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## Joint determinants of educational enrolment and first birth timing in France and West Germany

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## Abstract

We examined the reciprocal influence between educational decisions and the timing of first births, using the Family and Fertility Surveys of France and West Germany. Since these two processes are potentially endogenous, we modelled them jointly, using event history models. We hypothesise that the reciprocal impact of educational and fertility careers, as well as the impact of the common determinants of both processes, are gender specific and context specific.

The results show a significant endogeneity for women and men in both countries. This endogeneity is stronger for women than for men, while no substantial differences are found between the two countries. Removing this shared and unobserved heterogeneity, the results show a stronger reciprocal impact between the processes for women than for men. A similar impact of being enrolled in education on first birth in both countries is found, while the effect of the birth (and especially of the pregnancy) of the first child on terminating one's education appeared to be more marked in West Germany than in France.

## Keywords

Education, endogeneity, fertility, simultaneous equations.

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## 1. INTRODUCTION

Previous research has revealed strong empirical associations at the individual level between education and fertility, and it has also indicated a complex network of causal forces connecting the processes of education and family formation. Here we investigate the reciprocal causal impact between the processes of ending school enrolment and the transition to parenthood, taking into account the possible existence of factors affecting both processes simultaneously. Basing our reasoning on a life course framework and in several sociological and economic theories, we hypothesise that such reciprocal impact is likely to present differentials between men and women, and especially differentials according to the context in which the individual is placed. The approach highlights the importance of specific national contexts in shaping that relationship, and particularly tries to disentangle the role of institutions. We also argue in the paper that in order to distinguish the reciprocal effects of education and fertility at the individual level, it is crucial to distinguish them from common factors affecting both processes. Given that the roles associated with educational and family events compete in terms of resources or time, joint decision making or even strategies involving both processes may exist. Such factors like value orientations or the parental background of individuals may be relevant here. Therefore, we empirically explore the hypothesis of a joint determination (endogeneity) between educational decisions and the birth of a first child. Furthermore, we hypothesise that this interrelationship is also likely to be gender specific and context specific, as cultural models (in particular gender role models and family models) vary over time and space. In order to explore these issues, we use data from the Family and Fertility Survey for West Germany<sup>1</sup> and France, for the male and female cohorts born between 1952 and 1972.

These two countries offer an interesting comparison. Both countries are known to belong to the so-called continental type of a welfare state regime (Esping-Andersen, 1990), but they display different general fertility trends and institutional characteristics. In fact, despite the convergent decline of fertility rates in both France and West Germany since the end of the 1960s, fertility behaviour in the two countries differs. The West German fertility rate dropped drastically from a level of 2.03 in the beginning of the 1970s to only 1.36 in 2000. Corresponding figures for France are 2.47 and 1.89 respectively<sup>2</sup>. Among other aspects, this pertains to differences in the timing of the first child. It has repeatedly been shown that the timing of first birth is fundamental to understand completed fertility (Lesthaeghe, 2001; Kohler et al., 2002). In both countries, postponement of the first birth started with the cohorts born in the 1950s, but nowadays the first birth takes place earlier in France than in West Germany. The median age at first childbirth is 25.8 for French women in the cohort 1966-70. West German women of the same cohort are over 29 when they have their first child (Corijn and Klijzing, 2001). There are also important differences between the two countries' percentage of childless women. In West Germany, it was 25 to 30 percent in the 1990s, "(...) which is presumably one of the highest levels of childlessness worldwide" (Kreyenfeld, 2004: 287).

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<sup>1</sup> We discuss and analyse data from the western part of Germany only. Most of the life course (up to the date of the survey) of the birth cohorts studied took place before the German (re-)unification.

<sup>2</sup> EUROSTAT. Demographic Data. NewCronos Database 2000.

In both France and Germany, the processes of leaving the educational system and the transition to parenthood have increasingly been postponed (Marry et al., 1998; Corijn and Klijzing, 2001). Longer periods in the educational system have been considered to lead to a postponement of family formation events in general, and fertility choices in particular (Hoem, 1986; Blossfeld, 1995). Most previous analyses have treated educational enrolment and educational attainment as exogenous factors that impact first birth timing. One of the points of this paper is to investigate whether there is a joint determination of both processes. Education, as measured at a later age, can be used as a proxy for earlier educational goals and strategies that may not be exogenous to fertility choices (Liefbroer, 1999; Upchurch et al, 2001; Barber et al., 2002). It is therefore crucial to establish whether a certain interdependence between both processes does exist. Furthermore, the modelling strategy applied should take this situation into account if it is to provide reliable estimates of the effects of educational enrolment on fertility, and of the effects of fertility on leaving education. Here we apply simultaneous hazard models with correlated unobserved heterogeneity to disentangle these issues. Following the approach developed by Lillard (1993), we estimate the correlation between the unobserved heterogeneity components belonging to both processes (see also, Billari and Philipov, 2003; Baizán et al. 2003 and 2004).

Therefore, when comparing two countries, each of the populations may present a different degree of correlation between the processes studied, making it crucial to control for this correlation. Once this control is implemented, it is possible to compare more confidently the strength of the reciprocal influences between educational enrolment and first birth timing. These effects are different between men and women and, in some instances, between the two countries, as we will see. In particular, the impact of motherhood on leaving one's education is strong and positive when the woman is pregnant, and this effect is stronger in West Germany than in France. We relate these differentials to the opportunities and constraints that are specific to each context, and in particular to the ability of each population to combine motherhood with educational enrolment, which is connected to the support provided by welfare state institutions.

The remaining paper is organised as follows. In the next section we introduce our theoretical perspective and present the main research hypotheses of the analysis. We provide several theoretical considerations on why the reciprocal impact between the processes of first birth and the end of education, as well as their common determinants, should be gender specific and country specific. Section 3 contains a description of the data and a presentation of the model and the variables used. In Section 4 we present the results obtained from the analyses. For both countries and genders, we found a significant degree of endogeneity between the processes studied, as well as differentials in the reciprocal impact of education and first birth according to gender and country. The discussion of the main findings and some concluding remarks follow.

## 2. THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

During the transition from youth to adulthood, women are involved in the achievement of different interrelated events that are seen as outcomes of processes that interact dynamically with each other and with the multiple contexts in which the woman lives (Buchmann, 1989; Billari, 2004). Our theoretical perspective can be placed in this general framework that integrates key aspects of the life course approach (Giele and Elder, 1998; De Bruijn, 1999; Liefbroer, 1999) and of decision-making theory (e.g., Ajzen, 1991). Furthermore, it allows for the incorporation of specific sociological and economic theories of family formation and of the role of education.

One of the views in the literature is that there are normative expectations in modern societies, according to which young people who attend school are "not at risk" of entering parenthood (Blossfeld and Huinink, 1991). The roles of student and parent are sufficiently demanding and therefore, most individuals delay fertility until they are out of the educational system (Rindfuss et al., 1988; Blossfeld and Huinink, 1991). Moreover, this view is often complemented by the assertion that individuals attending school, university or a vocational training program, are often economically dependent on their parents, making family formation unlikely (Marini, 1984, 1995; Hoem, 1986, 1989; Upchurch and McCarthy, 1990; Blossfeld and Huinink, 1991; Thornton et al., 1995). This approach is in line with the literature on age grading, which emphasises the role of age, sex, and the statuses people occupy in explaining their behaviour. Normative expectations are thus seen as having an impact on the statuses and on the transitions made during the transition to adulthood. Furthermore, the incompatibility between educational and parental roles implies that having a child would lead to quitting school. However, this decision is generally costly because it truncates the accumulation of knowledge and credentials, resulting in significant opportunity costs (Thornton et al., 1995). Furthermore, proponents of the "*role expectation hypothesis*" (Hypothesis 1) not only consider the roles of student and parenthood as incompatible, but also as part of a sequence of statuses in which childbearing takes place after completing education. Therefore, being enrolled in education induces postponement of entry into parenthood and, inversely, a pregnancy or a birth triggers termination of education. The abundant literature cited above on the impact of educational *enrolment* on fertility often emphasises its stronger importance with respect to educational *attainment*. Taking into account potential endogeneity between several life course processes, Upchurch et al. (2002) study the determinants of non-marital childbearing, and find that the risk of a non-marital conception increases immediately after leaving school. The literature on the reverse effect, that is, on the impact of the first birth on educational enrolment, has mainly focused on adolescent pregnancies and on the situation in North America or the United Kingdom, where early childbearing is more prevalent than in continental Europe (e.g., Upchurch et al., 1990).

