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Sin City?

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Abstract

Is moving to the countryside a credible commitment device for couples? We investigate whether lowering the arrival rate of potential alternative partners by moving to a less populated area lowers the dissolution risk for a sample of Danish couples. We find that of the couples who married in the city, the ones who stay in the city have significant higher divorce rates. Similarly, for the couples who married outside the city, the ones who move to the city are more likely to divorce. This correlation can be explained by both a causal and a sorting effect. We disentangle them by using the timing-of-events approach. In addition we use information on father's location as an instrument. We find that the sorting effect dominates. Moving to the countryside is therefore not a cheap way to prolong relationships.

Keywords: Dissolution, search, mobility, city.

Classification-JEL: J12, J64

1 Introduction

We give evidence that of the marriages that are formed in the city, those who remain in the city have a higher divorce rate than the ones who move out. Likewise, the couples who

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marry in the countryside but move to the city are more likely to divorce than the ones who stay in the countryside. The main question we want to address in this paper is whether this correlation reflects a causal link. In Gautier et al. (2005) we give evidence that cities serve as a marriage market. The basic idea is that the rate at which singles meet potential partners is higher in the city either because of a size-of-the-market effect or because cities are more densely populated. Therefore, singles (in particular the most attractive ones) will exploit this and move to the city. The same observation suggests that leaving the city can be used as a credible commitment device for couples to stabilize their relationship. By moving to the countryside, the number of outside offers decreases for both partners which on its turn decreases the value of continued search while married. This is consistent with the fact that couples have a larger probability to leave the city, even those who never have kids. Alternatively, if relatively unstable relationships sort themselves in the city then we also observe a higher divorce rate in cities but then there is no causal link. One possible story that is consistent with sorting is that stable marriages are more likely to want kids and are more likely to buy a house, see Svarer and Verner (2006) for evidence. Since kids require more space and since there is more home ownership outside the city we find a large proportion of the stable marriages outside the city. Another possibility is that living in a remote area is attractive because of the low land prices but it also implies that one has to spend a large fraction of time together with one's partner and this requires a stable relationship.

We apply the timing-of-event methodology (Abbring and van den Berg, 2003) to distinguish the causal effect of living in a city on the divorce rate from the correlation-through-unobservables effect. In addition, we conduct an instrumental variable analysis using information on father's location as exclusionary restriction. The assumption is that father's location affects moving decisions but not the stability of a marriage. Our results suggest that the sorting effect dominates. There is no significant causal effect of living in the city on the divorce probability.

The paper is organized as follows, first we discuss some literature on endogenous separations and commitment in section 2. In section 3 we discuss the data and our empirical strategy. Section 4 contains our empirical results and section 5 concludes.

2 Theoretical background

2.1 Separations

Point of departure is the separations model of Burdett et al. (2004). We briefly discuss this model and the possible equilibria and then we discuss how various forms of commitment may help to select the most favorable equilibria and increase expected marriage duration. In the simplest version of the separations model, agents are ex ante identical and meet other agents at rate α while exogenous separations occur at rate σ. The quality of a marriage is a random variable that can take two values. With probability π, a potential marriage is good (G) and with probability $(1-\pi)$, the marriage is bad (B). In order to enter a new relationship, agents must leave their old partners. Agents can be in three possible states: N_G (good marriage), N_B (bad marriage), and N_S (single) where $N_G+N_B+N_S=1$ and the payoff of each state N_i is V_i. Let P_B and P_G be the probabilities of accepting respectively a good and a bad marriage and let S_B and S_G be indicator variables which equal one when agents search in respectively good and bad marriages and zero if they do not search. The cost of "searching on the job" are equal to K. P_i and S_i are chosen in equilibrium. Specifically, all agents choose p_i and s_i but since we only consider symmetric equilibria, $p_i = P_i$ and $s_i = S_i$. Burdett et al. (2004) show that depending on the parameter variables, five types of symmetric pure strategy equilibria exist. The conditions can be calculated straightforwardly by considering every possible strategy profile and deriving the implied parameter configurations for which the imposed strategy profile is an equilibrium. Rather then repeating this exercise we qualitatively state what those conditions are and refer for the exact expressions to their paper.

