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Effect of education on second births in Hungary. A test of the partner effect hypothesis*

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Abstract

The effect of education on the transition to second births is examined using three waves of the Hungarian Gender and Generations Survey data. We hypothesize that higher education increases the hazard of second conception and this effect is due to the presence of highly educated partner (Kreyenfeld 2002). Lognormal survival models are estimated using the sample of women born between 1946 and 1983. We find that women with higher education and women partnered to men with higher education space births closer together. The results remain robust after controlling for sample selection. The findings do not support the partner effect hypothesis.

Keywords: partner effect hypothesis, Hungary, education, fertility, second births

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1 Introduction

Recently, several studies have examined the relationship between female education and the transition to second birth (Kreyenfeld 2002, Gerster et al 2007, Kravdal 2001, 2007, Klesment and Puur 2010, Muresan and Hoem 2010, Billingsley 2011). In most of these studies, women's education has a significant positive effect on the transition to second birth. This finding contradicts the economic theory of fertility, which argues that both *quantum* and *tempo* fertility is negatively related to education. The negative quantum effect arises because the shadow price of raising (high-quality) children is relatively high for educated women (Becker and Lewis 1973, Jones, Schoonbroodt and Tertilt 2008). The negative tempo effect is due to the fact that wages rise with experience and postponement of childbearing minimizes the lifetime opportunity costs of career interruption (Mincer and Polachek 1974, Happel, Hill and Low 1984, Montgomery and Trussel 1986, Taniguchi 1999).

The surprising positive effect of female education on the transition to second birth can be understood with the help of three distinct hypotheses (Kreyenfeld 2002). The selection effect hypothesis states that women with a strong unobserved preference for children are over-represented among those who postpone the first birth, and this unobserved characteristic is responsible for the fast transition to second birth. The time-squeeze hypothesis argues that women who postpone the first birth are closer to the end of the reproductive span, which reduces the waiting time to the second birth. An economic reinterpretation of the time-squeeze hypothesis would be that women who delay the first birth face a shorter planning horizon, and thereby a smaller lifetime wage penalty from further career interruptions. Finally, the partner effect hypothesis states that the positive effect of family income on childbearing suppresses the opposite effect of the shadow price of raising high-quality children (Becker and Lewis 1973, Jones, Schoonbroodt and Tertilt 2008). The argument is supplemented with the empirically realistic assumption that highly educated women tend to marry (or live with) educated men, a phenomenon known as educational homogamy or assortative mating (Becker 1981, Kalmijn 1998). If wages rise with experience, especially among educated men, the postponement of the first child minimizes not only the lifetime foregone earnings of women but it also helps the educated partner to reach a high income level, which reduces the costs of raising high-quality children.

The objective of this paper is to describe and explain the relationship between education and the transition to second birth in Hungary. We are especially interested in testing the partner effect hypothesis. Our research questions are: (1) do women with higher education space births closer together? (2) Is that spacing behavior a consequence of the fact that highly educated women tend to be partnered to men with higher education, and women partnered to men with higher education space births closer together? So far, empirical tests of the partner effect hypothesis are encouraging but limited in number (Kreyenfeld 2002, Gerster et al 2007, Klesment and Puur 2010). The Hungarian setting is interesting for two reasons. First, less effort has been made to examine the relationship between education and the transition to second birth in Central and Eastern European countries, which are infamous for the low level of total fertility (Spéder 2006, Thornton and Philipov 2009, Gerber and Berman 2009, Kapitány and Spéder 2010). Second, previous research into fertility in Hungary found that there is an U shaped relationship between education and total fertility (Husz 2006). A similar pattern was found between education and the probability of delivering a second child within a five year interval after the first birth (Spéder 2006).

We will use the three waves of the *Turning Points of the Life Course* dataset, which is collected within the Generations and Gender Study. To our best knowledge, our study is the first to examine the relationship between education and fertility using all three waves of that dataset. The results of our study might differ from earlier studies which used only the first or the first two waves. For instance, Spéder (2006) shows that among women born after 1966, there is a substantial difference in the probability of becoming a mother by age 30 across educational groups. However, he used only data from the first wave, while we are able to observe fertility histories up to 2008. Besides, we will use different methods. Therefore, our conclusions might, and will differ from those which were drawn previously.

The paper is organized as follows. In the next section, we describe the data and methods we use to examine the relationship between education and fertility. The results of the analyses are presented in Section 3. Section 4 concludes.

2 Data and methods

2.1 The sample

The panel survey *Turning Points of the Life Course* (TPLC henceforth) was launched in 2001, then data collection was repeated in 2004 and 2008. The survey includes retrospective information on fertility and partnership histories, as well as cross-sectional information on the characteristics of partners. The target population includes people aged 18-74 in 2001. Individuals were selected using a stratified two-stage sampling procedure: the strata were defined in terms of settlement size and gender, the primary sampling units were settlements. The second wave of TPLC corresponds to the first harmonized wave of the Gender and Generations Survey (see Spéder 2001 for more information about the Hungarian survey and Vikat et al. 2007 about the GGS). The interviews were scheduled to take place in November, but sometimes interviewers were able to find the respondents and complete the interviews later.[1] The number of participants dropped from 16,300 to 10,641 from the first to the third wave. Although waves adjusting for dropout are available, the subsequent analyses will not use them.

The sample for subsequent empirical analyses was constructed as follows. First, we selected women who were born between 1946 and 1983. Since the last wave of data collection took place in 2008, the youngest women are 25 when our observation period ends. We also omitted respondents who got pregnant before turning 14 and respondents with incomplete or inconsistent life histories. Our sample includes 5890 women.