This perspective implies gender differences in the (causal) effect of being a student on the timing of first birth, and in the effects of first birth on transitioning out of education. To the extent that couples adhere to a gender-specific division of labour within the family, or to the extent that women feel more responsible for the household they form, the incompatibility between educational enrolment and family formation may be stronger among women (Davis and Bumpass, 1976; Alexander and Reilly, 1981; Liefbroer and Corijn, 1999; Corijn and Klijzing, 2001). It is therefore expected

that *the negative effect of educational enrolment on first childbirth is stronger among women than among men* (Hypothesis 2).

Moreover, one can expect differences in the strength of the reciprocal effect of educational enrolment and fertility according to the context in which the individual is placed<sup>3</sup>. Cultural differences, for instance, in norms related to the role combination or in gender relationships, should also imply differences between countries in the strength of the “role expectation hypothesis” discussed above. In addition, structural and institutional contexts establish different sets of opportunities and constraints that shape the life courses of individuals (Esping-Andersen, 1999; Mayer, 2001). Welfare state research has shown that important differences exist between groups of countries in Western Europe in the principles and objectives of their social policies. In societies where welfare state institutions and policies provide relatively important support to both students and parents, the simultaneous fulfilment of these roles should more easily be compatible. For instance, institutional support may be provided in terms of services (e.g., child-care, housing, education) and/or transfers (e.g., scholarships, subsidies to education, unemployment benefits, child benefits, paid parental leave). Incentives or disincentives for particular roles are shaped through the organisation of institutions such as the educational system or social security. Moreover, a connection exists between educational choices, including the level of education attained and the length of educational enrolment, and subsequent roles in the labour market and the family. Therefore, it will also be relevant how the labour market and childcare are organised in each society (Rindfuss and Brewster, 1996).

This can be illustrated by some differences between France and West Germany. In one of the most widely cited welfare state classifications, both countries appear in the same group of “conservative” welfare states (Esping-Andersen, 1990, 1999)<sup>4</sup>. This classification is to an important extent based on the degree of “de-commodification” of individuals, that is, on the degree to which individuals and their welfare are independent of the market. A common trait of “conservative” welfare states is the reliance on unpaid family work (“familism”) for the production of welfare, and the corresponding limited degree of public provision and market solutions. Furthermore, social rights are mainly derived from employment and a sharp division of labour between men and women in the family is promoted. In both France and West Germany, the family is seen as the main unit to which social rights refer, rather than the individual (Daune-Richard, 1998 and 2005; Neyer, 2003). However, these two countries are often opposed with respect to some key features of the welfare state relevant here, in particular, to their care arrangements, their family policies, and the educational system.

This contrast is especially stressed by gender research, which points to the degree to which women are relieved from family obligations (i.e. “de-familisation”) (Lewis 1992; Orloff, 1996; Gornick, Meyers and Ross, 1999). West Germany is considered prototypically conservative in its promotion of the male breadwinner/housewife family model, through policies in such dimensions as the labour market, taxes, social

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<sup>3</sup> Most behaviour depend to some extent on such non-motivational factors as the availability of opportunities and resources (Ajzen 1991, pp. 181-182; De Bruijn, 1999), that at least to some degree vary with the context.

<sup>4</sup> Other welfare state types are the “liberal” (represented notably by the United States and the United Kingdom), the “social-democratic” group (e.g., Nordic countries), and the “Mediterranean” welfare states, considered to be a particularly “familistic” sub-group among the conservative countries.

security, the lack of day care provision, and even through the maintenance of its educational system, which promotes gendered paths in secondary education (Allmendinger, 1989; Shavit and Blossfeld, 1994; Müller, and Gangl, 2003; Hofman et al., 2004). For instance, West Germany pursued a policy for decades that supported care by mothers over universal public childcare for pre-school children, leading to an extremely low provision, especially for children under 3 (Ostner, 1994; Land and Lewis, 1998; Eurostat, 2002). Only since the late 1990s is a change in orientation clearly visible, involving the expansion of day care provision and the promotion of women's labour market participation through changes in social security and labour legislation (Esch and Söber-Blossey, 2002).

In contrast to the very consistent "conservative" policies of West Germany, France offers a more ambivalent picture. Since the late 1970s, several policies imply a departure towards a more "universalistic" model of welfare state. These include some family policy measures, like a universal and not need-based childcare payment, and some changes in the labour legislation, such as restricted support to part-time work and the more recent limitation of weekly working time to 35 hours. However, the feature that is most stressed in the literature is the expansion of a publicly-founded childcare system, as it substantially changes the compatibility between the role of mother (and father) and the role of worker/student. France reached almost universal coverage for 3-5 year olds in 1970, and since then has greatly invested in day care for children below the age three, reaching 29 per cent of coverage in 1998. However, several social and economic cleavages exist, including urban/rural differentials, or concerning the inclusion of some vulnerable groups such as lone mothers (Martin et al., 1998).

On the whole, support for motherhood and the economic independence of students and young adults in general, can be considered to be more important in France than in West Germany, especially in terms of the provision of services (see, e.g., Corman, 2000; Mayer, 2001; Kreyenfeld, 2002). As a result, we expect a weaker reciprocal impact between educational and fertility careers in France than in West Germany. More generally, we can hypothesise that *in societies that provide stronger support for the simultaneous fulfilment of the roles of parent and student, the reciprocal impact between parenthood and educational enrolment will be weaker* (Hypothesis 3).

In addition to the above direct effects of educational attainment and enrolment status on the risk of first birth, there may be some selection effects. These effects will result from the existence of factors that are common to both processes. If such is the case, the reciprocal impact between the processes will be (partially) spurious<sup>5</sup>. For example, some women may have particular values and attitudes that may lead to both low aspirations and expectations regarding their educational prospects and a definite intention to start a family early. Several authors have focused on the interrelationship between educational attainment and aspirations and non-marital fertility, concerning the contexts of the United States or Britain (Geronimus and Korenman, 1992; Hotz et al., 1997; Upchurch et al., 2002). However a systematic investigation of selection effects is lacking, in particular with respect to other countries.

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<sup>5</sup> A recent discussion of causality issues and the effects of unobserved heterogeneity can be found in Moffit (2005).

This perspective, which can be termed "*common determinants hypothesis*" (Hypothesis 4), considers that the timing of leaving education and entering parenthood may be jointly determined to some extent (MartínGarcía and Baizán, 2006). Those young people who do not want (or do not have the intention) to enter parenthood early, attend school for a longer period of time; conversely, those individuals with stronger fertility intentions (including higher total fertility) will speed up both processes<sup>6</sup>. That is, individuals that continue on to higher education may be a selected group with characteristics that favour delayed fertility, such as particular values or adhering to particular norms concerning those behaviours. Several sources of unmeasured heterogeneity could impact both processes studied. For instance, (bad) health or intellectual capacities can affect the incentives to invest in education and labour market experience, which in turn influence the economic returns to postponing childbearing. In addition, they may also influence the use of contraception and partnership formation<sup>7</sup>. Other variables, such as parental education and social background have been shown to influence the processes studied (Huinink, 1987; Galland, 1995; Leridon and Toulemon, 1995). They directly affect the resources available to the studied individuals, which are important for educational investments. Parental background may also be important because it is related to differences in values or in norms, which might have impacted socialisation in the parental household (Alwin, 1996). Moreover, parental values and attitudes may have an influence on the family formation behaviour of their offspring (Barber, 2000).

