0.588	***	0.171	**	-0.078	
Socio-economic variables						
Year						
1988-2000 (slope)	0.059	***	0.050	***	0.029	***
Language						
Finnish	0		0		0	
Swedish	0.147	***	-0.311	***	-0.251	***
Educational enrolment						
Not enrolled	0		0		0	
Enrolled	-0.404	***	-0.173	***	-0.024	
Educational level						
Lower secondary	-0.044		-0.071	**	0.088	***
Upper secondary	0		0		0	
Vocational	0.079	***	0.184	***	0.020	
Lower tertiary	0.097	**	0.115	**	0.037	
Upper tertiary	0.019		0.313	***	0.037	

Variable	Detached house		Terraced house		Apartment	
Earnings						
None	-0.131	***	-0.039		0.080	***
Low	-0.035		0.025		0.075	***
Medium	0		0		0	
High	0.102	***	-0.002		-0.086	***
Very high	0.491	***	0.028		-0.059	
Place of Residence						
Large urban	-0.423	***	-0.444	***	0.050	***
Medium urban	0		0		0	
Small urban	0.336	***	0.209	***	-0.020	
Rural	0.511	***	0.447	***	-0.300	***
Housing conditions						
Housing type						
Single-family house	-1.081	***	-1.391	***	-1.440	***
Terraced house	0.060	**	-0.086	***	-0.920	***
Apartment	0		0		0	

Source: Calculations based on Finnish Longitudinal Fertility Register, 1988–2000.
Significance: '*'=10%; '**'=5%; '***'=1%.