1. Type D (degenerate), $P_B = P_G = 0$ (if utility of single > utility of marriage)

2. Type C (choosy), $P_B = 0, P_G = 1, S_G = 0$ (if utility of a good marriage is sufficiently high and utility of a bad marriage is sufficiently low)

3. Type F (faithful), $P_B = 1, P_G = 1, S_G = S_B = 0$ (if utility of both the good and bad marriages are sufficiently high and the payoffs of search on the job are sufficiently low)

4. Type U (unfaithful), $P_B = 1, P_G = 1, S_G = 0, S_B = 1$ (if utility of both the good

and bad marriages are sufficiently high and the payoffs of search on the job are sufficiently high)

5. Type P (perverse), $P_B = 1, P_G = 1, S_G = 1, S_B = 0$ (if utility of both the good and bad marriages are sufficiently high but their difference is sufficiently small and the payoffs of search on the job are sufficiently high).

There is no equilibrium where everybody continues searching (all S_i and P_i are 1) because if $S_B = 1$ good marriages will never separate because a good marriage strictly dominates a bad marriage. The P equilibrium is one of "self-fulfilling beliefs". I.e. if there is no difference between good and bad marriages, then if everybody belief that their partner searches in G-marriages this becomes an equilibrium. Even if $G-$marriages are slightly better, this common belief equilibrium can survive. It is easy to see that the P-equilibrium is never efficient. Burdett et al. (2004) show that under certain parameter configurations, the U equilibrium is efficient. If this is the case, the market will also select this equilibrium. Under alternative configurations, the F equilibrium is the most efficient one but in that case, the market may still select the inefficient U equilibrium. If search cost, K are sufficiently high, equilibria U and P no longer exist. Note that this can be welfare improving for the agents.

2.2 Commitment

For the configurations where the F equilibrium is most efficient but where also the U and the P equilibria exist, agents have incentives to engage in relationship-specific capital: investments that have a higher value inside than outside the relationship. Relationship-specific capital increases the value of the relationship, V_G, relative to the value of the other states, V_B and V_N. Examples of relationship-specific capital include home ownership (see e.g. Sullivan (1995)) and having kids [1] (see e.g. Becker et al. (1977) and Svarer and Verner (2006)), both increase the cost of divorce. In addition the act of getting formally married rather than cohabiting constitutes increased commitment. The sociological literature (see. e.g. Bennett et al. (1988) and Forste (2002)) suggests that lack of permanence and commitment between partners are primary features distinguishing cohabitation from

[1] Note that we allow kids to decrease V_G, but we assume that they reduce the value of the other states even more.

marriage[2]. If the outcome of the aging process is a random variable this can potentially also destabilize marriages if for one of the partners the outcome of this process is more favorable than for the other, see Masters (2005). He suggests a different form of commitment that we do not take into account namely that the more attractive aging partner voluntarily becomes less attractive (i.e. by increasing weight) in order to stabilize the relationship. This is however a costly commitment. Cornelius (2003) also studies divorces in a model where good and bad marriage partners form matches and decide whether or not to continue search but in her model, good marriages never dissolve. Finally, Chiappori et al. (2005) considers a marriage market with transferable utility. Since there is continuous renegotiation possible, inefficient separations do not occur and there are therefore less incentives to invest in commitment.

The form of commitment that we focus on in this paper is that agents can choose to reduce α and or increase K by moving to a less efficient search market like a rural area. This could also increases the set of parameter configurations for which the faithful, F, equilibrium occurs and can eliminate the perverse equilibrium.

To see this, consider two types of markets, cities (C) and rural areas (R) and assume that the contact rate is higher in the city than in a rural area: $\alpha_C > \alpha_R$. In that case, equilibria U and P may exist in the city but if α_R is sufficiently small, they will not exist in rural areas.

If there are only exogenous reasons for couples to stay in the city, irrespective of their marriage quality, i.e. labor market considerations, strong preferences for theatres etc. then we could identify the pure city effect in the divorce hazard. However, given that $\alpha_C > \alpha_R$, good marriages are, conditional on their preferences for the city amenities, more likely to leave the city than bad marriages because they are willing to pay a higher price in order to avoid a divorce[3]. Moreover, there may exist an interaction between some forms of relation specific capital and preferences for the country side. I.e. stable

[2] Premarital cohabitation is widely used in Denmark (as well as in the other Scandinavian countries). In the current data set around 78% of the couples who marry lived together before marriage. The occurance of cohabitation is also increasing substantially in other countries. In the U.S. the number of cohabiting couples has increased from 1.1 million in 1977 to 4.9 million in 1997 (see e.g. Svarer (2004) for more details on the development in cohabitation in the Western world).