In fact, value orientations and their related attitudes, among other possible sources of heterogeneity, are of particular relevance for demographic studies<sup>8</sup>. Certain types of value orientation, such as secularisation, post-materialist values, and women's emancipation, are important elements in the explanation of current and past demographic behaviour. Some authors emphasise that the contribution of value orientations to the study of family formation is not redundant with respect to structural or economic explanations (Lesthaeghe and Surkyn, 1988; Lesthaeghe and Moors, 1995). Value orientations produce a selection effect, by which individuals choose consistent paths over the life course. Furthermore, family formation may be embedded in a web of choices, in which young adults seek a strategic balance between their family-life goals and goals in other domains (Liefbroer, 1999). Favourable attitudes toward union formation and childbearing are likely to reinforce each other. Conversely, attitudes toward roles that potentially compete with family building, such as being a student or being employed, are likely to be adjusted to conform with family building attitudes (and vice versa). Attitudes toward childbearing and educational expectations have been shown to be negatively correlated (Barber et al., 2002). Therefore, initial heterogeneity in each of the populations, with respect to the value orientations associated with these attitudes, leads to distinct life course patterns.

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<sup>6</sup> Consistency between intentions and behaviour is an important element of Ajzen's "theory of planned behaviour" (1991). See also Barber et al. (2002).

<sup>7</sup> Here we focus on factors that are directly influencing both processes. Some (unobserved) characteristics, such as differentials in fecundity, lead to heterogeneity between individuals in one of the processes, but do not necessarily affect both of them.

<sup>8</sup> These types of indicators are not usually observed dynamically (panel design), resulting in a problematic interpretation in terms of their causal impact on life course events.



These theoretical perspectives provide reasons to believe that educational completion and motherhood could be simultaneously driven by (unmeasured) factors, shared by both of the processes, that lead young individuals to choose a specific life-course path out of a set of alternative possibilities. If such is the case, a measure of educational enrolment at a given moment in the life course as a predictor of fertility will provide a biased effect of its impact, unless the common determinants of both processes are taken into account. The same spurious dependence could be observed if the propensity to follow a normative sequence of events, as outlined above, varies within a population (Billari and Philipov, 2003). Furthermore, comparative analyses should benefit from the control of such endogeneity between the processes in each of the populations, since they will obtain more reliable estimates of the reciprocal influence of the processes studied, thus enhancing the comparability of results (Baizán et al., 2004).

The above theoretical discussion leads us to the following expectations in our empirical research: First, *we expect a stronger endogeneity between the timing of ending educational enrolment and first birth among women than among men* (Hypothesis 5), because women's investments in education (and human capital in general) may conflict with family roles more intensely than for men, leading to a more important interrelationship between life course trajectories. This will be especially the case in societies with a strong differentiation of roles between genders. Continuing our discussion of the differences between France and West Germany, these two countries seem to have followed diverging paths of modernisation of their cultural family models with respect to gender roles (Pfau-Effinger, 2005). In both countries, the "male breadwinner model" has weakened, already starting from the 1960s. Yet, while in Germany the most supported model of the family seems to be one in which the man is fully employed and the wife is part-time employed, with a possible break in employment after the birth of a child, in France, the continuation of employment after childbearing on a full-time basis has become a "self evident pattern" (Pfau-Effinger, 2005; Daune-Richard, 2005). Each of these patterns may have distinct repercussions for the character of education (presumably more oriented towards a life-long employment for women in France, versus a less career oriented education for women in Germany), for different groups of individuals in each population, and in the degree of connectedness between life course trajectories. Thus, a second expectation derived from the above discussion proposes that *in societies in which educational/labour market trajectories and family formation are more disconnected from each other, a weaker endogeneity between fertility and educational choices will be found* (Hypothesis 6).

### **3. DATA AND METHODS**

#### *3.1. Data and construction of variables*

We use data from the Family and Fertility Surveys (FFS), conducted in 1992 in West Germany (Pohl, 1995) and in 1994 in France (Guibert-Lantoine and Toulemon, 1996). These surveys offer comparable data in terms of the cohorts studied and the variables provided. The data include retrospective histories of partnership formation and dissolution, childbearing and education. Foreign populations were not excluded from the French sample, while the German sample did exclude foreign nationals. The

German survey was undertaken in 1992 with 10,012 interviews of men and women born between 1952 and 1972. We selected the West German sample, which resulted in usable records for 4,837 individuals (of which 2,883 are women). The French survey contains usable life histories on 4,819 respondents, from the cohorts born between 1944 and 1973 (2,903 women). However, in order to enhance the comparability of analyses with the German sample, we omitted individuals born before 1952, resulting in a sample of 3,773 individuals.

The event variables are based on retrospective histories provided by the respondents. The event of first conception is indicated by the date of the first birth, given to the nearest month, minus nine months. We focus on conception time, rather than on birth time, because this allows a closer connection between the decision to have a child and the situation of the individual in parallel careers. Pregnancies interrupted by abortions are ignored, since most of them do not reflect the intention to have a child<sup>9</sup>. Censoring dates are generally given as the date of interview. Observation begins with age 14 and ends with the event of the conception of the first child or, for right-censored cases, with the date of the interview.

In regards to the process of leaving the educational system, the observation is considered as censored when the individual has not left education at the time of the interview. The dependent variable is measured as the time the individual quits the educational system after the age of 14. The covariate *educational enrolment* reflects whether the woman is in or out of education.<sup>10</sup>

Both the German and the French FFS samples provide information on respondents' educational attainment, but the degree system in the two countries is different and not generally comparable. For France, we define four educational groups, which we label as Primary, Lower Secondary, Upper Secondary and Tertiary. Respondents fall into the first category if they quit education before they were 14 years old, into the second category if they successfully completed education at the age of 14, into the third category if they successfully completed education at the age of 17, and into the last category if they completed schooling at the age of 20. For Germany, all respondents are at least lower secondary-educated, leading us to define only three educational

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<sup>9</sup> Women who get pregnant during education might interrupt their pregnancies by an abortion. A previous analysis was conducted for the French data set in order to test the sensitivity of the results when the dependent variable in the process of leaving the educational system was not conception, but birth. Neither the magnitude of the effects nor their sign and significance were strongly affected. In addition, information on abortion is not equally available for the German survey. Consequently, we decided to keep conception leading to a first birth as the dependent variable and not address the issue of abortion in this study.

<sup>10</sup> Complete educational histories should ideally be available when assessing the effect of education on fertility, but unfortunately the educational histories are surveyed in an incomplete manner in the French and German FFS. In the French FFS, the ending date of all educational episodes is surveyed, but not the starting dates. In the German FFS, only the date of the highest educational level is recorded for all cases. Therefore, we have been obliged to carefully reconstruct the educational history of each individual when needed. From the information on the exact age of the individual, his/her completed education and the official stipulated progress through the corresponding educational system, we have imputed the missing data. See, however, Kravdal (2004) for a detailed illustration on the problems caused by incomplete educational histories in fertility research.

groups: Lower Secondary, Upper Secondary and Tertiary. *Educational attainment* is implemented as a time-varying variable.<sup>11</sup>

Different individuals experienced the transitions to adulthood in different historical periods. To control for birth-cohort effects and general historical and economic developments - particularly for the expansion of the educational system and fertility trends- we include a dummy variable for the *birth cohorts* 1952-56, 1957-1961 and 1962-1973.

A time-varying dummy, indicating whether the *parents of the individual ever disrupted their union* (if that event took place before the interviewee's first birth), did not appreciably improve the fit of the model, nor did it have a great impact on the remaining coefficients. It has consequently been dropped from the final specification of the first birth process; although it has been kept in the model for the process of leaving the educational system, where its inclusion did significantly improve the model. The variable *parental status* reflects whether the individual is childless, whether she/he is expecting a baby, or whether she/he already has a child.

### 3.2. Empirical model

We first use separate hazard models for the processes of first birth conception and ending educational enrolment. This can be represented mathematically in the following way:

$$\ln h(t) = y(t) + \sum_j a_j x_j + \sum_i \alpha_i w_i(t) \quad (1)$$

The subscript for an individual is suppressed for simplicity.  $y(t)$  denotes a piecewise linear spline<sup>12</sup> that captures the effect of duration on intensity. The  $\{x_j\}$  denotes fixed time-invariant covariates; and  $\{w_i(\cdot)\}$  are a set of time-varying covariates whose values change at discrete times in the spell and are constant over the time span between those changes.