In this paper, we examine the relationship between education and the hazard of second conception. In order to answer this question, we constructed a dataset of conception histories of the selected women using answers to retrospective life-history questions. Each record in this dataset contains an indicator for conception and the duration to the conception itself. The indicator variable takes on value 1 if the women delivered a child 9 months later, and 0 if the spell is censored. Then we calculated the time elapsed between first delivery and second conception (or the end of the observation period). Similar to earlier studies, analyses will be restricted to the first and the second transitions, thus higher order transitions are omitted.

In order to be able to test the partner effect hypothesis, the education of the eventual partner must be matched to the above described event history file. The matching procedure is not a trivial task since the event history file was constructed using responses to retrospective questions, while the education of the eventual partner is not retrospective but cross-sectional information. The matching of cross-sectional information to retrospective event histories proceeded as follows. First, we identified unique episodes of partnership histories, like being single, cohabiting or married in the event history file. Then we matched the education of the eventual partner to the partnership spell which started before and ended after the first wave interview. In this way, we treat the partner's education as a time-constant covariate. Finally, we marked the respondents where the partnership spell overlaps with the risk periods of the first

[1] The first wave of data collection was conducted between November 2001 and March 2002, the second one between November 2004 and July 2005, and the third one took place between November 2008 and February 2009.

and second conceptions. The matched dataset includes 3844 women out of the 5890 women in the full sample.

2.2 Method

In our subsequent empirical analyses, we will use event history or survival analysis to examine the effect of education and partner's education on parity-specific transitions to conceptions. The separate modeling of parity-specific transitions raises the issues of sample selection and endogeneity. First, separate estimates of parity-specific transitions might be subject to sample-selection bias. If education has a negative effect on the transition to first birth, education will be positively correlated with unobserved causes of fertility in samples of women who have one child and are at risk of second conception (Kravdal 2007). For instance, if highly educated people face better career opportunities and therefore postpone first birth, family-oriented values or preferences for children must be on average stronger among educated mothers than among mothers with poor education. Otherwise, highly educated women would not enter the sample of mothers. The comparison of the fertility outcomes across educational categories in the sample of mothers therefore measures not only the true effect of education but also the effect of unobserved factors (Kravdal 2001).

Second, results might be biased if explanatory variables, like union formation and the partner's education are endogenous. Partnership formation is obviously endogenous since intention to have children or unintended conception is one of the main causes of marriage (for evidence based on the GGS project, see Hoem et al 2009). Even education can be endogenous, since preferences for children, which were shaped during socialization, might affect the educational decisions (Baizan and Martin-Garcia 2007, Jones et al 2008).

In this paper, we will use the the Stata module cmp (Roodman 2011) to estimate survival models with sample selection and endogeneity.[2] The cmp module allows one to estimate recursive systems of equations under the assumption that the equation-specific disturbances are correlated and follow a multivariate normal distribution.[3] Because of this distributional assumption, we estimate lognormal survival models. The lognormal model has two distinctive features. First, the model is formulated only in the accelerated failure time metric. As a consequence, the dependent variable is the natural logarithm of time to event, and not the hazard rate. The second feature is that the hazard rate implicit in the lognormal model exhibits a non-

2 We are of course aware of the widespread use of aML among demographers.

3 No assumptions are imposed on the variance-covariance matrix of disturbances. Systems involving more than two equations are estimated using simulated maximum likelihood, in general, and the Geweke, Hajivassiliou, and Keane simulator, in particular. For details, consult Roodman (2011).

monotonic duration dependence: the implicit baseline hazard first increases, then decreases over time. The side-effect of using the cmp module is that we impose a specific form of duration dependence on our data. We do not regard this as a serious limitation since studies using the piecewise-exponential model often reported observed and baseline hazards which are first decreasing then decreasing with process time (Blossfeld, Golsch and Rohwer 2007, Kreyenfeld 2002, Kulu and Vikat 2007, Muresan and Hoem 2010, Oláh and Fratczak 2004, Gerster et al 2007).

2.3 Variables

The dependent variables in our study is the waiting time to second conception. Waiting time begins when delivering the first child and is measured in months. As explained above, we will model log durations instead of hazard rates. More specifically, we estimate interval-censored regression models on log durations. Interval-censored regression models require two dependent variables, indicating lower and upper bounds of time intervals. Let t denote the number of months that elapses since the first birth until the second conception or the end of the observation period (censoring date). For uncensored durations, the lower and upper bounds are $\ln(t\text{-}1)$ and $\ln(t)$, respectively, meaning that conception occurred somewhere between time points t-1 and t (Lillard and Panis 2003). For right-censored durations, the respective lower and upper bounds are $\ln(t)$ and $\ln(\infty)$; meaning that the event will occur somewhere in the future.

The key explanatory variables are education and the partner's education. Education is measured with the help of four educational levels: primary, vocational, secondary and higher. (For a good explanation of the Hungarian educational system, consult Kézdi, Köllő and Varga 2009). Primary education refers to the first stage of compulsory education, which typically begins at age 6. People who did not complete the primary education will be treated as having completed primary education. After completing primary education, children should follow either the vocational, the academic secondary or the vocational secondary track (by law, enrolment is compulsory until age 16.). In our analyses, secondary education embraces both vocational and academic secondary education. Traditionally, primary and secondary education lasted 8 and 4 years, respectively, but during the transition, other forms, like the combinations of 6+6 years and 4+8 years emerged. Secondary education is completed by passing the Matura (or A-level) exam, which is a necessary condition of college or university admission. In contrast, vocational schools do not offer the Matura exam. Throughout this paper, higher education refers to college and university graduates.

