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2004-16

The activities of CAM are financed by a grant from
The Danish National Research Foundation

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Abstract

In this paper we study the relationship between fertility behavior and the process of marriage duration. The potential endogeneity of fertility on marriage behavior is taken into account by modeling fertility and divorce jointly. We apply the "timing-of-event" method (Abbring & van den Berg (2003)) to identify the causal effect of births on the divorce hazard. We show that couples who are less prone to divorce are more prone to invest in children, and therefore one might (mistakenly) conclude that children tend to stabilize marriages. However, when correcting for this selectivity bias arising from the fertility decision, we conclude that children themselves do not have a positive effect on marriage duration.

JEL classification: J12, C3

Keywords: Marriage, divorce, children

*Financial support from the Danish Social Science Research Council, Centre for Research in Social Integration and Marginalization and National Centre for Register-based Research is gratefully acknowledged. Michael Svarer also thanks the Danish National Research Foundation for support through its grant to CAM. We thank Paul Bingley, Vani K. Borooah, Peter Jensen, Shelly Lundberg, Lars Skipper and seminar participants at the Centre for Applied Microeconometrics, Tinbergen Institute, Amsterdam and participants at the EALE Conference 2002 and the SFI conference 2003 for helpful comments. In addition, we are grateful to Susan Stilling for reading the manuscript. The usual disclaimer applies.

1 Introduction

Do children stabilize marriages? The higher the value of marriage, all other things equal, the less likely it is that the marriage breaks up. In order to achieve a higher value of the marriage, the couple can choose to invest in the relationship. The perhaps most important investment, at least a very long-term investment, is children. Children represent, according to Becker (1998), a marital-specific investment and this implies that the value to the partners of having children is not fully preserved outside marriage. Accordingly, the arrival of children implies that the expected gain from marriage increases and that divorce is discouraged.

When the question is adressed empirically, raw data sets also typically suggest that there is a positive relationsship between children and duration of marriage. Gross divorce rates are in general lower for couples with children than for their childless counterparts. However, when the association between the two processes; marital status and birth timing is investigated more thoroughly, the results are less clear. The empirical literature on the topic could be divided into two generations. The first generation models pursue a reduced-form strategy and simply includes various children regressors in models of marital dissolution. The second generation models raise the concern that these regressors might be endogenous. The decision to invest in children is presumably not independent of the quality of the current match and hence the probability of subsequent divorce (see e.g. Becker et al. (1977), Weiss (1997) and Vuri (2001a,b) for theoretical models that support this hypothesis). Different empirical approaches have been suggested to model the potential endogeneity of fertility in models of marital dissolution and the results are mixed.

Koo & Janowitz (1983), in a simultaneous logit model, find neither that the number of children or the age of the youngest child affects the divorce probability nor that separations affect childbearing throughout marriage. Lillard & Waite (1993) estimate a bivariate duration model and find that the fertility decision and the divorce risk are negatively correlated as suggested by economic theory, i.e. couples who are more

prone to divorce are less likely to invest in marital-specific capital, as constituted by children. After correcting for endogeneity of children, they find that the first child has a stabilizing effect on marriage, whereas second and higher order children have destabilizing effects. Vuri (2001b) analyzes the association between children and divorce inspired by the treatment-outcome literature and finds that the presence of children does stabilize marriages, and that this is mainly due to a very positive effect from the first child.

In the present paper, we investigate whether the presence of children stabilizes marriages in Denmark. We identify the causal effect of children on the divorce risk assisted by a newly developed bivariate duration model (Abbring & van den Berg (2003)) and a register-based data set. We find, without correcting for the potential endogeneity problem, that children stabilize marriages, but that this effect is due to negative correlation between the two processes; marriage continuation and birth timing. When this correlation is accounted for, we find no stabilizing effect of children on marriages, but actually a destabilising effect of the first and second born child. We discuss how this result could be explained by non-economic theories of marital satisfaction in association with childbearing. In addition, we discuss whether the results could be driven by country specific characteristics like relatively high labour force participation of mothers and institutional settings for the benefit of households with children.

Section 2 presents the background of our analysis in terms of the theoretical underpinnings and the related empirical literature. Section 3 describes the data, and Section 4 outlines the empirical specification and discusses identification issues in more depth. Section 5 contains the main results, and Section 6 concludes.

2 Background

2.1 Economic theory

Why should children stabilize marriages? According to Becker (1998), marriage is seen as a voluntary arrangement between two adults with the purpose of joint consumption and joint production. The higher the value of marriage, all other things equal, the less likely it is that the marriage breaks up. In order to achieve a higher value of the marriage, the couple can choose to invest in the relationship. A very important investment, at least a very long-term investment, is children. Children represent, according to Becker, a marital-specific investment since they belong to the couple rather than either one of the partners, which also implies that the value to both partners of having children is not fully preserved outside marriage. Therefore, the arrival of children raise the expected gain from marriage and discourage divorce.

Becker et al. (1977) argue and prove[1] that the causality runs in both directions: the possibility of divorce also discourages the accumulation of marital-specific capital. This feature has recently been modelled more rigourously by Weiss (1997) and Vuri (2001a).

Weiss (1997) introduces the notion of *defensive investment* which simply suggests that investment in children is hampered if prospects of divorce are high. In the model, fertility (and child quality) requires input of time and money by parents in the first period, and child quality requires input of time and money by parents in the second period. Also, the parents' wages in the second period depend on how much they worked in the first period (i.e. there is positive returns to experience in the labour market). In the second period, new information is available, which could induce the dissolution of the marriage. In the model, fertility in the first period, wages in the second period and the probability of divorce are therefore jointly determined.