According to the "common determinant hypothesis" (Hypothesis 4), we suspect that the effect of the educational biography on first birth may be biased in the above specification, which is standard in event history analyses. Unmeasured attributes may affect both protracted educational enrolment and first birth timing. We therefore run a joint multi-process model of educational enrolment and first birth. The statistical specification is derived from the framework developed by Lillard (1993)<sup>13</sup>. It consists of two simultaneous hazard rate equations: capturing time to first birth (conception) and to the end of educational enrolment.

<sup>11</sup> Some useful reflections on the measurement and comparability of educational attainment in the FFS can be obtained from Dourleijn et al. (2000).

<sup>12</sup> Piecewise linear splines are used to approximate continuous functions (such as a baseline hazard or a non-proportional relative risk), by using functions that are linear within each (possibly open-ended) interval. Those linear functions are connected at knots given *a priori*: piecewise linear splines are then also continuous functions. We have evenly distributed the knots over the life course, every three or four years, in order to capture the main features of the baseline.

<sup>13</sup> Similar models can be found, for instance, in Brian et al. (1999), Upchurch et al. (2003), Baizán et al. (2003 and 2004).

$$\begin{cases} \ln h^B(t) = y^B(t) + \sum_j a_j x_j + \sum_i \alpha_i w_i(t) + \varepsilon \\ \ln h^E(t) = y^E(t) + \sum_j b_j x_j + \sum_i \beta_i w_i(t) + \delta \end{cases} \quad (2)$$

The superscripts  $B$  and  $E$  denote, respectively, first birth and the end of educational enrolment. Model (2) differs from the model (1) above by the joint estimation of the parameters of both equations and by the inclusion of the random variables  $\varepsilon$  and  $\delta$ . These components are intended to capture unobserved heterogeneity, and are assumed to be constant with respect to age and prior life-course experiences. The heterogeneity components have a joint bivariate normal distribution:

$$\begin{pmatrix} \varepsilon \\ \delta \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_\varepsilon^2 & \rho_{\varepsilon\delta} \\ \rho_{\varepsilon\delta} & \sigma_\delta^2 \end{pmatrix}\right),$$

in which  $\rho_{\varepsilon\delta}$  is the correlation between the unobserved heterogeneity terms of the process. The measurement of the correlation between the heterogeneity components of each process is a crucial test of endogeneity between them. The variance of the heterogeneity component cannot be identified, so all components are set at the same value<sup>14</sup>. We estimate the models using maximum likelihood methods with the aML software (Lillard and Panis, 2000).

#### 4. RESULTS

In the theoretical part of the paper we have proposed several hypotheses that are empirically explored here. We present the results obtained from these analyses in Tables 1 to 6. Tables 1 and 2 report the parameters for the process of first birth for France and West Germany, respectively, and Tables 3, 4 and 5 include the coefficients for the process of leaving the educational system. Different models are also calculated for men and women. In each of the tables we compare the results obtained from a standard event history model (Model 1) with results from a model incorporating correlated unobserved heterogeneity (Model 2). For the sake of clarity, the results of this last model are presented in different tables, although they have been computed simultaneously. Table 6 shows the correlation between the processes. We computed an additional model with correlated unobserved heterogeneity (Model 3) for the processes of first birth and of leaving education. For this last process, Model 3 includes a specification of the variable “parenthood status”, which is more detailed than in Model 2 since the category “has a first child” is split into the period of “pregnancy” and the period when the child is already born.

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<sup>14</sup> We conducted experiments in order to test the robustness of our results to different values of the variance of the unobserved heterogeneity component. Though the magnitude of effects was affected (but not severely for the parameters of our interest) by the value of the variance, their sign and their significance were not. The results of these experiments are presented in annex (Tables 9 to 13).

The first hypothesis stated that there is a strong incompatibility between the roles of student and parent (*Hypothesis 1*). The results obtained clearly support this hypothesis with respect to the effect of school enrolment on first birth. They show that, net of common factors, the impact of educational enrolment on first birth is somewhat lower for French and German individuals in the models that incorporate correlated unobserved heterogeneity<sup>15</sup>. In the model that does not take into account correlated heterogeneity (Model 1), the estimate of being enrolled in education for women (versus not being enrolled in education) is  $-1.28$  (France) and  $-1.52$  (West Germany); whereas the models with heterogeneity give the estimates  $-1.18$  and  $-1.24$  respectively (Models 2). Moreover, the incompatibility between educational enrolment and family formation is stronger among women (*Hypothesis 2*). The negative effect of educational enrolment on first childbirth is clearly stronger among women than among men in both models and countries:  $-0.77$  (model 1) and  $-0.74$  (model 2) for men in France, and  $-0.83$  (model 1) and  $-0.69$  (model 2) for men in West Germany. All these results provide empirical support for the “role expectation hypothesis”, in line with previous studies. However, this hypothesis is qualified by the finding that, for both countries, the effect of educational enrolment is somewhat lower in Model 2, which incorporates unobserved heterogeneity, suggesting that joint factors play a role (see below). Finally, the results obtained concerning the effects of educational enrolment on first birth do not provide substantially different coefficients in West Germany and France, and therefore do not confirm our argument that the roles of parenting and attending school are more compatible in France than in West Germany (*Hypothesis 3*).

The results concerning the influence of pregnancy/first birth on the end of enrolment in the educational system presented in Tables 3 and 4 are puzzling, because they provide unexpected negative effects for women and positive effects for men (Models 1 and 2). These results are not significant in France, but they are in West Germany. In order to get a clearer picture of the effects involved we have distinguished the period of pregnancy in Model 3. In this last model, there is an important and significant positive effect of ending school enrolment when the woman is pregnant (estimates of 0.57 for France and of 0.87 for West Germany), while afterwards, the impact is the reverse. Once the child is born we find no significant differences with respect to women without children in France, while for Germany a significant negative effect is found:  $-0.36$ . Therefore, if the woman does not leave education while she is pregnant, she does not necessarily do so afterwards. The positive effect of (the partner’s) pregnancy on leaving education is also strong for men: the German coefficient is 0.68 and the French is 0.62. As discussed above, a possible reason for this might be the importance of men’s economic role in the family as a breadwinner. Contrary to the effect of educational enrolment on parenthood, these results can be interpreted as showing a higher ability of French individuals, as compared to West Germans, to make the roles of parent and student more compatible (*Hypothesis 3*). However, the low number of individuals involved in the computations of this covariate should induce caution when interpreting this particular result<sup>16</sup>.

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<sup>15</sup> We do not proceed to a formal test of the differences between models, or between countries and genders.

<sup>16</sup> Only 1.04 percent and 1.25 percent of the individuals in the process of leaving the educational system are pregnant in both the French and the (West) German data set. Corresponding figures for individuals with a first child are 1.25 percent and 3.3 percent respectively.

It is worth noting that the introduction of correlated heterogeneity has an important impact on the estimated effects of some other covariates (tables 1 to 5). Thus, the impact of the birth-cohort is stronger for both processes, for both genders. In the same way, the impact on the process of leaving the educational system of the time-varying dummy that indicates whether the parents of the interviewed individual ever disrupted their union before the birth of the first child, also becomes larger when the unobserved heterogeneity is added. In particular, the results regarding the effects of the level of education on first birth timing show a much stronger differentiation between the categories, while the pattern remains the same as in Model 1.

In previous sections we have hypothesised that the processes of first birth and leaving the educational system may share some common unmeasured factors and have proposed a method to test for that correlation (*Hypothesis 5*). As displayed in Table 6, the results obtained are in line with that hypothesis, since we find significant positive correlations between the heterogeneity components in France and in West Germany, for both men and women. The results therefore attest to the existence of selection effects in the timing of entering motherhood and leaving education. Both processes may be driven by a set of values, preferences or norms that lead to choosing specific life-course paths out of many alternative choices (*Hypothesis 4*: “common determinants hypothesis”). The correlation term between the heterogeneity components of each process was designed to capture these common factors, under the hypotheses, stated above, that the unobservables are individual-specific, invariant in time, and that they are normally distributed. In other words, there are unmeasured respondent-specific characteristics that affect both processes in which the person engages, i.e., the processes of first birth and the end of the educational enrolment. It implies that the individuals who are most likely to have a first birth are also most likely to quit school earlier (and *vice versa*). As expected in *Hypothesis 5*, women display higher correlations than men in both countries, showing a stronger interconnectedness between the educational and family formation processes. Finally, the results do not provide support for *Hypothesis 6*, in which a higher correlation was expected between the heterogeneity components in France than in West Germany: 0.38 and 0.36 respectively for France and West German women, and 0.23 and 0.25 for men.