For reasons of simplicity, we treat education as a time-constant variable. When the first wave of the TPLC survey was administered, a small fraction of the women in our sample were enrolled in education. We assume that they behave as if they had the degree provided by the current studies. On the basis of this assumption, enrolled women are treated as if they had completed the current studies. For example, higher education is assigned to students enrolled in colleges and universities.

In regression analyses, we will also include indicator variables for birth cohort and several variables related to the age of mother at first delivery. Birth cohorts are grouped into seven categories, the first including women born between 1946 and 1950, the last including women born between 1976 and 1983. In order to control for the time-squeeze mechanism, we will include the age at first delivery centered around 30, the square thereof, and the interactions between the age variables and the education dummies.[4] Since the fear of reaching the biological limits of fertility must be stronger for those who spend more time in education *and* postpone childbearing, the time-squeeze mechanism implies a negative effect of the interaction between higher education and the age at previous birth.

Table 1 presents means and standard deviations of the variables in the full sample as well as in the merged sample. Recall that the latter sample is used to test the partner effect hypothesis. In the full sample, about 3 out of 4 women became a mother and is at the risk of delivering a second child. Out of these 4 women 2 delivered two children. The probability of giving birth to the second child, conditional on being a mother is about 70 percent. The average waiting time to second conception is exp(3.341)=28.25 months. The sample is relatively balanced in terms of education: the most frequent educational level is secondary (36 percent), the relative frequencies of the other educational levels range between 20 and 22 percent.

TABLE 1 HERE

The table indicates that the merged sample, which serves the purpose of testing the partner effect hypothesis: the ratio of partnered women is about 70 percent in the full sample, but 91 percent in the merged sample. Given the construction of the merged subsample, this is not surprising. By construction, the merged subsample excludes women who have experienced the disruption of marriage or cohabitation prior to the first wave of data collection. In other words, successful partnerships are overrepresented in the merged sample. If the survival of the

[4] Substracting 30 years from age at previous delivery resulted in a substantial decrease in the correlation between the two age variables. 30 is also close to the mean age when highly educated women deliver their first child.

partnership up to the first wave interview depends on unobserved factors then the merged sample cannot be treated as a random sample of the full sample. This problem and the solution thereof will be discussed in subsection 3.3 which is devoted to the test of the partner effect hypothesis.

3 Empirical analyses

The empirical analyses proceed in three steps. First, we present a simple description of the relationship between education and the waiting time to second conception. These analyses ignore the censoring of fertility histories of younger women. In the second step, we correct for this problem by estimating survival models of transitions to conceptions. Finally, we use survival models to examine the partner effect hypothesis.

3.1 The relationship between education and time to second conception

Table 2 presents the mean of the waiting time to second conception by education and birth cohort. The figures are just raw means and they are not adjusted for censoring. The third wave of the TPLC was administered in November 2008. At this time, the youngest members of the sample were only 18-25 years old at the time of the first wave and 25-33 at the time of the last wave of the TPLC survey.

TABLE 2 HERE

The first thing to note is that the mean number of children did not vary dramatically across educational categories; all of the cohort and education-specific averages range between 2 and 3.5. The relationship between the average number of children and education nevertheless exhibits an inverted U shaped pattern: within each cohort, women with higher education space births closer together than their low educated counterparts. The longest waiting time can be found among women with either vocational or secondary education. The fact that highly educated women space births closest together, the same group which pospone the transition to motherhood, seems to be consistent with the time-squeeze hypothesis.

It is also noteworthy that within each educational level, younger cohorts tend to space births closer together than older cohorts. The reduction of waiting time is about half year for women with vocational education and one year for other educational levels.

Before generalizing the results from our sample to the population, one should keep in mind that data on waiting times are calculated using a probably selective sample of women. The sample is selective since it includes only mothers, and the factors affecting the probability of becoming a mother in our sample are not randomly distributed. It is well-known that women with higher education wait more to the first conception than their lower educated counterparts. For instance, out of 100 highly educated women born between 1976-1983, only 44 became a mother, opposed to the 90 percent which characterizes members of the same cohort with primary education. This difference is due to the fact that the highly educated members of this cohort were too young to become a mother; they were only 18-25 years old at the time of the first wave and 25-33 at the time of the last wave of the TPLC survey. Note that in 2008, the total fertility rate was 1.35 in Hungary (Kapitány and Spéder 2010).

As a consequence, unobserved variables which affecting childbearing and are correlated with education should be, on average, more pronounced among mothers with higher education than among mothers with lower education. The relationship between education and the waiting time to second concdeption therefore might be due to the persence of such factors. We will consider this issue in the next subsection.

3.2 Education and the transition to conception

We proceed to estimating duration models for the waiting time to second conceptions. We estimate two duration models. Since we use interval regression, the two dependent variables were constructed which indicate lower and upper bounds for the true value of the partially observed waiting time. For uncensored durations, the lower and upper bounds are $\ln(t\text{-}1)$ and $\ln(t)$, respectively, meaning that conception occurred somewhere between time points t-1 and t (Lillard and Panis 2003). For right-censored durations, the respective lower and upper bounds are $\ln(t)$ and $\ln(\infty)$; meaning that the event will occur somewhere in the future. The explanatory variables include indicator variables for educational level and birth cohors, the age of mother at first delivery, and the square thereof, as well as interactions between education and the age variables.[5] The interaction terms between educational levels and the age variables allows us to assess the time-squeeze mechanism. Since the fear of reaching the biological limits of fertility must be stronger for those who spend more time in education *and* postpone childbearing, the time-squeeze mechanism implies a negative effect of the interaction between higher education

[5] Substracting 30 years from age at previous delivery resulted in a substantial decrease in the correlation between the two age variables.

and the age at previous birth. To simplify interpretation, we chose higher education as reference category. As a consequence, the time-squeeze mechanism implies that the interaction terms between education and age at previous delivery will be positive, meaning that women who spend less time in education and did not postpone the first birth much will wait longer until the second conception.