Vuri (2001a) also addresses the two processes in a two-period model. In the first period, the couple observes a noicy signal of the true quality of the marriage. Based on this signal, the couple decides how many children, if any, to have. In the second period,

[1] In the 1976 NBER working paper version of the paper.

the true value of the match is revealed and the couple decides to divorce or not. This decision is guided by comparison of the utilities obtained by continuing the marriages or by entering the single state. These utilities depend on the amount of children produced in the first period. Vuri (2001a) shows that couples with children are less likely to divorce, and that couples with higher *ex-ante* divorce probabilities are less likely to give birth to children.

To sum-up, the theoretical economic literature suggests that children are stabilizing marriages, but that the decision to have children depends on the percieved match quality.

2.2 Other theories

Theorists within other disciplines have also been concerned about the effects of child-bearing on marriage. Especially within psychology and sociology this has been given considerable thoughts. Twenge et. al. (2003) summarize this in four theories explaining the negative correlation between parenthood and marital satisfaction found in several studies: 1) *The role conflict model* explains how the reorganization of social roles towards the traditional family pattern when children are born may lead to marital dissatisfaction. The new roles as parents are added to other roles as e.g. professional roles and this may cause more stress and conflicts within the couple. 2) *The restriction of freedom model* predicts that the presence of children in the household limits the freedom of the parents and hence dissatisfaction may occur. One implication of the model is that this dissatisfaction is greater when children are infants and especially for mothers, because they often give up more freedom than fathers. 3) *The sexual dissatisfaction model* explains how children's interference with parents' sex lives increases the marital dissatisfaction, especially for men. This explanation may be strongest when children are very young because infants demand more attention - also during the evening and night. 4) *The financial cost model* suggests that the fact that children are expensive creates a financial pressure on the couple and if the family have traditional role models,

this pressure will be strongest for the father bearing the largest responsibility for the economic situation of the family.

These four models all predict a negative correlation between children and marital satisfaction and this is confirmed by the meta-analysis performed in the paper. Hence, contrary the economic theories, the prediction from this literature is that children may destabilize marriages and encourage divorce.

2.3 Empirical literature

The empirical studies of the effect of children on marital dissolution do not offer a consensus on the nature or direction of the effects of children and this may appear surprising given the unambiguous effect derived from the economic theory.

Lillard & Waite (1993) survey most of the literature (prior to 1993) in the reduced-form category, where various children characteristics are included as exogenouos variables in models of divorce. The majority (but not all) of these studies find that number of children and children born in the marriage stabilize the relationship, especially when the children are in the preschool age. Older children, children born before marriage (but to the couple) and stepchildren tend to increase divorce risk. More recent studies have in general confirmed these patterns (see e.g. Huffman & Duncan (1995), Anderson (1997), Weiss & Willis (1997) and Svarer (2002)). Lately, Böheim & Ermisch (2001) find on British data that the divorce risk increases with number of children. This finding is reiterated in Chan & Halpin (2002), but here the authors show that the result is driven by a cohort effect. Interacting number of children with cohort reveals that for older cohorts the divorce probability actually decreases with number of children, whereas the opposite is true for younger cohorts.

The more structural[2] oriented empirical literature was initiated by Koo & Janowitz

[2]We will refer to models that endogenize fertility in the divorce equations as structural models or second generation models. The models are not structural in the sense that we are recovering the deep structural parameters. The notation merely reflects that we are imposing dependency between the

(1983). They model a simultaneous logit model of the probability of separation and of having a birth in a brief period. They find that neither number of children or age of the youngest child affects the divorce probability nor that separations affect childbearing throughout marriage. The logit model is not very well suited for estimation of dynamic processes as timing of birth and divorce. Lillard & Waite (1993) improve upon this by specifying and estimating a bivariate duration model in which the two processes of interest are allowed to be dependent. They find, that the fertility decision and the divorce risk are negatively correlated, i.e. couples who are more prone to divorce are less likely to invest in children. After correcting for endogeneity of children, they find that the first child has a stabilizing effect on marriages, whereas second and higher order children have destabilizing effects. Comparing different family compositions, they show that families with 1 child, all other things equal, have the highest probability of continuing beyond their 12th anniversary. In terms of marriage survival probabilities, this family type is followed by families with either two or no children. Families with 3 children have the lowest marriage survival probability among these families. Vuri (2001b) analyzes the association between children and divorce inspired by the treatment-outcome literature. The treatment being the arrival of a(nother) child and the outcome being the continuation of marriages. The identifying assumption in Vuri's formulation is the notion of conditional independence, which implies that data include all systematic determinants of the process of treatment assignment (the birth of a child), so that, conditional on these observables, the remaining observed variation in the treatment assignment is uncorrelated with the determinants of the outcome variable (in this case the event of divorce). She finds that having children reduces the probability of divorce. In terms of additional children, she finds that having another child (on average) reduces the probability of marital dissolution, but that this result seems to be driven mainly by the negative effect that having children in the first place has on divorce while higher order children only slightly affect the divorce risk.

In sum, the literature mentioned in this section suggests that (i) children are en-

birth process and the divorce process.

dogenous to the marital dissolution and that (ii) children born to the couple tend to stabilize marriages. In this paper, we take a closer look at the association between children and marital status following the tradition in the structural branch of the literature. Our analysis is based on a rich register-based data set that, compared to the data sets used in the structural part of the literature, contains *both* economic variables and demographic variables. Our empirical investigation is conducted with a more flexible econometric model that does not rely on that the data set contains multiple-spells of a given event per individual (like Lillard & Waite (1993)), exclusionary restrictions or conditional independence (like Vuri (2001b)).