[3] Drewinka (2005) discusses complementarities in relation specific investments. This bears close resemblance to the investment model in psychology, see Rusbult (1980).

relationships are more likely to move to remote areas. Therefore, a lower divorce rate in rural areas can just reflect a correlation of unobservable characteristics and location choice. In general, good marriages will only invest more in relation specific capital than bad marriages if they actually do stabilize the marriage. In the next section, we test how marriage durations respond to living in the city and we disentangle the commitment effect of living in the countryside from the sorting effect with the timing-of-events method in combination with IV.

3 Data and empirical model

The data that we use to test the main implications of the model 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 conditions 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 on the marriage market on an annual basis. In addition we have information about current geographical location. This implies that we observe an individual's mobility pattern on an annual basis. If the individual enters a relationship we also observe the personal characteristics of the partner. Based on the available information we sample all partnerships that are formed during the observation period. That is, we follow much of the duration literature (see e.g. van den Berg (2001)) and base inference on a flow sample of partnership by discarding those partnerships that were formed before 1980. With respect to the movement process we set the clock at zero at the moment of marriage.

We divide Denmark into two regions: cities and rural areas. In the main part of this paper we only include Copenhagen, the most dense area in Denmark which hosts 12.7 % of the population in 1995, in the city category and the rest of Denmark is considered to be the countryside. We also experiment with different city definitions but this does not change our conclusions. The main explanatory variable in our analysis is thus an indicator variable that takes the value 1 if the individual is currently living in Copenhagen.

Individuals can occupy one of three states in the marriage market: single, cohabiting, or married. Cohabitation as either a prelude to or a substitute of marriage is very common in Denmark (see e.g. Svarer, 2004). There are some qualifications to this definition of marriage. Some of the couples - presumably a small minority - that are registered as cohabiting are simply sharing a housing unit, and do not live together as a married couple.

3.1 Explanatory variables

Our main variable of interest is the city dummy. In addition, we also include three other commitment variables in the analysis. First, we distinguish between couples who are formally married or not by the indicator variable, *marriage*. Second, we consider the housing status of the couple in the sense that we discriminate between *home owners* and those who do not own their own house. Finally, we have an indicator variable, *children 0-6*, for the presence of children between 0 and 6 years old in the household. We report descriptive statistics for these and the additional explanatory variables in Table 2. In Table 1 we present the association measure gamma[4] for the four commitment variables.

TABLE 1
ASSOCIATION MEASURE (GAMMA) OF THE COMMITMENT VARIABLES

	Countryside	Married	Kids 0-6 years old	Homeowner
Countryside	1	0.57*	0.48*	0.71*
Married		1	0.57*	0.47*
Kids 0-6 yrs old			1	0.34*

Note: * denotes significant different from 0 at the 5% level

As Table 1 shows, the association between the four commitment variables suggest they are strong complements. As Drewianka (2005) argues, this is not surprising since each of these features increases the relative value of a relationship and stimulates additional commitment investments.

In addition to the commitment variables we also include a number of additional explanatory variables in the subsequent analysis like dummies for educational attainment.

[4]Gamma is calculated as $\frac{P-Q}{P+Q}$, where P is the number of pairs of the two indicator variables that take the same value (1 and 1 or -1 and -1) whereas Q is the number of pairs that takes opposing values (-1 and 1 or 1 and -1).

Some individuals may still be studying (we observe the current education at the time of observation). The educational variables are therefore also allowed to be time-varying. The reference group has less than high school education. Vocational education refers to individuals that have some sort of practical training, like carpenters etc. The other categories refers to different levels of further education. "Short" represents people who have studied for 14 years, "medium" stands for 16 years of education and "long" for at least 18 years. Next, we use information on gross income. Gross income is measured in 1980 prices and includes both labour and non labour income as well as received unemployment insurance benefits. We also include variables measuring the age of the partners as well as their age difference. The variable, *sickness*, is an indicator variable taking the value 1 if the individual receives sickness benefits during the year. As a general rule sickness benefits are received if a person has a spell of illness for more than 13 weeks. Each individual's degree of unemployment during the year is defined as the number of hours of unemployment divided by the number of potential supplied working hours. Finally, we have an indicator variable that takes the value 1 if the father (data limitations imply that we only observe location of father, not the mother, and we can also not see if they are still together) of at least one of the individuals in a given couple is living in the countryside. This variable works as an exclusionary restriction in the subsequent analysis where we explicitly model the moving decision from the city to the countryside and vice versa. Our conjecture is that having a father currently living in the countryside can have a pull effect on one's location decision but is unrelated to the quality of the marriage.