The first model addresses the issue of time squeeze but it does not address that of sample selection. To minimize selection bias, the conception equation, described in the previous paragraph, is estimated jointly with an exposure equation. The dependent variable in the exposure equation is an indicator variable marking mothers of one child. The independent variables include education and birth cohort. The link function for the exposure equation is probit. The residuals of the conception and exposure equations are assumed to follow a bivariate normal distribution.

Table 3 presents the estimation results. The reader should keep in mind that coefficients reflect partial changes in log durations, instead of changes in hazard rates, and a positive effect on duration is equivalent to a negative effect on the hazard rate. The positive main effects of the education variables in Model 1 thus means that, compared to women with higher education, women with lower education tend to *postpone* the second birth. In other words, the positive coefficients are evidence for the hypothesis that highly educated women space births closer together than women with lower education.

TABLE 3 HERE

The coefficients of the same education dummies remain positive as well as statistically significant in Model 2. This finding indicates that differences in spacing behavior across educational levels cannot be attributed to sample selection. Note that the residuals of the conception and exposure equations are negatively correlated and the correlation is significant. That is, there are unobserved factors common to both models which have the opposite effect of being a mother and the waiting time to second conception. Since the exposure equation is a simple model of the transition to first births, and the log hazard of second conception is the minus one times the log waiting time, the negative correlation indicates that the unobserved factors have the same effect on the transition to first and second conceptions. Nevertheless, the selection bias resulting from the presence of common unobserved factors is very small, and the results from Model 1 are robust against selection bias.

Now we address the question whether differences in spacing of second births across educational categories can be explained in terms of time-squeeze. The inclusion of interaction terms was motivated by that hypothesis. Due to the presence of the interaction terms and centering age at first delivery around 30, the main effects measure the effect of education in a population of women who delivered the first baby at age 30. By the same token, the effects of age at previous delivery and the square thereof are meaningful in a population of women with higher education. In both models, the coefficient of age at first delivery is about ten times larger than the coefficient of the squared term. Both coefficients are positive and significant. Therefore, there is an U shaped relationship between the waiting time to second conception and age at first delivery, and waiting time is minimal if the first child was delivered at age 25.[6] On average, women with higher education deliver the first child when they are older than 25, especially when they are member of a younger birth cohort. Given the U shaped relationship, the postponement of first delivery works against spacing births close together, an effect which is at odds with the time-squeeze hypothesis.

Another evidence against the time-squeeze hypothesis is that the interaction terms between education and age at first delivery are not significant with one exception: the interaction between vocational education and age at previous delivery is positive and statistically significant. This means that there is no evidence that education would modify the effect of age at first delivery at spacing of births. Nevertheless, the time-squeeze mechanism is at work among women with vocational education. The sum of that interaction term and the main effect of age at previous delivery are roughly 30 times larger than the main effect of the squared age term. This implies that women with vocational education space the births closest together if they are about 30/2+30=45 years old. Given the U shaped relationship between waiting time and age at previous delivery, and given the fact that the average age at first delivery is below 45 among women, postponement of childbearing reduces the waiting time among women with vocational education.

To summarize, we found evidence for the positive effect of higher education on the transition to second birth. Women with higher education space births closer together than women with lower education. This effect cannot be explained away with the help of the selection and the time-squeeze hypotheses. The former hypotheses can be rejected on the ground that the estimates in Models 1 and 2 do not differ substantially, thus the educational effect cannot be attributed to

[6] The minimum obtains if the coefficient of age at first delivery is divided by minus 2 times the coeffiicient of the squared variable. The value of this ratio is about -5. Since the variables are centered around 30, -5 corresponds to 25 on the natural age scale.

unobserved factors which affect the waiting times to first and second births. The time-squeeze hypothesis is at odds with two findings. First, the relationship between age at first birth and waiting time to second conception exhibits a U shaped pattern, and the time-squeeze effect applies only to women who become mothers at an below-average age. Second, education does not seem to modify the effect of age at first delivery at spacing behavior.

Another explanation for the positive effect of education to transition to second birth is the partner effect hypothesis (Kreyenfeld 2002). We turn to testing that hypothesis.

3.3 The partner effect hypothesis

The partner effect hypothesis will be examined using the matched sample of event histories and cross-sectional information on partner's characteristics (see Section 2). Since information on the partner's education are taken from the first wave, we carry out a prospective study in which the partner's education is treated as time-constant variable, which, by the construction of the dataset, precedes events of conceptions. By keeping the partner's education constant, we do not make any attempt to study changes in partnership status and thereby changes in partnership status on fertility.

The partner effect assumes couples with similar education. The distribution of partner's education is presented in Table 4. The strength of educational homogamy depends on education: the chances of being partnered to a men with the same education is about 35 percent among women with either primary or secondary education, and about 55 percent among women with either vocational or higher education. The chances of living with highly educated men shows considerable variation. While 54 percent of college educated women were partnered to highly educated men, this proportion drops to 14 percent among women with secondary education, and to 2 percent among women with even lower education.