3 Data

The data used in this study come from IDA (Integrated Database for Labour Market Research) created by Statistics Denmark. The information comes from various administrative registers that are merged in Statistics Denmark. The IDA sample used here contains (among other things) information on marriage market variables for a randomly drawn sub-sample of all individuals born between January 1, 1955, and January 1, 1965. The individuals are followed from 1980 to 1995. The data set enables us to identify individual transitions between different states in the marriage market on an annual basis. The information about civil status is based on the individual's situation on December 31 each year and is derived from household information. This means that only individuals sharing the same address are identified as cohabiting or married. If two individuals are sharing a flat, say, without being a couple, it will still count as cohabitation in the data. The only way we can ascertain that individuals living together actually are partners is to consider married couples only. In this study, we therefore restrict focus to marriages[3]. Of course, married couples who are not living together will

[3]According to Statistics Denmark the fraction of cohabitants who are partners is around 80%. Of the married couples 78% lived together as cohabitans prior to marriage and a substantial number of these had their first child(ren) before they married. While we only consider marriages in the following

be registered as single, but this type of relationships is likely to be low in number. If there is a break in a marriage, e.g. we observe a couple to be married in 1987, to live as single individuals in 1988 and then as a married couple again in 1989, we disregard the break and contribute the intervening spell to measurement error.

The information used in the analysis is gathered in the following way: we observe the individuals in 1980, where we have information about various personal characteristics and marriage market status. For each subsequent year, we observe a new stream of data for the individuals. If the individual enters a relationship, we also observe the personal characteristics of the partner. Since we are interested in marriages, and especially the personal characteristics during the marriage, we disregard left-censored marriages.

Table 1 shows the distribution of marriages, and it is worth noticing that very few individuals experience more than 1 marriage in the sample period

TABLE 1: DISTRIBUTION OF THE NUMBER OF MARRIAGES.

Number of marriages	Number of persons	Percentage
1	6994	95.5
2	323	4.4
3	8	0.1
4	2	0.0

3.1 Fertility data

Information about fertility is obtained from a fertility database administered by Statistics Denmark. The database contains information about all births in Denmark. For each birth, we have information about the identity of the mother. We know the sex of the child, the date of birth and whether it was a twin birth. On top of that, we also have information about the identity if the father. The latter information is captured from each child birth certificate. Here the name of the father is stated. In 96% of the births, the information is actually provided. Based on this information, we are able to identify all children born to the couple, whether the couple is married or not. In

we will also present results (in Section 5) for a model where we include the cohabitation period in the analysis.

addition, we can see if either of the partners in a specific marriage has children from previous relationships.

The stream of information about births enables us to construct variables that very precisely describe the individual birth history of each individual in our sample. In Table 2, the resulting distribution of children born in the observational period is presented. It should be noted that this distribution is clearly not equal to the distribution of completed fertility.

Table 2: Distribution of children born in the marriages.

Number of children	Number of marriages	Percentage
0	2558	0.35
1	2360	0.32
2	1967	0.27
3	388	0.05
4 or more	54	0.01

3.2 Fertility and divorce

The main topic of this paper is to analyse the relationship between fertility and divorce. In this subsection, we present some associations between fertility and divorce. Table 3 shows the divorce rate for different family types depending on the number of children born in the marriage. The overall divorce rate[4] in the sample is 18%. However, the divorce rate does not seem to be independent of the number of children born within the marriage. The divorce rate of the marriages with no children is 23% and this declines steadily with the number of children and is as low as 4% for marriages with 3 children. This clearly indicates that, all other things equal, marriages with a higher level of investment in children are stable or the reverse, namely that it is only the high-quality marriages that have (several) children.

Table 3: Divorce rate, by number of children born in marriage.

[4]The divorce rate is the fraction of marriages that have dissolved before 1995.

Number of children	Number of divorces	Divorce rate
0	598	0.23
1	467	0.20
2	201	0.10
3	14	0.04
4	1	0.02

Eventhough relatively few of the individuals in the sample experience more than 1 marriage in the sample period, in 19% of the marriages at least one of the partners has children from an earlier relationship. Becker et al. (1977) argue that stepchildren may constitute negative capital to the marriage and hence should tend to be a destabilizing factor of the marriage. This hypothesis is confirmed in a number of studies (see e.g. White & Booth (1985)). In our data, the divorce rate for marriages with stepchildren is 24.6% and 15.1% for marriages with no stepchildren.

4 Empirical model

We are interested in the causal effect of children on the exit rate out of marriages. Since both the process that leads to births and the process that leads to divorce are dynamic by nature, we follow the econometric approach described in Lillard (1993) and Lillard & Waite (1993) and model the two processes by a bivariate duration model. In these models, it is claimed that in order to identify the causal effect, either functional form assumptions or identifying restrictions are required. Recently, Abbring & van den Berg (2003) prove that the causal effect actually can be identified in the types of models considered in this paper without relying on either functional form assumptions or identifying restrictions. In addition Abbring & van den Berg (2003) show that the causal effect is identified even if the data set only contains single-spells of observations for a given individual. This feature of the method improves the interpretation of the empirical model, as we will discuss below. Next, we present the finer details of the econometric approach, which is labeled the timing-of-events method. In the process, we borrow heavily from Abbring & van den Berg (2003).

4.1 Timing-of-events method

The timing-of-events method enables us to identify the causal effect of children on the divorce rate under some well-defined assumptions which we return to below. The estimation strategy requires simultaneous modelling of the transition from marriages and the birth hazard. Let $T_{m(arriage)}$ and $T_{b(irth)}$ denote the two continuous nonnegative random variables. We assume that all individual differences in the joint distribution of the processes can be characterized by observed explanatory variables, x, and unobserved variables, v. The arrival of a(nother) child and the exit rate out of marriage are characterized by the moments at which they occur, and we are interested in the effect of the realization of T_b on the distribution of T_m. The distributions of the random variables are expressed in terms of their hazard rates $h_b(t|x,v)$ and $h_m(t|t_b,x,v)$.[5] Conditional on x and v, we can therefore ascertain that the realization of T_b affects the shape of the hazard of T_m from t_b onwards in a deterministic way. This independence assumption implies that the causal effect is captured by the effect of t_b on $h_m(t|t_b,x,v)$ for $t > t_b$. This rules out that t_b affects $h_m(t|t_b,x,v)$ for $t \leq t_b$, i.e. this implies that anticipation of the birth has no effect on the marriage hazard. This assumption is clearly a bit strong in the context of births, since births normally are announced around 9 months prior to delivery. However, as noted by Abbring & van den Berg (2003), the time span between the moment at which the anticipation occurs and the moment of the actual delivery is short relative to the duration of marriages which implies that the potential bias in the effect of children on the marriage hazard presumably is rather small. Furthermore, the assumption of imperfect anticipation can be justified in the case of births since it usually takes some time to concieve, unplanned children are born despite modern contraceptive possibilities or couples may have fertility problems.