TABLE 2
DESCRIPTIVE STATISTICS (AT THE BEGINNING OF RELATIONSHIP)

	Couples formed in city		Couples formed in countryside	
	Mean	Std. dev.	Mean	Std. dev.
Commitment variables				
City	1		0	
Married	0.13		0.11	
Homeowner	0.15		0.19	
Kids. 0-6 years old	0.06		0.08	
Kids. 7-17 years old	0.04		0.06	
Father living in countryside	0.65		0.96	
Male's education				
Vocational	0.33		0.52	
Short	0.06		0.05	
Medium	0.10		0.06	
Long	0.14		0.04	
Same level of education	0.70		0.50	
Male more educated	0.15		0.25	
Income (in dkk 1980 level)				
Female income	64,975	(39,435)	56,480	(35,743)
Male income	85,482	(62,555)	87,516	(52,924)
Age				
Female between 15-20	0.54		0.66	
Female between 21-25	0.33		0.23	
Female between 26-30	0.10		0.09	
Male between 15-20	0.38		0.48	
Male between 21-25	0.37		0.31	
Male between 26-30	0.18		0.14	
Female more than 4 years older	0.08		0.06	
Male more than 4 years older	0.25		0.26	
Sickness and unemployment				
Sickness, female	0.08		0.10	
Sickness, male	0.08		0.11	
Unemployment degree, female	0.09	(0.20)	0.13	(0.24)
Unemployment degree, male	0.09	(0.21)	0.11	(0.21)
Relationship duration (in years)	5.86	(3.92)	6.82	(4.3)
Fraction of couples who leave*	0.38		0.04	
Number of observations	3292		16646	

note:* denotes the fraction of couples formed in city (countryside) that move to the countryside (city)

Of the couples formed in Copenhagen around 38% move to a less populated area during the course of the relationship. On the other hand, only 4% of the partnerships that are formed in the countryside move to Copenhagen.

3.2 Empirical Model

In order to investigate the effect of locating in a given area on the dissolution risk we estimate a duration model where the random variable is the time spent in a given relationship. Since the location decision is potentially endogenous to the dissolution risk, our goal is to disentangle the commitment effect from the sorting effect. First, we apply the timing-of-event model of Abbring and van den Berg (2003). We estimate the process of dissolution simultaneously with the process of moving to a less populated area allowing the two processes to be interdependent through the error structure. Second, we use an exclusionary restriction to strengthen identification. We assume that the moving process starts at the beginning of the relationship.

3.2.1 Timing-of-events method

The timing-of-events method enables us to identify the causal effect of location choice on the dissolution rate under some well-defined assumptions which we discuss below. The estimation strategy requires simultaneous modelling of the divorce rate and the moving hazard. Let $T_{r(elationship)}$ and $T_{m(ove)}$ denote the duration of a relationships and the duration till the agent moves in or out of a city. Both are continuous nonnegative random variables. We allow T_r and T_m to interact through correlation of unobservables or through a possible treatment effect of moving in or out of the city. Suppose for example that each period, the couple draws an r =(utility in city/ utility in countryside), where r depends on for example job market opportunities. Let the marriage quality be given by $q \in [0, 1]$. Then, the optimal strategy is to define a reservation value $r^*(q)$ above which the couple moves to the city. Then T_m depends on the quality of marriage but not in a deterministic way. This randomness is necessary for identification. We assume further that all individual differences in the joint distribution of the processes can be characterized by observed explanatory variables, x, and unobserved variables, v. The moving incidence 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_m on the distribution of T_r. The distributions of the random variables are expressed in terms of their hazard rates $h_m(t|x_{m,t}, v_m)$ and $h_r(t|t_m, x_{r,t}, v_r)$. Conditional on x and v, we can therefore ascertain that the realization of T_m affects the shape of the hazard of T_r from t_m onwards in a deterministic way. This independence assumption implies that the causal effect is captured by the effect of t_m on