TABLE 4 HERE

The fact that about half of the college and university educated women should marry downwards is associated with the unequal distribution of highest level of education between the two sexes. There are simply more highly educated women than men with the same education; and similarly, there are more secondary education graduates among women than among men. As a consequence, some of the highly educated women must be married to men with lower education. In the first wave of the TPLC, the ratio of the number of college and university graduated women to the number of men with the same educational level is 3 to 2 in the birth cohorts 1966-1983. This means that perfect educational homogamy cannot be achieved and half of the highly educated women must marry men with secondary education. This leads to an increasing competition among women with secondary education to find partners with similar education. The first wave data suggests that in the marriage market for men with secondary education, the ratio of the number of female competitors to the number of male partners will be again 3 to 2. Therefore, half of the female competitors should marry men with a lower education. The lesson is that women with tertiary and secondary education are disadvantaged in the marriage market since some of them should marry men with lower education.

We now proceed to examine the effect of partner's education on birth transitions. Again, we specify two models. Model 1 includes the partner's education in the model which was labeled Model 1 in the previous subsection. Model 2 consists of three equations, which are estimated simultaneously. The first equation, labeled conception, is the same equation as Model 1. The second equation, labeled exposure, is a probit model of being a mother on female education and birth cohort. Similar to the previous subsection, this equation is included in order to control for unobserved factors which affect both transitions to first and second births. The third equation, labeled selection, is new. It is a probit model of being in the matched sample on female education and birth cohort. Recall that the matched sample is not a random sample of retrospective event histories; by construction, it excludes unions that failed to survive until the first wave of data collection. We include the third equation in order to control for unobserved factors which affect both the transition to births and the stability of unions. The equations which constitute Model 2 are estimated simultaneously by allowing the equation specific residuals to be correlated.

The estimation results are presented in Table 5. The coefficients of the two models are quite similar to each other, meaning that the results from Model 1 cannot be attributed to sample selection. The variables capturing the partner's education have positive and significant effects, with the exception of primary education. Since higher education is the reference category, there is evidence that women partnered to highly educated men space births closer together than women partnered to men with secondary or vocational education. However, there is no significant difference in spacing behavior between women partnered to men with primary education and women partnered to highly educated men. In short, there is an inverted U shaped pattern between the partner's education and the waiting time to second birth.

TABLE 5 HERE

The estimation results for the other variables are virtually the same as the results presented in the previous subsection and in Table 3. Women with higher education space births closer together than women with lower education; since most of the interaction effects lack significance, we have no evidence to conclude that age at first delivery would modify the differences across education.

Our finding is that female education matters in spacing behavior even after controlling for partner's education. This finding is consistent with those reported in Gerster etal (2007) and Klesment and Puur (2010). While our study supports the partner effect hypothesis, it does not support Kreyenfeld's (2002) hypothesis that the partner effect hypothesis accounts for the effect of female education on the transition to second births. The relationship between women's education and spacing behavior is likely to be a causal one, and the partner effect hypothesis describes another mechanism which strengthen the correlation between higher education and the transition to second births. Future research should examine the conditions under which women's education has no causal effect on the transition to second births and it should also address the question why the relative importance of women's education depends on parity.

4 Conclusions and discussion

This paper describes the relationship between education and fertility in one of the former socialist countries, Hungary, and makes an attempt to explain the observed patterns. One of the well-known predictions of the economic theory of fertility is the negative relationship between female labor market participation and fertility. Recent studies carried out in Western European countries, however, found a positive effect of education on the transition rate to second births (Kreyenfeld 2002, Gerster et al 2007, Kravdal 2001, 2007). The relationship between education and transition to second births was also examined in some former socialist countries: the results are mixed and do not always support the hypothesis that fertility is likely to decrease with women's deducation (Muresan and Hoem 2010, Klesment and Puur 2010, Billingsley 2011). Previous research into fertility in Hungary suggests that the relationship should be U shaped instead of a decreasing one (Husz 2006, Spéder 2006). The U shaped pattern is paradoxical since the opportunity costs of raising children are larger among people with college and university education than among people with secondary education.

To explain this paradox, we relied on the partner effect hypothesis (Kreyenfeld 2002). Highly educated women tend to marry (or live with) educated men, and highly educated men face better career opportunities than their female counterparts. Highly educated couples thus can afford the costs associated with raising high-quality children, a phenomenon also known as the income effect (Becker and Lewis 1973). Besides, the generous cash benefits and the limited availability of child-care force women to exhaust the 3 years of paid leave. This leads to a substantial depreciation of human capital and results in a male-female wage gap among qualified employees. Highly educated women therefore are likely to prefer leaving the labor force only once and squeezing births together over experiencing repeated spells of being in and out of the labor force.

We use three waves of the Hungarian GGS data to describe the relationship between education and fertility as well as to test the partner effect hypothesis. We examined parity-specific transitions to conceptions using lognormal survival models. The analyses took into account both the time-squeeze and the selection hypotheses (Kreyenfeld 2002). Our results can be summarized as follows. First, in line with the prediction of the economic theory of fertility, education has a negative effect on the transition to first birth: the time to first conception is the longest among college and university educated women. Second, the transition to second birth is faster among highly educated women than among women with secondary education in the sample of women born between 1946 and 1983.

Next to describing the relationship between education and fertility, we also made an attempt to explain this relationship. More specifically, we tested the partner effect hypothesis by including the partner's education in the regression model. The education of the partner has the expected effect: women partnered to college educated men space births closer together than women partnered to men with lower education. However, the effect of female education remained significant, thus the effect of female education cannot be explained away in terms of the partner's education. This finding is consistent with those reported in Gerster etal (2007) and Klesment and Puur (2010), but it does not support the partner effect hypothesis. The effect of highly educated partners therefore cannot be interpreted in terms of the income effect, which posits that highly educated men can afford the costs of investments into the human capital of children, which are likely to increase over time. The relationship between women's education and spacing behavior is likely to be a causal one, and the partner effect hypothesis describes another mechanism which strengthen the correlation between higher education and the transition to second births. Future research should examine the conditions under which women's education has no causal effect on the transition to second births.