Given the independence and no anticipation assumptions, the causal effect of chil-

[5] The hazard rate is defined as the rate at which individuals leave the current stage:

$$h\left(t|x,v\right) = \lim_{dt \to 0} \frac{\mathbf{P}\left(t < T \leq t + dt | T > t, x, v\right)}{dt}.$$

dren on the hazard out of marriage is identified by a mixed proportional hazard model. That is, it is a product of a function of time spent in the given event (the baseline hazard), a function of observed time-varying characteristics, x_t, and a function of unobserved characteristics, v

$$h\left(t|x_t, v\right) = \lambda\left(t\right) \cdot \varphi\left(x_t, v\right), \tag{1}$$

where $\lambda\left(t\right)$ is the baseline hazard and $\varphi\left(x_t, v\right)$ is the scaling function specified as $exp(\beta' x_t + v)$. More specifically the system of equations is:[6]

$$h_b(t|x_{b,t}, v_b) = \exp(\beta_b' x_{b,t} + \lambda_b(t) + v_b) \tag{2}$$

$$h_m(t|t_b, x_{m,t}, v_m) = \exp(\beta_m' x_{m,t} + \delta D(t_b) + \lambda_m(t) + v_m), \tag{3}$$

where $D(t_b) := (D_1(t_b), D_2(t_b), D_3(t_b))$ is a vector of time-varying indicator variables. $D_1(t_b)$ is 0 until the first birth in the current marriage, hereafter it takes the value 1. $D_2(t_b)$ is 0 until the second birth in the current marriage, hereafter it takes the value 1. $D_3(t_b)$ is 0 until the third birth in the current marriage, hereafter it takes the value 1.

The timing-of-events method provides identification on single-spell data. That is, the data set does not need to contain multiple spells of either fertility or marriage to identify the correlation between the two processes. This is a remarkable improvement compared to earlier models. In Lillard & Waite (1993), it is assumed that the unobserved components, v_b and v_m, are specific to each individual. This implies that the unobserved component in the divorce hazard has a given value independent of the current partner. A woman marrying her *soulmate* has, based on the unobservables, the same risk of facing a divorce if she had married an observational equivalent person, but with a completely different personality. The timing-of-event method enables us to discard this harsh restriction on the unobservable components. Instead we assume that the unobserved components, v_b and v_m, are specific to each couple. In terms of the birth hazard this implies that v_b captures the persistent difference in the conception hazard across a given couple's birth intervals.

[6] See Abbring & van den Berg (2003) for technical details.

Intuitively, the timing-of-events method uses variation in marriage duration and in duration until birth (conditional on observed characteristics) to identify the unobserved heterogeneity distribution.

4.2 Likelihood function

Since we only observe the transitions on a yearly basis, we specify a model for grouped duration data (see e.g. Kiefer (1990)). The duration T_e, $e = b, m$ is observed to lie in one of K_e intervals, with the k_e'th interval being $(t_{k-1,e}; t_{k,e}]$ and the convention $t_0 = 0$ for $k_e = 1, ..., 15$. The probability that the duration T_e for an individual with explanatory variables $x_{e,t}$ and unobserved characteristics v_e is greater than $t_{k,e}$ given that the duration is greater than $t_{k-1,e}$ is given by:

$$P(T_e > t_{k,e} | T_e > t_{k-1,e}, x_{k,e}, v_e) \quad = \exp\left[- \int_{t_{k-1,e}}^{t_{k,e}} h_e(t | x_{e,t}, v_e) dt \right] \tag{4}$$

where $\Lambda_{e,k_e} = \int_{t_{k-1,e}}^{t_{k,e}} \lambda_e(t) dt$. The interval-specific survivor expression (4) is henceforth denoted α_{e,k_e}. The probability of observing a given event in interval k_e, conditional on survival until $T_e > t_{k-1,e}$, is consequently $1 - \alpha_{e,k_e}$. If we do not specify a functional form for the baseline hazard within the interval, the $\Lambda_{k,e}$s are just parameters to be estimated.

Given that the observed covariates are time-invariant within intervals (i.e. years), we can now express the interval-specific survivor probabilities as

$$\alpha_{m,k_m} = \exp\left[- \exp\left[\beta_m' x_{m,k_m} + \delta D(t_b) + v_m \right] \cdot \Lambda_{m,k_m} \right]$$

and

$$\alpha_{b,k_b} = \exp\left[- \exp\left[\beta_b' x_{b,k_b} + v_b \right] \cdot \Lambda_{b,k_b} \right]$$

Notice, that $\Lambda = \int_{t_{k-1}}^{t_k} \exp(\lambda_i(t)) dt$ is simply estimated as the average baseline hazard in the given interval.