## 5. CONCLUSIONS

In this article we investigated the reciprocal effects of leaving the educational system and first birth timing in France and West Germany, paying particular attention to the possible existence of joint unobserved determinants to both processes. From the standpoint of life course theory during the transition to adulthood, several factors may jointly determine the processes studied; some of which are generally included in the existing data sources and empirical analyses, but rarely all of them. In particular, as in the case of the European Family and Fertility Surveys of the 1990s used here, important variables, such as values and perceived norms, were not dynamically measured, making them difficult to interpret and use in the analyses. In addition, given that the roles associated to the events studied here compete in terms of resources, joint decision-making may exist. We therefore have tried to overcome these problems by using simultaneous hazard models with correlated unobserved

heterogeneity. Furthermore, we have shown that this methodology is useful when comparing different populations, since it allows a control for the possible endogeneity of the processes of educational enrolment and first birth timing. Once this control is made, it is possible to compare more confidently the strength of the reciprocal effects between educational enrolment and first birth timing. Here we have hypothesised that international differences in these effects are mainly connected with the institutional and cultural contexts in which the individuals live.

The test we made for the existence of endogeneity between the processes of leaving education and first birth showed that, indeed, it is present in the case of the French and West German cohorts studied here. We found positive significant correlations between the unmeasured characteristics that affect both processes, implying that individuals who are more likely to have a first birth early, are also more likely to leave school early in her life course. A distinct result, found in both countries, was a stronger correlation for women than for men, implying that men make decisions in the domains of education and fertility more independently from each other. Contrary to our expectation, we did not find a stronger correlation between both processes in West Germany as compared to France, resulting from a hypothesised stronger incompatibility between the role of student and family formation in the former country. This result suggests that other factors may play a role. For instance, this could result from the existence of more strict norms or cultural models prescribing a sequence in which childbearing takes place after completion of school in West Germany, while in France these norms would be weaker or more heterogeneous in the population, leading to more connections between events in the respective individual trajectories (this would be consistent with the weaker “direct” effects found in France, as we discuss below). The younger age pattern of first childbearing observed in France may also be related to a higher degree of interrelationship between educational and fertility careers. In that respect, it would be useful to test these hypotheses in a variety of contexts in order to clarify these issues<sup>17</sup>. We also have to take into account that all these results concerning selection effects rest on a statistical model that makes several assumptions, e.g., the constancy of the heterogeneity terms and normality in the form of these residuals. At the present stage of event–history techniques, these assumptions cannot be relaxed, but they have the potential to be empirically tested, if better data sets become available in the future.

The results concerning the reciprocal effects of the processes of leaving education and the timing of first birth, (removing endogeneity biases), allowed us to qualify the commonly held hypothesis according to which the strong incompatibility between the roles of student and parent is the consequence of norms and the lack of resources to simultaneously accomplish both roles, that is, the “role expectation hypothesis”. We have provided some empirical evidence that joint determination also plays a role, in accordance to our “common determinant hypothesis”. The reciprocal effects of educational enrolment and maternity/paternity have been found to be somewhat less important in a model that accounts for heterogeneity, than in a more conventional model that does not control for correlated unobserved heterogeneity. On the one hand, these results suggest that only relatively modest biases may be involved if the statistical model used does not account for selection effects; and on the other hand,

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<sup>17</sup> Of course, a direct measurement of the variables behind the interrelationship would be the ideal situation.

the importance of these effects can only be assessed if such a test for endogeneity is made.

As for the results concerning the importance of the correlation between the processes, the reciprocal impact of educational enrolment and first birth has been found to be gender specific, in connection with the hypothesised gender role differentiation existent in both countries. However, no clear differences were found between the two countries in the effect of educational enrolment on first birth, suggesting that the institutional differences may have been overemphasised, or that other structural or institutional differences that have not been taken into account are countering the expected effects. Finally, the results concerning the influence of pregnancy and first birth on the end of educational enrolment show an important influence of the former process. In particular, the analyses show a strong positive effect when the woman is pregnant in both countries, while the impact becomes negative once the child is born in West Germany, and not significantly different from the pre-conception period in France. These results are consistent with a stronger compatibility of motherhood and educational enrolment in France than in West Germany, in connection with the hypothesised more important support provided by the French welfare state to young adults in terms of services and income support to students and parents.

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TABLE 1. Hazard of First Birth (Conception). WEST GERMANY

| Parameter               | <i>MODEL 1. NO HETEROGENEITY</i> |         |          |         | <i>MODEL 2. WITH HETEROGENEITY</i> |         |          |         |
|-------------------------|----------------------------------|---------|----------|---------|------------------------------------|---------|----------|---------|
|                         | Women                            |         | Men      |         | Women                              |         | Men      |         |
|                         | Estimate                         | S.E     | Estimate | S.E     | Estimate                           | S.E     | Estimate | S.E     |
| NUMBER OF SIBLINGS      |                                  |         |          |         |                                    |         |          |         |
| 0                       | -0.34                            | 0.08*** | -0.42    | 0.12*** | -0.42                              | 0.11*** | -0.54    | 0.15*** |
| 1 – 2 [ref]             | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| 3 +                     | 0.34                             | 0.06*** | 0.24     | 0.10**  | 0.50                               | 0.08*** | 0.33     | 0.13**  |
| BIRTH COHORT            |                                  |         |          |         |                                    |         |          |         |
| 1952 – 1956 [Ref.]      | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| 1957 – 1961             | -0.18                            | 0.06*** | -0.26    | 0.09*** | -0.32                              | 0.09*** | -0.36    | 0.13*** |
| 1962 – 1972             | -0.54                            | 0.07*** | -1.07    | 0.12*** | -0.82                              | 0.09*** | -1.24    | 0.14*** |
| EDUCATIONAL ENROLMENT   |                                  |         |          |         |                                    |         |          |         |
| In education            | -1.52                            | 0.10*** | -0.83    | 0.12*** | -1.24                              | 0.12*** | -0.69    | 0.18*** |
| Not in education [Ref.] | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| EDUCATIONAL LEVEL       |                                  |         |          |         |                                    |         |          |         |
| Lower Secondary         | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| Upper Secondary         | -0.15                            | 0.06**  | 0.06     | 0.10    | -0.22                              | 0.09**  | 0.11     | 0.13    |
| Tertiary                | -0.17                            | 0.11    | 0.23     | 0.12*   | -0.30                              | 0.16*   | 0.30     | 0.18*   |
| Log-Likelihood          | -20687                           |         | -12400   |         | -20660                             |         | -12398   |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods from 14 to 19; from 19 to 23; of three years, from 23 to 32; and then open intervals.