$h_r(t|t_m, x_{r,t}, v_r)$ for $t > t_m$. This rules out that t_m affects $h_r(t|t_m, x_{r,t}, v_r)$ for $t \leq t_m$, i.e. anticipation of the move has no effect on the relationship hazard. This assumption will be falsified if one or both partners stop searching in the anticipation period before moving to the city or searches extra hard in the anticipation period before moving to the countryside. However, we justify the use of the model by the fact that the time span between the moment at which the anticipation occurs and the moment that the actual move takes place is relatively short compared with the duration of a marriage (the average duration of relationships is approximately 6.7 years in our sample while the average time to find a house is only a few months). This implies that the potential bias from anticipation is small.

Given the independence and no anticipation assumptions, the causal effect of moving on the divorce rate is identified by a mixed proportional hazard model. That is, it is a product of a function of time spent in the given state (the baseline hazard), a function of observed time-varying characteristics, x_t, and a function of unobserved characteristics, v

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

where $\lambda\left(t\right)$ specified as $exp(\lambda_m(t))$ 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:

$$h_m(t|x_{m,t}, v_m) = \exp(\beta_m' x_{m,t} + \lambda_m(t) + v_m) \tag{1}$$

$$h_r(t|t_m, x_{r,t}, v_r) = \exp(\beta_r' x_{r,t} + \delta D(t_m) + \lambda_r(t) + v_r),$$

where $D(t_m)$ is a time-varying indicator variable taking the value 0 before the couple moves, and 1 after the couple moves.

Intuitively, the timing-of-events method uses variation in marriage duration and in duration until moving (conditional on observed characteristics) to identify the unobserved heterogeneity distribution. The selection or sorting effect is captured by a positive correlation between v_r and v_m while the causal effect of living in the city on marriage duration is captured by the effect of the time spent outside the city conditional on the observables and v_r and v_m. If couples who move to the city divorce fast, irrespective of how long they lived outside the city there is a causal effect of living in the city on the divorce rate. Alternatively, if only the couples who move to the city just after marriage divorce faster while the ones who move later do not divorce faster, there is a sorting effect. The most stable relationships are more likely to remain in the countryside for a long time because they are more likely to have kids or prefer to spend lots of time together while the relatively unstable relationships move to the city fast. This requires however that there is no interaction between marriage quality and treatment. If for example living in the city causes bad marriages to dissolve faster this also implies a positive correlation between v_r and v_m. In that case, if we would randomly pick a treatment group of 1000 couples from the countryside and place them in the city we would find a positive treatment effect caused by the unstable relations who divorce faster in the city than in the countryside. Abbring and Van den Berg (2003) show that under further proportionality assumptions a cross effect of marriage quality and the treatments (city and countryside) is identified by allowing the unobserved characteristics of the marriage quality ν_r to be different for the movers and the non movers. The time varying piecewise constant duration effect is then informative on the city effect. We do not travel this avenue because the assumption of independence between observables and non-observables after the move cannot be justified.

Alternatively, we impose an exclusionary restriction in the moving equation (this identification strategy is along the lines of e.g. Lillard (1993)). Specifically, we include as an extra explanatory variable in the moving hazard -an indicator variable that takes the value 1 if the father of one of the individuals in a given couple currently lives in the countryside- assuming that this variable does not affect the dissolution risk but it does affect the location of the couple. For the Likelihood function we refer to the appendix.

4 Results

Since the quality of a relationship may depend on the location of the marriage -agents who met in a city could have been more choosy because of the higher contact rate α_C- we report the results separately for the subset of relationships that are formed in the city and those that are formed in the countryside.

The variables of interest are the commitment variables: being married, whether one owns a house, having young kids, and having older kids. The latter distinction is important because the cost of divorce is larger for young kids. Of particular interest in this study is the time-varying indicator variable that denotes whether the couple is currently living in the city or in the countryside. In addition to this variable we also condition on the usual suspects in the divorce literature (see e.g. Svarer (2004)). We only report the coefficients for the commitment variables here. In Table 3 and 4 below, we present three sets of results for partnerships that were initiated in the city and the countryside, respectively. First, we show the results for a model where we do not model the moving decision (model 1). Second, we take the moving decision into account and use the timing-of-event model to address the potential endogeneity of moving in relation to the dissolution risk (model 2). Third, we use as exclusionary restriction an indicator variable that takes the value 1 if the father of one of the individuals in a given couple lives in the countryside and 0 otherwise (model 3). Specifically, we include this variable in the moving hazard equation.