First, notice that each marriage contributes to the likelihood function as long as the marriage is intact. The contribution to the likelihood function from the marriage duration alone is therefore

$$\mathcal{L}_m = (1 - \alpha_{m,k_m})^{j_m} \alpha_{m,k_m}^{1-j_m} \prod_{l_m=1}^{k_m-1} \alpha_{m,l_m}, \tag{5}$$

where $j_m = 1$ if the marriage is not right censored and 0 otherwise. Uncompleted durations therefore only contribute with the survivor probabilities. The interval indicator here runs monotonically from 1 up to the end of the marriage or is right censored at k_m. Concerning the birth events, things are a bit different because multiple events can occur during a given marriage. The interval indicator now runs from 1 to k_b and then back to 1 if a birth occurs. If the marriage ends, so does the observation of births within the marriage. In sum, the contribution for a given marriage is then $(1 - \alpha_{b,k_b})$ in intervals with births and α_{b,k_b} in intervals without births. Let the indicator variable, j_b, take the value 1 if a birth occurs in a given interval and 0 otherwise. Consequently, the interval indicator is reset at 1 in the interval following $j_b = 1$. The contribution to the likelihood function from the birth events alone is then

$$\mathcal{L}_b = \prod_{l_b=1}^{k_m} (1 - \alpha_{b,k_b})^{j_b} \left(\alpha_{b,l_b}\right)^{1-j_b}. \tag{6}$$

Combining the two expressions yield the full likelihood function

$$\mathcal{L} = \int \int \mathcal{L}_m \mathcal{L}_b dG(v_m, v_b),$$

where $G(v_m, v_b)$ is the joint distribution of the unobserved heterogeneity components. In the present application, we impose two restrictions on $G(\cdot)$:

A1: Each of the v_i, $i = m, b$ follows a discrete distribution with two points of support, v_i^1 and v_i^2.

A2: v^b and v^m are perfectly correlated.[7]

[7] Theoretically, it is not required that the correlation structure is assumed to be perfect. However,

We normalize one of the support points in each of the cause-specific hazard functions to zero, since the baseline hazard acts as a constant term. The second assumption restricts the correlation between the unobservables in the two hazard functions to be either -1 or 1.

5 Empirical findings

In this section, the empirical results are presented. Our main interest is the association between children and the divorce rate. In Table 4, we present the results from two different models. In the first model, we follow the reduced-form literature and estimate the fertility and divorce equations separately, in the second model we consider the two equations simultaneously. We only present the coefficients for the child variables in Table 4. Besides these variables, we condition on a long range of other covariates. The choice of covariates is based on what is usually applied in the fertility model literature (see e.g. Heckman & Walker (1990)) and the divorce model literature (see e.g. Svarer (2004)).[8] The complete set of results can be found in Appendix 1.

empirically it is much easier to identify a more restricted correlation structure. As shown in e.g. Rosholm & Svarer (2001), this crucially depends on the amount of multiple observations per individual. In our sample very few individuals experience more than 1 marriage, therefore we restrict the correlation structure from the outset.

[8]Since the timing-of-events method does not require exclusionary restrictions on observed characteristics to identify the causal effect of children, we include the same covariates in the fertility and divorce equation. This implies that the identified effect of children on the divorce risk is not driven by instrumental variables. For summary statistics of the included explanatory variables see Table 5 in Appendix 1.

Table 4: Effect of children on fertility and divorce[9]

	Reduced-form model		Structural model	
	Fertility	Divorce	Fertility	Divorce
In marriage				
First child	-0.4386^a	-0.4078^a	-0.9171^a	0.8688^a
	0.0264	*0.0679*	*0.0320*	*0.1693*
Second child	-1.1459^a	-0.2172^a	-1.2640^a	0.1623
	0.0485	*0.0934*	*0.0536*	*0.1090*
Third or later child	0.0266	-0.8727^a	0.0703	-0.7013^a
	0.1149	*0.2750*	*0.1023*	*0.2765*
Before marriage				
Stepchildren	-0.2759^a	0.4593^a	-0.3288^a	0.5449^a
	0.0348	*0.0728*	*0.0398*	*0.0852*
Premarital birth	-0.6437^a	0.0658	-0.7992^a	0.3419^a
	0.0292	*0.0709*	*0.0369*	*0.0839*
v_b^2				-2.6798^a
				0.1598
v_m^2				2.1492^a
				0.2097
$P(v_b = v_b^2, v_m = v_m^2)$				0.8056^a
				0.0828
Number of observations		7327		

Note: Asymptotic standard errors are in italics.
^{a} significant at 5%, ^{b} significant at 10%.

A postive coefficient implies a positive effect on the hazard rate out of marriages. The inclusion of birth order indicators in the fertility model (first, second and third births) identifies the marginal effect of a given birth on the duration until the next birth (hence, they are to be added to get the total effect). Hence, the finding of a negative effect of the first and second births in the reduced-form model indicates that the likelihood of a second or third order birth is lower than that of the first birth, which

[9]The results in this table are from a single-spell specification. We also ran a multiple-spell specification a long the lines of Lillard & Waite (1993). The qualitative results did not change. This confims that single-spell data is sufficient for identification. The results from the multiple-spell version are available upon request.

is perfectly consistent with the distribution of children in the sample. The coefficient of the indicators of third and higher order births is positive but insignificant, and this result presumably is due to the low incidence of higher order births in our sample. Both the presence of stepchildren and a premarital birth decrease the fertility hazard. In the divorce hazard, all three child indicators have highly significant negative marginal effects and the order of magnitude reflects that the birth of the second child stabilizes more than the first birth and that the third birth is even more stabilizing. Hence, according to the simple specification the prediction is quite clear: Children have a stabilizing effect on marriages. However, the potential endogeneity of the fertility decision is not taken into account in this specification and if the child indicators are endogenous, the coefficient estimates are likely to be biased.

The results from the structural model in which the two processes are modelled simultaneously reveal that the specification of the model is crucial to the conclusion of the impact of children on divorce behavior. In the fertility equation, the two first birth order indicators decrease the likelihood of another child. For the third birth, however, no significant effect is found for higher order births. These qualitative results are in line with the results of the separate fertility model, though the effects are stronger in the joint model. What is more remarkable is that the results for the divorce hazard change considerably. In the structural model, we find that the effect of the birth indicator for the first birth is positive, the effect of a second birth is insignificant, hence the total positive effect remains after a second birth. The marginal effect of a third birth is significant and very negative, resulting in a net effect which is negative.