TABLE 2. Hazard of First Birth (Conception). FRANCE

| Parameter                    | <i>MODEL 1. NO HETEROGENEITY</i> |         |          |         | <i>MODEL 2. WITH HETEROGENEITY</i> |         |          |         |
|------------------------------|----------------------------------|---------|----------|---------|------------------------------------|---------|----------|---------|
|                              | Women                            |         | Men      |         | Women                              |         | Men      |         |
|                              | Estimate                         | S.E     | Estimate | S.E     | Estimate                           | S.E     | Estimate | S.E     |
| <b>BIRTH COHORT</b>          |                                  |         |          |         |                                    |         |          |         |
| 1952 – 1956 [Ref.]           | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| 1957 – 1961                  | -0.06                            | 0.05    | -0.13    | 0.07*   | -0.09                              | 0.07    | -0.22    | 0.10**  |
| 1962 – 1973                  | -0.18                            | 0.05*** | -0.57    | 0.07*** | -0.34                              | 0.07*** | -0.80    | 0.10*** |
| <b>EDUCATIONAL ENROLMENT</b> |                                  |         |          |         |                                    |         |          |         |
| In education                 | -1.28                            | 0.09*** | -0.77    | 0.14*** | -1.18                              | 0.10*** | -0.74    | 0.17*** |
| Not in education [Ref.]      | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| <b>EDUCATIONAL LEVEL</b>     |                                  |         |          |         |                                    |         |          |         |
| Primary                      | -0.08                            | 0.07    | 0.05     | 0.11    | -0.24                              | 0.10**  | -0.07    | 0.17    |
| Lower Secondary [Ref..]      | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| Upper Secondary              | -0.36                            | 0.07*** | -0.03    | 0.11    | -0.52                              | 0.10*** | -0.11    | 0.15    |
| Tertiary                     | -0.50                            | 0.09*** | -0.17    | 0.14    | -0.71                              | 0.13*** | -0.27    | 0.20    |
| Log-Likelihood               | -26122                           |         | -15795   |         | -26073                             |         | -15767   |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods from 14 to 19; from 19 to 23; of three years, from 23 to 32; and then open intervals.

TABLE 3. Hazard of ending educational enrolment. WEST GERMANY

| Parameter                        | <i>MODEL 1. NO HETEROGENEITY</i> |         |          |         | <i>MODEL 2. WITH HETEROGENEITY</i> |         |          |         |
|----------------------------------|----------------------------------|---------|----------|---------|------------------------------------|---------|----------|---------|
|                                  | Women                            |         | Men      |         | Women                              |         | Men      |         |
|                                  | Estimate                         | S.E     | Estimate | S.E     | Estimate                           | S.E     | Estimate | S.E     |
| <b>RESIDENCE UP TO 15</b>        |                                  |         |          |         |                                    |         |          |         |
| Urban [Ref.]                     | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| Rural                            | 0.35                             | 0.04*** | 0.16     | 0.05*** | 0.52                               | 0.06*** | 0.24     | 0.07*** |
| <b>BIRTH COHORT</b>              |                                  |         |          |         |                                    |         |          |         |
| 1952 – 1956 [Ref.]               | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| 1957 – 1961                      | -0.22                            | 0.05*** | 0.15     | 0.07**  | -0.40                              | 0.09*** | 0.21     | 0.11*   |
| 1962 – 1972                      | -0.55                            | 0.05*** | -0.03    | 0.06    | -0.84                              | 0.07*** | -0.05    | 0.09    |
| <b>PARENTAL UNION DISRUPTION</b> |                                  |         |          |         |                                    |         |          |         |
| No disruption [Ref.]             | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| Divorced / Separated             | 0.11                             | 0.06*   | 0.29     | 0.08*** | 0.17                               | 0.09*   | 0.41     | 0.12*** |
| <b>PARENTHOOD STATUS</b>         |                                  |         |          |         |                                    |         |          |         |
| No child [Ref.]                  | 0                                | 0       | 0        | 0       | 0                                  | 0       | 0        | 0       |
| Has a 1 <sup>st</sup> child      | -0.35                            | 0.11*** | 0.39     | 0.12*** | -0.56                              | 0.16*** | 0.39     | 0.18**  |
| Log-Likelihood                   | -20687                           |         | -12400   |         | -20660                             |         | -12398   |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods of two years, from 14 to age 18; of three years, from 18 to 24; and then open intervals.



TABLE 4. Hazard of ending educational enrolment. FRANCE

| Parameter                        | <i>MODEL 1. NO HETEROGENEITY</i> |         |          |        | <i>MODEL 2. WITH HETEROGENEITY</i> |         |          |         |
|----------------------------------|----------------------------------|---------|----------|--------|------------------------------------|---------|----------|---------|
|                                  | Women                            |         | Men      |        | Women                              |         | Men      |         |
|                                  | Estimate                         | S.E     | Estimate | S.E    | Estimate                           | S.E     | Estimate | S.E     |
| <b>BIRTH COHORT</b>              |                                  |         |          |        |                                    |         |          |         |
| 1952 – 1956 [Ref.]               | 0                                | 0       | 0        | 0      | 0                                  | 0       | 0        | 0       |
| 1957 – 1961                      | -0.04                            | 0.04    | -0.07    | 0.06   | -0.12                              | 0.07*   | -0.22    | 0.09**  |
| 1962 – 1973                      | -0.18                            | 0.04*** | -0.11    | 0.05*  | -0.44                              | 0.07*** | -0.38    | 0.08*** |
| <b>PARENTAL UNION DISRUPTION</b> |                                  |         |          |        |                                    |         |          |         |
| No disruption [Ref.]             | 0                                | 0       | 0        | 0      | 0                                  | 0       | 0        | 0       |
| Divorced / Separated             | 0.25                             | 0.05*** | 0.14     | 0.07** | 0.34                               | 0.08*** | 0.26     | 0.11**  |
| <b>PARENTHOOD STATUS</b>         |                                  |         |          |        |                                    |         |          |         |
| No child [Ref.]                  | 0                                | 0       | 0        | 0      | 0                                  | 0       | 0        | 0       |
| Has a 1 <sup>st</sup> child      | -0.20                            | 0.13    | -0.04    | 0.21   | -0.23                              | 0.18    | -0.01    | 0.28    |
| Log-Likelihood                   | -26122                           |         | -15795   |        | -26073                             |         | -15767   |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods of two years, from 14 to age 18; of three years, from 18 to 24; and then open intervals.

TABLE 5. Hazard of ending educational enrolment

| <i>MODEL 3. WITH HETEROGENEITY</i> |              |         |          |         |          |         |          |         |
|------------------------------------|--------------|---------|----------|---------|----------|---------|----------|---------|
| Parameter                          | WEST GERMANY |         |          |         | FRANCE   |         |          |         |
|                                    | Women        |         | Men      |         | Women    |         | Men      |         |
|                                    | Estimate     | S.E     | Estimate | S.E     | Estimate | S.E     | Estimate | S.E     |
| <b>RESIDENCE UP TO 15</b>          |              |         |          |         |          |         |          |         |
| Urban [Ref.]                       | 0            | 0       | 0        | 0       |          |         |          |         |
| Rural                              | 0.51         | 0.06*** | 0.24     | 0.07*** |          |         |          |         |
| <b>BIRTH COHORT</b>                |              |         |          |         |          |         |          |         |
| 1952 – 1956 [Ref.]                 | 0            | 0       | 0        | 0       | 0        | 0       | 0        | 0       |
| 1957 – 1961                        | -0.39        | 0.08*** | 0.22     | 0.11    | -0.13    | 0.07*   | -0.23    | 0.09**  |
| 1962 – 1972                        | -0.82        | 0.07*** | -0.03    | 0.09    | -0.44    | 0.07*** | -0.38    | 0.08*** |
| <b>PARENTAL UNION DISRUPTION</b>   |              |         |          |         |          |         |          |         |
| No disruption [Ref.]               | 0            | 0       | 0        | 0       | 0        | 0       | 0        | 0       |
| Divorced / Separated               | 0.17         | 0.09*   | 0.41     | 0.12*** | 0.34     | 0.08*** | 0.25     | 0.10**  |
| <b>PARENTHOOD STATUS</b>           |              |         |          |         |          |         |          |         |
| No child [Ref.]                    | 0            | 0       | 0        | 0       | 0        | 0       | 0        | 0       |
| Pregnant                           | 0.87         | 0.18*** | 0.68     | 0.25*** | 0.57     | 0.18*** | 0.62     | 0.31**  |
| Has a 1 <sup>st</sup> child        | -0.36        | 0.17**  | 0.53     | 0.20*** | -0.08    | 0.19    | 0.08     | 0.30    |
| Log-Likelihood                     | -20649       |         | -12395   |         | -26068   |         | -15765   |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods of two years, from 14 to age 18; of three years, from 18 to 24; and then open intervals.