Table 3

Results for dissolution hazard for relationships formed in the city[5]

	Model 1		Model 2 Timing-of-event		Model 3 T-o-E and IV	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Countryside	-0.264*	0.077	-0.121	0.136	-0.146	0.135
Married	-1.499*	0.113	-1.474*	0.113	-1.499*	0.114
Kids 0-6 yrs old	-0.325*	0.070	-0.319*	0.071	-0.320*	0.071
Kids 7-17 yrs old	0.013	0.102	-0.009	0.101	-0.008	0.102
Homeowner	-0.233*	0.084	-0.288*	0.088	-0.293*	0.089
Father living in countryside**					0.660*	0.090
$\mathrm{Corr}(v_m, v_r)$***			-0.209*	0.073	-0.190*	0.070
# couples	3292		3292		3292	
Log likelihood	-4409		-7737		-7713	

Note: * denotes significant different from 0 at the 5% level. ** gives the results from the moving hazard. ***The standard error for the correlation coefficient has been calculated based on 1,000 drawings from the multivariate normal distribution with matrix set equal to the estimated parameter vector and covariance matrix.

Table 3 shows that the variables that increase the relative value of the relationship indeed decrease the divorce hazard significantly. Couples that leave Copenhagen experience a drop in the dissolution hazard of 23% (exp(-0.264)-1). The effect of the other commitment variables coincides with previous research on partnership dissolution. Böheim and Ermisch (2001) also find that formally married couples are less likely to divorce than their cohabiting counterparts. Weiss and Willis (1997) and Peters (1986) among others find that children (especially when they are young) are associated with lower dissolution risk. Sullivan (1995) and Jalovaara (2001) find that homeowners are less likely to divorce. We have on the other hand not been able to locate any previous work that explores the effect of moving from more populated areas to lesser populated on the dissolution risk.

[5] In addition we condition on a number of other explanatory variables. See Table A1 in appendix for the full set of results. Here we also present the results from the moving hazard.

Although the fact that the divorce risk is lower in rural areas has also been observed by Peters (1986) and Jalovaara (2001).

The results presented in model 2 suggest that moving to the countryside is not an exogenous event in relation to the dissolution process. Indeed, the significant effect of leaving Copenhagen vanishes once we model the moving decision simultaneously with the dissolution process. Taken at face value this implies that based on unobservable factors, the stable relationships are more likely to leave Copenhagen and this association is what drives the findings of model 1. This is captured by the correlation between the unobserved heterogeneity terms in the moving hazard and the dissolution hazard. This correlation is significantly negative. As we argued before, this could also be caused by an interaction between marriage quality and living in the city (cities have a causal effect on dissolution of bad marriages). Model 3, where we introduce an exclusionary restriction in the moving equation suggests however that this is not the case. Couples where at least one partner has a father currently living in the countryside have a much higher moving probability. In fact, the hazard rate out of Copenhagen is 93% higher for these couples. Assuming that father's location is unrelated to marriage stability and assuming that the effect of location choice on father's location is independent of marriage quality this variable randomizes locations of couples (irrespective of marriage quality). With this exclusion restriction we find no significant effect of living in the countryside on the divorce hazard. Moreover, we show in Table A1 (in appendix) that the moving hazard is higher for couples that also invest in the other commitment variables like becoming homeowner, having young children and being formally married. This suggests that also in terms of observables, the stable relationships are more likely to move to the countryside. We do want to stress however that we use those variables mainly as controls and do not want to give them a structural interpretation because of endogeneity problems.

The process of moving to a new location is a stressful event. To what extent does this affect our divorce rate? If we assume that the process of moving can only have an effect on the hazard rate in the first 2 years we can control for it by allowing for (piecewise constant) time varying treatment effects of the moving variable in the dissolution hazard. We do however not find significant time varying effects of moving on the dissolution hazard and conclude that this exercise does not change our main findings presented in Table 3. Moreover, below we also look at the reverse movement from countryside to city and find that allowing for sorting results in an insignificant city effect.

We do not consider the exogeneity status of the other commitment variables in this study. In a related study, Svarer and Verner (2006) take a closer look at children. They find that couples that are less prone to end their relationship are more likely to get children. Since couples with children are more likely to leave the city and are also more likely to buy a house this suggests indeed that stable relationships are more likely to engage in various forms of commitment.