The coefficient of the stepchild indicator is positive indicating that the presence of stepchildren is bad for the marriage, which is also the case for premarital births[10].

[10]Premarital births could - when they are children of the married couple - be endogenized by considering the complete duration of the relationsship instead of just the period when the couple is married. As discussed in Section 3 we choose to exclude time spend cohabiting due to misclassification in the data. Premarital cohabitaion is however a big issue in the Danish marriage market - 78% of the marriages in this analysis began as cohabitation. Likewise, a substantial number of children were born when the couple cohabited, but before they married. We have estimated the model including the co-

These results are in line with other studies in the literature.

In the joint specification of the model, the correlation between the unobservables is estimated to be negative. This means that marriages, in which the fertility is likely to be high (in terms of unobserved characteristics to the marriage), are less likely to divorce. Together with the results from the observed heterogeneity, this serves to conclude that it is *not* the presence of children as such that tends to stabilize marriages (which is found, when children are not endogenised). Actually, these results indicate that children only stabilize to the extent that couples in good matches choose to have children. When compared to the predictions from economic theory reviewed previously in this paper, our results only partly confirm the theoretical hypotheses posed. The correlation of he unobserved heterogeneity terms confirms the results of Weiss (1997) and Vuri (2001a), namely that couples with a high probability of divorce are less likely to give birth. However, when children *are* born, we do not find clear indications of them being a stabilizing factor, which was predicted by Becker et. al. (1977) and Vuri (2001a). Several factors could attribute to this finding. These are discussed below.

5.1 Child benefits and divorce

Recently, Bradshaw & Finch (2002) have compared "child benefit packages" in 22 countries including Denmark, the UK and the US.[11] "Child benefit packages" consist of a range of elements; income tax reductions, social security contributions, cash benefits, housing benefits, childcare cost reductions, education cost reductions, health cost reduc-

habitation period. The results are presented in Table 8 in the appendix. The results show that again there is a negative correlation between the unobserved components of the two processes. In addition, the effect of children on the divorce risk is in line with the results for marriages only. That is, the divorce hazard increases with the arrival of the first (insignficant though) and second child. In sum, the qualitative conclusion is unaffected by the inclusion of premarital cohabitation.

[11] The report is based on figures from 2001 and therefore it does not cover the period we are investigating. Still, we believe it is fruitful to present their findings, since the difference between the countries in terms of the contents of the child benefit packages in 2001 is probably not the worst predictor of the child benefits package in earlier time periods.

tions, maternity leave programs and social assistance. In some countries the different elements are means-tested and in others related to household composition which makes the comparison somewhat difficult. However, some interesting patterns are visible in the comparison. We will focus on two aspects. First, we consider the economic impact of a transition from being in a relationship to becoming a lone parent. In Bradshaw & Finch (2002, table 9.9b, p. 149), there is a comparison of the child benefit package for a lone parent and couples with the same earnings after tax and cash benefits. The figures reveal the difference in the amount of money a lone parent with 2 children receives due to the child benefit package compared to a couple with 2 children. For a household that have half average male earnings the lone parent in Denmark receives an additional £130 per month (PPP adjusted) than a couple with the same earnings. In contrast there is no difference in child benefit payments in the UK between the two family types, and in the US the lone parent receives £91 per month (PPP adjusted) less than the couple. These numbers suggest[12] that, other things being equal, the economic disincentives to become a lone parent are smaller in Denmark, which is in line with the results reported previously concerning the effect of children on divorce. Second, Bradshaw & Finch (2002, figure 11.10, p. 180) compare the relationship between the prevalence of lone parents and the level of the child benefit package paid to lone parents. There is a slight tendency for countries with higher proportions of lone parents to have higher child benefits. The relationship is, however, not very close – the coefficient of correlation is 0.06. In addition, it is of course very difficult to interpret whether this relationship is due to more care about lone parents in countries with higher incidence of lone parenthood or whether lone parent families are generated by the generous child benefits.

[12] A big note of caution is appropriate here. There are, of course, other economic consequences related to the transition out of marriage like tax exemptions and the size of alimony which are not considered here.

5.2 Labour force participation and divorce

Childcare facilities are readily available in Denmark. OECD (2001) presents data showing that in 1998 91% of pre-school children in Denmark attended formal child-care arrangements. The numbers for the UK and the US were 60% and 74%, respectively. In accordance, the labour force participation of mothers to young children is much higher in Denmark compared to other countries. Ejrnæs et. al. (2002) show that more than 70% of all mothers to pre-school children are active in the labour market and that this high participation rate has persisted since the early 1980s. In comparison, OECD (2001) find that in the US the participation rate for mothers of pre-school children was 61.5% in 1998 rising from 54% in 1989, and in the UK it was 55.8% in 1998 rising from 42.7% in 1989. The fact that Danish women are more active on the labour market also makes them more economic independent of the husbands. In the divorce literature, it is commonly found that higher wages for women are correlated with higher divorce risk (see. e.g. Weiss & Willis (1997) and Burgess et al. (1997)). Burgess et al. (1997) refer to a *self-reliance* effect for women to explain the result.

In sum, the institutional setup in Denmark is providing more favorable conditions for women with young children that decide to divorce their current spouse. Whether this is the main reason for the difference between the results in this paper and the results found in Vuri (2001b) is of course hard to determine. Nevertheless, the different institutional settings provide a plausible explanation for the deviations. In addition, the data presented above suggest that in terms of labour force participation of mothers of pre-school children, an increasing proportion of mothers are becoming active in the labour market. OECD (2001) provides numbers showing that rising labour force participation rates are found in almost all OECD countries. The increasing labour force participation of women might alter the effect of children on divorce in other countries as well.