TABLE 6. Correlation between first birth and the end of educational enrolment. Results of estimation.

|                                     | MODEL 2 (WITH HETEROGENEITY) |         |          |         |              |         |          |       |
|-------------------------------------|------------------------------|---------|----------|---------|--------------|---------|----------|-------|
|                                     | FRANCE                       |         |          |         | WEST GERMANY |         |          |       |
|                                     | WOMEN                        |         | MEN      |         | WOMEN        |         | MEN      |       |
|                                     | Estimate                     | S.E     | Estimate | S.E     | Estimate     | S.E     | Estimate | S.E   |
| STANDARD DEVIATIONS                 |                              |         |          |         |              |         |          |       |
| First birth $\epsilon$              | 1                            | 0       | 1        | 0       | 1            | 0       | 1        | 0     |
| Leaving educational system $\delta$ | 1                            | 0       | 1        | 0       | 1            | 0       | 1        | 0     |
| CORRELATION $\epsilon \delta$       | 0.38                         | 0.06*** | 0.23     | 0.08*** | 0.36         | 0.09*** | 0.25     | 0.14* |
| Log-Likelihood                      | -26073                       |         | -15767   |         | -20660       |         | -12398   |       |

Significance levels: \*\*\*= $p < 0.01$ , \*\*= $p < 0.05$ , \*= $p < 0.1$

## Annex

TABLE 7. Hazard of First Birth (Conception)

| <i>MODEL 3. WITH HETEROGENEITY</i> |              |         |          |         |          |         |          |         |
|------------------------------------|--------------|---------|----------|---------|----------|---------|----------|---------|
| Parameter                          | WEST GERMANY |         |          |         | FRANCE   |         |          |         |
|                                    | Women        |         | Men      |         | Women    |         | Men      |         |
|                                    | Estimate     | S.E     | Estimate | S.E     | Estimate | S.E     | Estimate | S.E     |
| NUMBER OF SIBLINGS                 |              |         |          |         |          |         |          |         |
| 0                                  | -0.42        | 0.11*** | -0.54    | 0.15*** |          |         |          |         |
| 1 – 2 [ref]                        | 0            | 0       | 0        | 0       |          |         |          |         |
| 3 +                                | 0.50         | 0.08*** | 0.33     | 0.13**  |          |         |          |         |
| BIRTH COHORT                       |              |         |          |         |          |         |          |         |
| 1952 – 1956 [Ref.]                 | 0            | 0       | 0        | 0       | 0        | 0       | 0        | 0       |
| 1957 – 1961                        | -0.31        | 0.09*** | -0.36    | 0.13*** | -0.09    | 0.07    | -0.22    | 0.10**  |
| 1962 – 1972                        | -0.79        | 0.09*** | -1.24    | 0.14*** | -0.33    | 0.07*** | -0.80    | 0.10*** |
| EDUCATIONAL ENROLMENT              |              |         |          |         |          |         |          |         |
| In education                       | -1.32        | 0.13*** | -0.78    | 0.19*** | -1.20    | 0.10*** | -0.74    | 0.17*** |
| Out education [Ref.]               | 0            | 0       | 0        | 0       | 0        | 0       | 0        | 0       |
| EDUCATIONAL LEVEL                  |              |         |          |         |          |         |          |         |
| Primary                            |              |         |          |         | -0.23    | 0.10**  | -0.05    | 0.17    |
| Lower Secondary [Ref.]             | 0            | 0       | 0        | 0       | 0        | 0       | 0        | 0       |
| Upper Secondary                    | -0.27        | 0.09*** | 0.06     | 0.13    | -0.52    | 0.10*** | -0.10    | 0.15    |
| Superior                           | -0.40        | 0.17**  | 0.21     | 0.19    | -0.74    | 0.14*** | -0.29    | 0.20    |
| Log-Likelihood                     | -20649       |         | -12395   |         | -26068   |         | -15765   |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1. Baseline: Time periods from 14 to 19; from 19 to 23; of three years, from 23 to 32; and then open intervals.

TABLE 8: Correlation between first birth and the end of the educational enrolment. Results of estimation

|                                     | MODEL 3 (WITH HETEROGENEITY) |         |          |      |          |         |          |        |
|-------------------------------------|------------------------------|---------|----------|------|----------|---------|----------|--------|
|                                     | WEST GERMANY                 |         |          |      | FRANCE   |         |          |        |
|                                     | WOMEN                        |         | MEN      |      | WOMEN    |         | MEN      |        |
|                                     | Estimate                     | S.E     | Estimate | S.E  | Estimate | S.E     | Estimate | S.E    |
| STANDARD DEVIATIONS                 |                              |         |          |      |          |         |          |        |
| First birth $\epsilon$              | 1                            | 0       | 1        | 0    | 1        | 0       | 1        | 0      |
| Leaving educational system $\delta$ | 1                            | 0       | 1        | 0    | 1        | 0       | 1        | 0      |
| CORRELATION $\epsilon \delta$       | 0.25                         | 0.09*** | 0.13     | 0.16 | 0.34     | 0.06*** | 0.20     | 0.09** |
| Log-Likelihood                      | -20649                       |         | -12395   |      | -26068   |         | -15767   |        |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1

TABLE 9: Sensitivity of the results to a different value of variance. Hazard of First Birth (Conception). WEST GERMANY

| MODEL 2. WITH HETEROGENEITY |               |         |                |         |               |         |                |         |
|-----------------------------|---------------|---------|----------------|---------|---------------|---------|----------------|---------|
| Parameter                   | WOMEN         |         |                |         | MEN           |         |                |         |
|                             | FREE VARIANCE |         | FIXED VARIANCE |         | FREE VARIANCE |         | FIXED VARIANCE |         |
|                             | Estimate      | S.E     | Estimate       | S.E     | Estimate      | S.E     | Estimate       | S.E     |
| NUMBER OF SIBLINGS          |               |         |                |         |               |         |                |         |
| 0                           | -0.47         | 0.12*** | -0.42          | 0.11*** | -0.43         | 0.13*** | -0.54          | 0.15*** |
| 1 – 2 [ref]                 | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| 3 +                         | 0.59          | 0.10*** | 0.50           | 0.08*** | 0.25          | 0.10**  | 0.33           | 0.13**  |
| BIRTH COHORT                |               |         |                |         |               |         |                |         |
| 1952 – 1956 [Ref.]          | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| 1957 – 1961                 | -0.43         | 0.11*** | -0.32          | 0.09*** | -0.27         | 0.10*** | -0.36          | 0.13*** |
| 1962 – 1972                 | -0.98         | 0.12*** | -0.82          | 0.09*** | -1.08         | 0.12*** | -1.24          | 0.14*** |
| EDUCATIONAL ENROLMENT       |               |         |                |         |               |         |                |         |
| In education                | -1.16         | 0.13*** | -1.24          | 0.12*** | -0.90         | 0.15*** | -0.69          | 0.18*** |
| Out education [Ref.]        | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| EDUCATIONAL LEVEL           |               |         |                |         |               |         |                |         |
| Lower Secondary             | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| Upper Secondary             | -0.32         | 0.10*** | -0.22          | 0.09**  | 0.03          | 0.10    | 0.11           | 0.13    |
| Superior                    | -0.47         | 0.19**  | -0.30          | 0.16*   | 0.21          | 0.13*   | 0.30           | 0.18*   |
| Log-Likelihood              | -20656        |         | -20660         |         | -12377        |         | -12398         |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods from 14 to 19; from 19 to 23; of three years, from 23 to 32; and then open intervals.