We did not examine alternative explanations for the positive effect of partner's education on transition to second birth. It might be the case that the education of the partner has a positive effect on marital stability. Partners with low education lack the resources to support the family, which might result in family conflicts, especially in a society where the male-breadwinner model is predominant. One might also speculate that highly educated men are more involved in housework than their counterparts with lower education, which also might affect the stability of the marriage. Future research should offer a more detailed description of the mechanisms which link the partner's education to the fast transition to second births.

References

Ahn, N. and Mira, P. (2002). A note on the changing relationship between fertility and female employment rates in developed countries. *Journal of Population Economics*, 15: 667-682.

Becker, G. S. (1981). *A treatise on the family*. Second, enlarged edition. Cambridge, MA: Harvard University Press.

Becker, G. S. and H. G. Lewis (1973). On the Interaction between the Quantity and Quality of Children. *The Journal of Political Economy* 81: S279–S288.

Billingsley, S. (2011). Economic crisis and recovery: Changes in second birth rates within occupational classes and educational groups. *Demographic Research* 24: 375-406.

Blossfeld, H.-P. and Drobnic, S. (2001). Theoretical perspectives on couples' careers. In: Blossfeld, H.-P. and Drobnic, S. (eds.). *Careers of couples in contemporary societies: From male breadwinner to dual earner families*. Oxford: Oxford University Press: 16-50.

Blossfeld, H.-P., Golsch, K. and Rohwer, G. (2007). *Techniques of event history modeling using Stata: New approaches to causal analysis*. Mahwah (NJ): Erlbaum.

Brewster, K. L. and Rindfuss, R. R. (2000). Fertility and women's employment in industrialized nations. *Annual Review of Sociology* 26: 271-296.

Coate, S. and Loury, G. (1993). Will affirmative-action policies eliminate negative stereotypes? *American Economic Review* 83: 1220-1240.

Gerber, T. P. and Berman, D. (2010). Entry to marriage and cohabitation in Russia, 1985-2000: Trends, correlates, and implications for the Second Demographic Transiton. *European Journal of Population* 26(1): 3-31.

Gerster, M., Keiding, N., Knudsen, L. B. and Strandberg-Larsen, K. (2007). Education and second birth rates in Denmark 1981-1994. *Demographic Research* 17: 181-210.

Happel, S. K., J.K. Hill and S. A. Low (1984) An economic analysis of the timing of childbirth. Population Studies, 38: 299-311.

Hoem, J. M., Kostova, D., Jasilioniene, A. and Mureşan, C. (2009). Traces of the Second Demographic Transition in four selected countries in Central and Eastern Europe: Union formation as a demographic manifestation. *European Journal of Population* 25(3): 239-255

Husz, I. (2006). Iskolázottság és a gyermekvállalás időzítése [Education and the timing of childbearing.] *Demográfia* 49(1): 46-67.

Jones, L. E., Schoonbroodt, A. and Tertilt, M. (2008). Fertility theories: Can they explain the negative fertility-income relationship? NBER Working Paper No. 14266. http://www.nber.org/papers/w14266.pdf. Accessed: 22 June 2011

Kalmijn, M. (1998). Intermarriage and homogamy: Causes, patterns and trends. *Annual Review of Sociology* 24: 395-421.

Kantorová, V. (2004). Education and entry into motherhood: The Czech Republic during state socialism and the transition period (1970-1997). *Demographic Research* Special Collection 3: 245-274.

Kapitány, B. and Spéder, Zs. (2010). Fertility. In: Monostori, J., Őri, P., S. Molnár, E. and Spéder, Zs. (eds.). *Demographic portrait of Hungary 2009: Report on the conditions of the Hungarian population*. Budapest: HCSO Demographic Research Institute: 29-40.

Kézdi, G., Köllő, J. and Varga, J. (2009). The failures of "uncertified" vocational training. In: Fazekas, K. and Köllő, J. (eds.). *The Hungarian labour market: Review and analysis 2009*. Budapest: Institute of Economics HAS, National Employment Foundation: 95-147. http://econ.core.hu/file/download/mt09/infocus.pdf Accessed: 22 June 2011

Klasen, S. and Launov, A. (2006). Analysis of the determinants of fertility decline in the Czech Republic. *Journal of Population Economics* 19: 25-54.

Klesment, M. and Puur, A. (2010). Effects of education on second births before and after societal transition: Evidence from the Estonian GGS. *Demographic Research* 22: 891-932.

Korintus, M. (2010) Hungary. In: Moss, P. (ed.). *International review of leave policies and related research 2010. London: Department for Business, Innovation and Skills*: 115-141. (Employment relations research series no. 115*)* .http://www.bis.gov.uk/assets/biscore/employment-matters/docs/i/10-1157-international-review-leave-policies.pdf Accessed: 22 June 2011

Kravdal, O. (2001). The high fertility of college educated women in Norway: An artefact of the separate modeling of each parity transition. *Demographic Research* 5: 187-216.

Kravdal, O. (2007). Effects of current education on second- and third-birth rates among Norwegian women and men born in 1964: Substantive interpretation and methodological issues. *Demographic Research* 17: 211-246.