5.3 Children and marital satisfaction

As discussed in Section 2 psychologists have suggested that children affect marital satisfaction through various channels. These all point in the same direction suggesting that the arrival of children into the household is followed by a number of challenges to the couple. With an eye to these studies the results found in this paper are not too surprising. Especially the combination of a high female labour force participation, the conflicts arising because of the reorganization of social roles in the family and the resriction of freedom of mothers may lead to a higher divorce rate for Danish couples with children than observed in other countries. Furthermore, the relatively generous child benefits schemes for lone parents combined with the economic dependent Danish women may increase the likelihood of actually divorcing.

6 Concluding remarks

The purpose of this paper is to analyze the relationship between fertility behavior and the process of marriage duration in order to investigate whether children born to a couple stabilize their relationship. The analysis is based on Danish register data. The potential endogeneity of fertility on marriage behavior is taken into account by modeling fertility and divorce jointly. We use the "timing-of-event" method (Abbring & van den Berg (2003)) to identify the causal effect of births on the divorce hazard.

The results presented in this paper show that couples that are less prone to divorce are more prone to invest in children, and therefore children tend to stabilize marriages. However, when correcting for this selection effect, children in themselves do not have a positive effect on marriage duration.

In sum, the results in this article confirm what papers in the more structural-oriented literature on the effect of children on divorce have found, namely, that the two processes should not be considered independently. When they are considered independently, as in the more reduced-form part of the literature, the estimated effects are likely to be

biased. This may explain why different results are found in different applications. Still, the findings in this paper suggest, that endogenizing fertility is not sufficient to align results. We present cross-country data showing that Danish mothers of pre-school children – compared to mothers of pre-school children in other OECD countries – have more favorable conditions in terms of child benefits and labour force participation in case they decide to divorce their present spouse. In addition, the development in e.g. labour force participation of mothers to young children in other OECD contries in the last decade shows that there is a marked increase in labour force participation in almost all countries. If this development continues and reaches the level of Danish mothers, it could also affect the effect of children on divorce risk in those countries.

In future research it would be fruitful to include more information about the characteristics of the different countries in terms of child-related attributes; child allowances, day-care facilities, economic conditions for lone-parents etc. in order to shed more light on what causes the different results on the effect of children on divorce. On the theoretical side it is clear that the results in this paper suggest that the theoretical models on the effect of children on divorce risk could benefit from more elaboration perhaps inspired by the psychology literature.

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Appendix 1

Table 5: Sample characteristics

	Mean	Standard deviation
Children		
Stepchildren	0.1932	0.3948
Premarital birth to the couple	0.3214	0.4670
Cohabitation		
Couple has cohabited	0.7831	0.4121
Duration of cohabitation	2.8172	2.7730
Wife's education		
Vocational	0.4634	0.4987
Short	0.1197	0.3246
Medium	0.0861	0.2805
Long	0.0523	0.2227
Husband more educated	0.2828	0.4504
Couple has same degree of eduation	0.4663	0.4989
Income (in 1980 DKK)		
Wife's income	0.7836	0.3268
Husband's income	1.1191	0.5918
Age		
Wife between 15-20	0.3966	0.4892
Wife between 21-25	0.4278	0.4943
Wife between 26-30	0.1339	0.3406
Husband between 15-20	0.2154	0.4112
Husband between 21-25	0.4608	0.4985
Husband between 26-30	0.2247	0.4174
Wife more than 4 years older	0.0315	0.1747
Husband more than 4 years older	0.2303	0.4211
Sickness and unemployment		
Sickness, wife	0.1779	0.3850
Sickness, husband	0.1247	0.3314
Unemployment degree, wife	0.1268	0.2368
Unemployment degree, husband	0.0712	0.1767
Other characteristics		
Work for same employer	0.0998	0.2998
Province	0.6312	0.2332
Number of divorces	1298	
Number of observations	7327	

Table 6: Results from the Reduced-form model

	Fertiliy hazard		Divorce hazard	
	Coeff.	Std dev.	Coeff.	Std dev.
Children				
First child this marriage	**-0.4492**	0.0278	**-0.4063**	0.0686
Second child this marriage	**-1.1472**	0.0536	**-0.2153**	0.0942
Third or later child this marriage	0.0632	0.1033	**-0.7635**	0.2773
Stepchildren	**-0.2548**	0.0352	**0.4744**	0.0727
Premarital birth to the couple	**-0.5879**	0.0332	0.0682	0.0715
Cohabitation				
Couple has cohabited	0.0361	0.0298	**-0.2093**	0.0798
Duration of cohabitation	**-0.0284**	0.0067	**-0.1161**	0.0215
Wife's education				
Vocational	**0.1177**	0.0305	**-0.4538**	0.0756
Short	**0.2096**	0.0437	**-0.5241**	0.1242
Medium	**0.2818**	0.0454	**-0.4344**	0.1303
Long	**0.2549**	0.0558	**-0.5715**	0.1680
Husband more educated	**0.0897**	0.0343	**-0.4243**	0.0977
Couple has same degree of eduation	0.0137	0.0291	-0.0641	0.0786
Income (in 1980 DKK)				
Wife's income	**0.1163**	0.0369	**0.3482**	0.0910
Husband's income	0.0335	0.0219	**0.1008**	0.0516
Age				
Wife between 15-20	**0.8650**	0.0807	**0.3939**	0.1710
Wife between 21-25	**0.8453**	0.0708	**0.3150**	0.1351
Wife between 26-30	**0.6131**	0.0671	0.0913	0.1196
Husband between 15-20	**0.2390**	0.0703	**0.5295**	0.1744
Husband between 21-25	**0.2594**	0.0514	**0.2714**	0.1232
Husband between 26-30	**0.3013**	0.0420	**0.2002**	0.0937
Wife more than 4 years older	**-0.2185**	0.0849	0.1759	0.1701
Husband more than 4 years older	-0.0063	0.0346	**0.2346**	0.0889
Sickness and unemployment				
Sickness, wife	**-0.1045**	0.0317	0.1132	0.0720
Sickness, husband	**-0.1406**	0.0372	**0.2221**	0.0786
Unemployment degree, wife	**0.1920**	0.0469	**0.2826**	0.1109
Unemployment degree, husband	-0.1009	0.0736	**0.9528**	0.1385
Other characteristics				
Work for same employer	0.0662	0.0362	**0.2327**	0.0834
Province	**0.1427**	0.0239	**-0.2530**	0.0600
Number of observations	7327			

Note: Bold figures indicate significant different from 0 at 5% level.