In Table 4 we consider the dissolution hazard of individuals who married in the countryside.

Table 4

Results for dissolution hazard for relationships formed in the countryside[6]

	Model 1		Model 2 Timing-of-event		Model 3 T-o-E and IV	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
City	0.298*	0.072	0.187*	0.077	-0.017	0.099
Married	-1.482*	0.052	-1.134*	0.040	-1.488*	0.052
Kids 0-6 yrs old	-0.202*	0.030	-0.199*	0.026	-0.201*	0.029
Kids 7-17 yrs old	0.213*	0.042	0.189*	0.035	0.203*	0.042
Homeowner	-0.381*	0.035	-0.302*	0.029	-0.388*	0.034
Father living in countryside**					-1.937*	0.175
$\text{Corr}(v_r, v_m)$***			0.413	0.283	0.221*	0.086
# couples	19938		19938		19938	
Log likelihood	-22227		-26166		-26451	

Note: * denotes significant different from 0 at the 5% level. ** gives the results from the moving hazard. ***The standard error for the correlation coefficient has been calculated based on 1,000 drawings from the multivariate normal distribution with matrix set equal to the estimated parameter vector and covariance matrix.

[6] In addition we condition on a number of other explanatory variables. See Table A2 in appendix for the full set of results. Here we also present the results from the moving hazard.

Again, we find a positive association between living in a more populated area and the risk of dissolution. This association looses power once we address endogeneity with only the timing-of-event model but remains significant. The correlation between the unobserved heterogeneity terms is also insignificant for model 2. However, when we use our exclusion restriction we find that there is a large and significant positive association between the unobservables in the moving and dissolution hazard and that the effect of moving to Copenhagen is driven by this association and not by a causal effect generated by our proposed mechanism. Our interpretation of the difference between model 2 and model 3 is that identification gets stronger when we include the instrument. In model 2 identification in only based on the rather low fraction of couples that move (around 4% cf. Table 2). Apparently, this is not sufficient to identify the correlation between the two sets of unobservables and the sorting effect is not significant (as shown in Table 4). Identification improves with the inclusion of the very significant dummy variable for whether at least one of the fathers of the couple lives in the countryside.

The fact that our results hold both for couples remaining in the city and for couples moving to the city strengthens our conclusion that stable relationships sort in the countryside.

The higher divorce rates are not caused by the fact that we mismeasure cohabitation in the city. If because of the larger student population, spurious cohabitations more frequently take place in the city, this could explain the higher divorce rate there. However, (i) if we repeat our estimations excluding the cohabiting population, we find similar results[7] and (ii) the couples who move together to the city are likely to have a real relationship and we also find higher divorce rates for them. Finally, the results presented in Table 3 and 4 still hold when we change the definition of the city versus the countryside or also consider Aarhus and Odense to be cities. Including less populated areas in the city definition lowers the effect on dissolution risk in model 1, where the moving decision is not modelled. Not surprisingly, this effect also vanishes once moving is modelled explicitly.

[7] Since most partnerships begin as cohabitation (around 80%) the sample is severely reduced when we focus on those formally married. The effect of leaving Copenhagen is almost the same as when we included the cohabiting couples. The standard errors are however a lot larger due to the lower sample size which makes the results not as stastically robust as the ones based on the entire sample.

5 Concluding remarks

Is moving to the countryside a credible commitment device for couples? In this paper, we investigate whether lowering the arrival rate of potential marriage partners by moving to a less populated area lowers the divorce rate for a sample of Danish couples. We find, using the timing-of-events model of Abbring and van den Berg (2003), that conditional on location of marriage, the divorce risks are higher in the city but that this is mainly caused by sorting of relatively stable relationships in the countryside. This is confirmed by using an exclusion restriction. Our main conclusion is that moving to the countryside is not a cheap way to prolong relationships.