TABLE 10: Sensitivity of the results to a different value of variance. Hazard of First Birth (Conception). FRANCE

| <i>MODEL 2. WITH HETEROGENEITY</i> |               |         |                |         |               |         |                |         |   |
|------------------------------------|---------------|---------|----------------|---------|---------------|---------|----------------|---------|---|
| Parameter                          | WOMEN         |         |                |         | MEN           |         |                |         |   |
|                                    | FREE VARIANCE |         | FIXED VARIANCE |         | FREE VARIANCE |         | FIXED VARIANCE |         |   |
|                                    | Estimate      | S.E     | Estimate       | S.E     | Estimate      | S.E     | Estimate       | S.E     |   |
| BIRTH COHORT                       |               |         |                |         |               |         |                |         |   |
| 1952 – 1956 [Ref.]                 | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       | 0 |
| 1957 – 1961                        | -0.05         | 0.05    | -0.09          | 0.07    | -0.13         | 0.07*   | -0.22          | 0.10**  |   |
| 1962 – 1973                        | -0.18         | 0.05*** | -0.34          | 0.07*** | -0.57         | 0.07*** | -0.80          | 0.10*** |   |
| EDUCATIONAL ENROLMENT              |               |         |                |         |               |         |                |         |   |
| In education                       | -1.23         | 0.09*** | -1.18          | 0.10*** | -0.75         | 0.14*** | -0.74          | 0.17*** |   |
| Out education [Ref.]               | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |   |
| EDUCATIONAL LEVEL                  |               |         |                |         |               |         |                |         |   |
| Primary                            | -0.15         | 0.07**  | -0.24          | 0.10**  | 0.01          | 0.12    | -0.07          | 0.17    |   |
| Lower Secondary [Ref.]             | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |   |
| Upper Secondary                    | -0.35         | 0.07*** | -0.52          | 0.10*** | -0.03         | 0.11    | -0.11          | 0.15    |   |
| Superior                           | -0.42         | 0.09*** | -0.71          | 0.13*** | -0.14         | 0.14    | -0.27          | 0.20    |   |
| Log-Likelihood                     | -25997        |         | -26073         |         | -15695        |         | -15767         |         |   |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods from 14 to 19; from 19 to 23; of three years, from 23 to 32; and then open intervals.

TABLE 11: Sensitivity of the results to a different value of variance.  
Hazard of end of the educational enrolment. WEST GERMANY

| <i>MODEL 2. WITH HETEROGENEITY</i> |               |         |                |         |               |         |                |         |
|------------------------------------|---------------|---------|----------------|---------|---------------|---------|----------------|---------|
| Parameter                          | WOMEN         |         |                |         | MEN           |         |                |         |
|                                    | FREE VARIANCE |         | FIXED VARIANCE |         | FREE VARIANCE |         | FIXED VARIANCE |         |
|                                    | Estimate      | S.E     | Estimate       | S.E     | Estimate      | S.E     | Estimate       | S.E     |
| <b>RESIDENCE UP TO 15</b>          |               |         |                |         |               |         |                |         |
| Urban [Ref.]                       | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| Rural                              | 0.54          | 0.07*** | 0.52           | 0.06*** | 0.25          | 0.08*** | 0.24           | 0.07*** |
| <b>BIRTH COHORT</b>                |               |         |                |         |               |         |                |         |
| 1952 – 1956 [Ref.]                 | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| 1957 – 1961                        | -0.43         | 0.09*** | -0.40          | 0.09*** | 0.04          | 0.11    | 0.21           | 0.11*   |
| 1962 – 1972                        | -0.89         | 0.10*** | -0.84          | 0.07*** | -0.22         | 0.10**  | -0.05          | 0.09    |
| <b>PARENTAL UNION DISRUPTION</b>   |               |         |                |         |               |         |                |         |
| No disruption [Ref.]               | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| Divorced / Separated               | 0.19          | 0.10*   | 0.17           | 0.09*   | 0.41          | 0.14*** | 0.41           | 0.12*** |
| <b>PARENTHOOD STATUS</b>           |               |         |                |         |               |         |                |         |
| No child [Ref.]                    | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       |
| Have a 1 <sup>st</sup> child       | -0.66         | 0.17*** | -0.56          | 0.16*** | 0.57          | 0.18**  | 0.39           | 0.18**  |
| Log-Likelihood                     | -20656        |         | -20660         |         | -12377        |         | -12398         |         |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods of two years, from 14 to age 18; of three years, from 18 to 24; and then open intervals.



TABLE 12: Sensitivity of the results to a different value of variance.  
Hazard of end of the educational enrolment. FRANCE

| <i>MODEL 2. WITH HETEROGENEITY</i> |               |         |                |         |               |         |                |         |   |
|------------------------------------|---------------|---------|----------------|---------|---------------|---------|----------------|---------|---|
| Parameter                          | WOMEN         |         |                |         | MEN           |         |                |         |   |
|                                    | FREE VARIANCE |         | FIXED VARIANCE |         | FREE VARIANCE |         | FIXED VARIANCE |         |   |
|                                    | Estimate      | S.E     | Estimate       | S.E     | Estimate      | S.E     | Estimate       | S.E     |   |
| <b>BIRTH COHORT</b>                |               |         |                |         |               |         |                |         |   |
| 1952 – 1956 [Ref.]                 | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       | 0 |
| 1957 – 1961                        | -0.33         | 0.11*** | -0.12          | 0.07*   | -0.30         | 0.11**  | -0.22          | 0.09**  |   |
| 1962 – 1973                        | -0.65         | 0.10*** | -0.44          | 0.07*** | -0.38         | 0.10*** | -0.38          | 0.08*** |   |
| <b>PARENTAL UNION DISRUPTION</b>   |               |         |                |         |               |         |                |         |   |
| No disruption [Ref.]               | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       | 0 |
| Divorced / Separated               | 0.32          | 0.13**  | 0.34           | 0.08*** | 0.01          | 0.12    | 0.26           | 0.11**  |   |
| <b>PARENTHOOD STATUS</b>           |               |         |                |         |               |         |                |         |   |
| No child [Ref.]                    | 0             | 0       | 0              | 0       | 0             | 0       | 0              | 0       | 0 |
| Have a 1 <sup>st</sup> child       | 0.08          | 0.22    | -0.23          | 0.18    | 0.60          | 0.37    | -0.01          | 0.28    |   |
| Log-Likelihood                     | -25997        |         | -26073         |         | -15695        |         | -15767         |         |   |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1.

Baseline: Time periods of two years, from 14 to age 18; of three years, from 18 to 24; and then open intervals.

TABLE 13: Sensitivity of the results to a different value of variance.  
Correlation between first birth and the end of the educational enrolment. Results of estimation.

|                                     | MODEL 2 (WITH HETEROGENEITY) |         |                |         |               |         |                |         |               |         |                |         |               |         |                |       |
|-------------------------------------|------------------------------|---------|----------------|---------|---------------|---------|----------------|---------|---------------|---------|----------------|---------|---------------|---------|----------------|-------|
|                                     | FRANCE                       |         |                |         |               |         |                |         | WEST GERMANY  |         |                |         |               |         |                |       |
|                                     | WOMEN                        |         |                |         | MEN           |         |                |         | WOMEN         |         |                |         | MEN           |         |                |       |
|                                     | Free variance                |         | Fixed variance |         | Free variance |         | Fixed variance |         | Free variance |         | Fixed variance |         | Free variance |         | Fixed variance |       |
| Est.                                | S.E.                         | Est.    | S.E.           | Est.    | S.E.          | Est.    | S.E.           | Est.    | S.E.          | Est.    | S.E.           | Est.    | S.E.          | Estim.  | S.E.           |       |
| STANDARD DEVIATIONS                 |                              |         |                |         |               |         |                |         |               |         |                |         |               |         |                |       |
| First birth $\varepsilon$           | 0.13                         | 0.05**  | 1              | 0       | 0.05          | 0.07    | 1              | 0       | 1.43          | 0.14*** | 1              | 0       | 0.27          | 0.30    | 1              | 0     |
| Leaving educational system $\delta$ | 3.36                         | 0.17*** | 1              | 0       | 3.36          | 0.23*** | 1              | 0       | 1.17          | 0.16*** | 1              | 0       | 2.38          | 0.29*** | 1              | 0     |
| CORRELATION $\varepsilon \delta$    | 0.57                         | 0.01*** | 0.38           | 0.06*** | 0.64          | 0.03*** | 0.23           | 0.08*** | 0.35          | 0.06*** | 0.36           | 0.09*** | -0.14         | 0.09    | 0.25           | 0.14* |
| Log-Likelihood                      | -25997                       |         | -26073         |         | -15695        |         | -15767         |         | -20656        |         | -20660         |         | -12377        |         | -12398         |       |

Significance levels: \*\*\*=p<0.01, \*\*=p<0.05, \*=p<0.1