Table 7: Results from the Structural Model

	Fertiliy hazard		Divorce hazard	
	Coeff.	Std dev.	Coeff.	Std dev.
Children				
First child this marriage	**-0.9171**	0.0320	**0.8688**	0.1693
Second child this marriage	**-1.2640**	0.0536	0.1623	0.1090
Third or later child this marriage	0.0703	0.1023	**-0.7013**	0.2765
Stepchildren	**-0.3288**	0.0398	**0.5449**	0.0805
Premarital birth to the couple	**-0.7992**	0.0369	**0.3419**	0.0839
Cohabitation				
Couple has cohabited	0.0478	0.0348	**-0.2453**	0.0852
Duration of cohabitation	**-0.0310**	0.0077	**-0.1188**	0.0227
Wife's education				
Vocational	0.0566	0.0342	**-0.4146**	0.0798
Short	**0.1406**	0.0495	**-0.4979**	0.1304
Medium	**0.2380**	0.0511	**-0.4628**	0.1379
Long	**0.2410**	0.0673	**-0.5488**	0.1761
Husband more educated	0.0499	0.0390	**-0.4478**	0.1039
Couple has same degree of eduation	0.0057	0.0334	-0.0950	0.0829
Income (in 1980 DKK)				
Wife's income	**0.1114**	0.0436	**0.3399**	0.0958
Husband's income	**0.0604**	0.0252	0.0746	0.0572
Age				
Wife between 15-20	**0.8178**	0.0849	0.3297	0.1760
Wife between 21-25	**0.8660**	0.0729	0.2109	0.1407
Wife between 26-30	**0.6640**	0.0667	-0.0311	0.1234
Husband between 15-20	**0.1715**	0.0759	**0.5820**	0.1802
Husband between 21-25	**0.2135**	0.0559	**0.3117**	0.1257
Husband between 26-30	**0.3070**	0.0439	**0.2010**	0.0964
Wife more than 4 years older	**-0.3034**	0.0885	0.2501	0.2032
Husband more than 4 years older	0.0011	0.0395	**0.2296**	0.0924
Sickness and unemployment				
Sickness, wife	-0.0108	0.0329	0.0429	0.0723
Sickness, husband	-0.0791	0.0393	**0.1834**	0.0802
Unemployment degree, wife	**0.2391**	0.0489	**0.2692**	0.1147
Unemployment degree, husband	-0.0802	0.0767	**0.9330**	0.1429
Other characteristics				
Work for same employer	**0.0977**	0.0381	**0.1881**	0.0857
Province	**0.1308**	0.0270	**-0.2644**	0.0630
v_2^b			**-2.6798**	0.1598
v_2^m			**2.1492**	0.2097
$P(v^b = v_2^b, v^m = v_2^m)$			**0.8014**	0.0686
Number of observations		7327		

Note: Bold figures indicate significant different from 0 at 5% level.

Table 8: Results from the Structural Model - cohabitation and marriage

	Fertiliy hazard		Divorce hazard	
	Coeff.	Std dev.	Coeff.	Std dev.
Children				
First child this marriage	**-0,2409**	0,0266	0,0580	0,0611
Second child this marriage	**-1,4018**	0,0352	**0,1692**	0,0683
Third or later child this marriage	**-3,1911**	0,4635	-0,0561	0,1377
Stepchildren	**-0,1751**	0,0145	**0,1448**	0,0171
Wife's education				
Vocational	**-0,0959**	0,0243	**-0,1675**	0,0328
Short	**-0,0754**	0,0366	**-0,2279**	0,0516
Medium	0,0627	0,0391	**-0,2951**	0,0583
Long	**-0,1729**	0,0476	-0,0563	0,0627
Husband more educated	-0,0488	0,0289	**-0,2053**	0,0407
Couple has same degree of eduation	0,0227	0,0241	**-0,1394**	0,0333
Income (in 1980 DKK)				
Wife's income	**0,2956**	0,0281	**-0,1957**	0.0399
Husband's income	**0,1252**	0,0138	**-0,2751**	0.0260
Age				
Wife between 15-20	**0,4791**	0.0601	**0.1836**	0.0789
Wife between 21-25	**0,8286**	0.0518	-0.0022	0.0675
Wife between 26-30	**0,7666**	0,0484	**-0,1735**	0,0616
Husband between 15-20	**-0,2536**	0,0511	**0,1740**	0,0708
Husband between 21-25	0,0704	0,0390	**0,1248**	0,0565
Husband between 26-30	**0,2049**	0,0319	0,0542	0,0469
Wife more than 4 years older	**-0,2461**	0,0539	**0,4229**	0,0682
Husband more than 4 years older	-0,0378	0,0273	**0,1891**	0,0387
Sickness and unemployment				
Sickness, wife	**0,1329**	0,0223	0,0452	0,0321
Sickness, husband	0,0039	0,0257	0,0455	0,0338
Unemployment degree, wife	**0,3348**	0,0329	**0,2253**	0,0467
Unemployment degree, husband	0,0651	0,0437	**0,5461**	0,0521
Other characteristics				
Work for same employer	**0,1139**	0,0260	0,0336	0,0339
Province	**0,1770**	0,0194	**-0,3082**	0,0262
v_2^b			**-1.8095**	0.0782
v_2^m			**1.4291**	0.1028
$P(v^b = v_2^b, v^m = v_2^m)$			**0.3714**	0.0762
Number of observations		19471		

Note: Bold figures indicate significant different from 0 at 5% level.