Kreyenfeld, M. (2002). Time-squeeze, partner effect or self-selection? An investigation into the positive effect of women's education on second birth risks in West Germany. *Demographic Research* 7: 15-48.

Kulu, H. and Vikat, A. (2007). Fertility differences by housing type: The effect of housing conditions or of selective moves? *Demographic Research* 17: 775-802.

Lillard, L. A. and Panis, C. W. A. (2003). aML Multilevel Multiprocess Statistical Software, version 2.0. EconWare, Los Angeles, California. http://www.applied-ml.com/download/amldoc.pdf Accessed: 22 June 2011.

Matysiak, A. and Vignoli, D. (2008). Fertility and women's employment: A meta-analysis. *European Journal of Population* 24: 363-384.

Mincer, J. and S. Polachek (1974). Family investments in human capital: earnings of women. Journal of Political Economy, 82: S76-S108.

Montgomery, M. and J. Trussel (1986). Models of marital status and childbearing. Pp. 205-271 in Handbook of Labor Economics, Vol. I., ed. Bz O. Ashenfelter and R. Layard. Amsterdam: North-Holland.

Mureşan, C. and Hoem, J. M. (2010). The negative educational gradients in Romanian fertility. *Demographic Research* 22: 95-114.

Oláh, L. Sz. and Fratczak, E. (2004). Becoming a mother in Hungary and Poland during state socialism. *Demographic Research* Special Collection 3: 213-244.

Roodman, D. (2011). Estimating fully observed recursive mixed-process models with cmp. Stata Journal 11(2): 159-206.

Spéder, Zs. (2001). Turning points of the life course: research plan and questionnaire of the Hungarian Social and Demographic Panel Survey (HSDPS). Budapest: HCSO DRI. http://www.demografia.hu/letoltes/dpa/panel_koncepcio_a.pdf. Accessed: 22 June 2011

Spéder, Zs. (2006). Rudiments of recent fertility decline in Hungary: Postponement, educational differences, and outcomes of changing partnership forms. *Demographic Research* 15: 253-288.

Spéder, Zs. and Kapitány, B. (2009). How are time-dependent childbearing intentions realized? Realization, postponement, abandonment, bringing forward. *European Journal of Population* 25: 503-523.

Taniguchi, H. (1999): The timing of childbearing and women's wages. Journal of Marriage and the Family 61: 1008-1019.

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: 123-156.

Vikat, A., Spéder, Zs., Beets, G., Billari, F. C., Bühler, C., Désesquelles, A., Fokkema, T., Hoem, J. M., MacDonald, A., Neyer, G., Pailhé, A., Pinelli, A., Solaz, A. (2007). Generations and gender survey (GGS): Towards a better understanding of relationships and processes in the life course. *Demographic Research*, 17(14), 389-440.

TABLES AND FIGURES

Table 1
Descriptive statistics for the full and the merged samples

Variables	Full sample (N=5890)		Merged sample (N=3844)	
	Mean	S.D.	Mean	S.D.
Dependent variables				
Exposed to second conception	0.764	0.425	0.981	0.138
Second conception observed	0.542	0.498	0.720	0.449
Lower limit of log waiting time to conception	3.718	1.294	3.690	1.247
Upper limit of log waiting time to conception	3.341	0.866	3.311	0.822
Independent variables				
Parner's education				
not partnered	0.291	0.454	0.087	0.282
primary	0.086	0.281	0.117	0.321
vocational	0.288	0.453	0.385	0.487
secondary	0.198	0.398	0.249	0.432
higher	0.137	0.344	0.162	0.369
Education				
primary	0.205	0.403	0.209	0.407
vocational	0.211	0.408	0.242	0.428
secondary	0.357	0.479	0.363	0.481
higher	0.228	0.419	0.186	0.389
Age at previous delivery-30	-6.926	4.024	-6.721	3.867
(Age at previous delivery - 30)^2	64.162	47.439	60.122	43.939
Birth cohort				
1946-1950	0.138	0.345	0.149	0.356
1951-1955	0.151	0.358	0.161	0.368
1956-1960	0.129	0.335	0.160	0.367
1961-1965	0.108	0.310	0.138	0.345
1966-1970	0.119	0.324	0.144	0.351
1971-1975	0.146	0.353	0.156	0.363
1976-1983	0.210	0.407	0.092	0.289

Table 2

Mean years between first birth and second conception by education and birth cohort

	primary	vocational	secondary	higher
1946-1950	3.46	3.76	3.60	2.92
1951-1955	3.00	3.19	3.40	2.99
1956-1960	3.25	3.30	3.96	3.19
1961-1965	3.10	3.90	3.07	2.80
1966-1970	3.01	3.36	3.34	2.96
1971-1975	3.06	3.51	3.23	2.66
1976-1983	2.49	3.25	2.70	1.99

Table 3

Education and waiting time to second conception

Variable	Model 1		Model 2			
	Conception		Conception		Exposure	
Education[a]						
primary	0.873***	(3.59)	0.804***	(3.3)	0.62***	(9.52)
vocational	1.404***	(5.55)	1.331***	(5.26)	0.605***	(10.01)
secondary	0.622***	(4.09)	0.589***	(3.87)	0.24***	(5)
Age at previous delivery-30	0.117**	(3.12)	0.117**	(3.12)		
(Age at previous delivery - 30)^2	0.011**	(2.71)	0.011**	(2.7)		
Interaction between (age at previous delivery-30) and…						
primary education	0.045	(0.72)	0.046	(0.73)		
vocational education	0.205**	(2.99)	0.206**	(2.99)		
secondary education	0.014	(0.28)	0.014	(0.28)		
Interaction between (age at previous delivery - 30)^2 and…						
primary education	-0.008	(1.63)	-0.008	(1.62)		
vocational education	0.004	(0.81)	0.004	(0.82)		
secondary education	-0.006	(1.17)	-0.006	(1.17)		
Birth cohort[b]						
1946-1950	-0.137	(1.43)	-0.369***	(3.63)	1.459***	(20.11)
1951-1955	-0.202*	(2.17)	-0.426***	(4.32)	1.379***	(20.29)
1956-1960	-0.236*	(2.55)	-0.479***	(4.88)	1.571***	(20.73)
1961-1965	-0.349***	(3.66)	-0.602***	(5.83)	1.683***	(19.65)
1966-1970	-0.3**	(3.26)	-0.51***	(5.22)	1.241***	(18.03)
1971-1975	-0.076	(0.83)	-0.216*	(2.28)	0.737***	(12.78)
Constant	4.363***	(35.59)	4.711***	(34.6)	-0.524***	(11.54)
log SD of the residual[c]	0.394***	(26.79)	0.402***	(25.97)	0	
Correlation of residuals[d]					-0.236***	(5.31)
N	4495				5890	
Chi^2 test[e]	222.48***				247.60***	

Coefficients from interval regressions of log durations until conceptions. See the text for details of the estimation method.
Numbers in parentheses are *t* statistics. * p<0.05, * p<0.01; *** p<0.001; two tailed tests assumed.
a reference category is higher education
b reference category is 1976-1983
c The standard deviation of the residual in the selection equation is normalized to unity.
d Correlation coefficients are in fact the Firsher's transformations, calculated as $0.5[\ln(1+r) - \ln(1-r)]$, where r is the correlation coefficient.
e Log-likelihoods in Models 1 and 2 are -17466.38 and -19998.66, respectively

Table 4

Distribution of partner's education in the estimation sample

	primary	vocational	secondary	higher
not partnered	10.51	9.48	7.17	8.77
primary	34.55	13.05	3.45	0.53
vocational	45.06	56.04	36.39	13.16
secondary	7.8	19.37	39.11	23.16
higher	2.07	2.06	13.88	54.39
N				

Table 5

Parner's education and waiting time to second conception

Variable	Model 1 Conception		Model 2 Conception		Model 2 Exposure		Model 2 Selection	
Partner's education								
not partnered	1.085***	(7)	0.979***	(6.29)				
primary	0.158	(1.25)	0.152	(1.22)				
vocational	0.278**	(2.94)	0.267**	(2.83)				
secondary	0.231*	(2.51)	0.223*	(2.46)				
Education[a]								
primary	0.718*	(2.49)	0.715**	(2.68)	0.135	(0.87)	0.100	(1.88)
vocational	1.132***	(4.4)	1.128***	(4.44)	0.156	(0.87)	0.364***	(7.01)
secondary	0.466**	(2.58)	0.453*	(2.43)	0.244	(1.7)	0.174***	(3.9)
Age at previous delivery-30	0.121**	(3.17)	0.109**	(3.03)				
$(\text{Age at previous delivery} - 30)^2$	0.01*	(2.41)	0.009*	(2.4)				
Interaction between (age at previous delivery-30) and…								
primary education	0.031	(0.43)	0.036	(0.56)				
vocational education	0.159*	(2.42)	0.17**	(2.69)				
secondary education	-0.011	(0.2)	-0.011	(0.2)				
Interaction between $(\text{age at previous delivery} - 30)^2$ and…								
primary education	-0.007	(1.22)	-0.006	(1.26)				
vocational education	0.002	(0.46)	0.003	(0.61)				
secondary education	-0.006	(1.2)	-0.006	(1.22)				
Birth cohort[b]								
1946-1950	-0.066	(0.53)	-0.097	(0.54)	0.562	(1.85)	0.906***	(14.78)
1951-1955	-0.164	(1.35)	-0.185	(1.04)	0.452	(1.52)	0.882***	(14.81)
1956-1960	-0.178	(1.49)	-0.212	(1.11)	0.534	(1.52)	1.133***	(18.08)
1961-1965	-0.37**	(3.07)	-0.402*	(2.01)	0.731*	(1.99)	1.182***	(17.89)
1966-1970	-0.325**	(2.81)	-0.341	(1.86)	0.578	(1.6)	1.079***	(17.18)
1971-1975	-0.168	(1.45)	-0.23	(1.34)	0.083	(0.27)	0.89***	(15.13)
Constant	4.088***	(25.88)	4.147***	(13.03)	1.232	(1.75)	-0.895***	(19.76)
log SD of the residual[c]	0.336***	(17.96)	0.378***	(17.55)	0		0	
Correlation matrix of residuals[d]								
conception			1		1.029***	(6.18)	-0.087	(0.68)
partnership					1		0.278	(0.68)
selection							1	
N	2967		2967		3094		5890	
Log-likelihood	-11726.13				-15748.71			
Chi^2 test[e]	217.15***				187.30***			

Coefficients from interval regressions of log durations until conceptions. See the text for details of the estimation method.
Numbers in parentheses are *t* statistics. * $p<0.05$, * $p<0.01$; *** $p<0.001$; two tailed tests assumed.
a reference category is higher education
b reference category is 1976-1983
c The standard deviation of the residual in the selection and the partnership equations is normalized to unity.
d Correlation coefficients are in fact the Firsher's transformations, calculated as $0.5[\ln(1+r) - \ln(1-r)]$, where *r* is the correlation coefficient.
e Log-likelihoods in Models 1 and 2 are -11726.13 and -15748.71, respectively