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Table A1
Full set of Results for Partnerships formed in Copenhagen

	Timing-of-event model				Timing-of-event model with exclusionary restriction			
	Moving		Dissolution		Moving		Dissolution	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E	Coeff.	S.E
Commitment variables								
Homeowner	2.005*	0.082	-0.288*	0.089	2.157*	0.090	-0.293*	0.089
Married	0.469*	0.088	-1.474*	0.113	0.456*	0.091	-1.499*	0.114
Have moved from Copenhagen			-0.121	0.136			-0.146	0.135
Children 0-6	0.472*	0.076	-0.319*	0.071	0.469*	0.075	-0.320*	0.071
Children 7-17	0.209	0.136	-0.010	0.102	0.214	0.138	-0.009	0.102
Exclusionary restriction								
Father living in countryside					0.660*	0.090		
Other variables								
Vocational education, male	0.240*	0.096	-0.227*	0.090	0.281*	0.097	-0.227*	0.091
Short cycle further edu., male	0.351*	0.170	-0.320*	0.158	0.414*	0.178	-0.345*	0.160
Medium cycle further edu., male	0.277	0.147	-0.440*	0.132	0.242	0.147	-0.453*	0.133
Long cycle further edu., male	-0.148	0.122	-0.084	0.108	-0.198	0.123	-0.080	0.109
Couple have same level of edu.	0.063	0.091	-0.001	0.078	0.106	0.091	-0.002	0.079
Male more educated	-0.198	0.129	0.232*	0.112	-0.128	0.130	0.235*	0.113
Relationship number	-0.104*	0.063	0.245*	0.055	-0.071	0.065	0.248*	0.056
Female between 15-20	-0.313	0.271	0.003	0.209	-0.028	0.274	-0.045	0.210
Female between 21-25	-0.046	0.236	0.023	0.179	0.165	0.239	-0.015	0.180
Female between 26-30	-0.123	0.213	-0.155	0.157	0.036	0.214	-0.180	0.158
Male between 15-20	0.475*	0.221	0.140	0.181	0.584*	0.225	0.153	0.182
Male between 21-25	0.394*	0.177	-0.115	0.146	0.459*	0.180	-0.101	0.147
Male between 26-30	0.209	0.151	-0.052	0.120	0.230	0.153	-0.042	0.121
Female more than 4 years older	-0.698*	0.217	0.537*	0.178	-0.583*	0.226	0.514*	0.179
Male more than 4 years older	0.174	0.129	0.340*	0.110	0.180	0.130	0.346*	0.111
Female income	0.309*	0.098	-0.232*	0.064	0.339*	0.044	-0.229*	0.064
Male income	0.340*	0.047	-0.289*	0.096	0.285*	0.098	-0.298*	0.097
Sickness, female	-0.045	0.103	0.123	0.086	-0.041	0.104	0.122	0.086
Sickness, male	-0.065	0.124	-0.025	0.101	-0.062	0.124	-0.015	0.102
Unemployment degree, female	0.629*	0.181	0.140	0.132	0.660*	0.180	0.125	0.133
Unemployment degree, male	-0.195	0.195	0.469	0.135	-0.228	0.195	0.464	0.135
Mass points (v_m^2, v_r^2)	-3.026*	0.154	-2.227*	0.172	-3.031*	0.153	-2.276*	0.170
$p_1(v_r^1, v_m^1)$	0.173*	0.034			0.159*	0.662		
$p_2(v_r^2, v_m^1)$	0.330*	0.029			0.316*	0.145		
$p_3(v_r^1, v_m^2)$	0.274*	0.030			0.278	0.231		
$p_4(v_r^2, v_m^2)$	0.223*	0.026			0.244*	0.123		
$\text{Corr}(v_r, v_m)$	-0.210*	0.073			-0.190*	0.070		

Note: * denotes significance at the 5 % level.The standard error for the correlation coefficient and probabilities has been calculated based on 1,000 drawings from the multivariate normal distribution with mean and covariance matrix set equal to the estimated parameter vector and covariance matrix.

TABLE A2
FULL SET OF RESULTS FOR PARTNERSHIPS FORMED IN COUNTRYSIDE

	Timing-of-event model				Timing-of-event model with exclusionary restriction			
	Moving		Dissolution		Moving		Dissolution	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E	Coeff.	S.E
Commitment variables								
Homeowner	-0.518*	0.076	-0.303*	0.029	-0542*	0.083	-0.389*	0.034
Married	-0.135	0.085	-0.134*	0.040	-0.188*	0.090	-1.488*	0.052
Have moved to Copenhagen			0.187*	0.077			-0.018	0.099
Children 0-6 years	-0.645*	0.098	-0.199*	0.026	-0.688*	0.102	-0.209*	0.030
Children 7-17 years	-0.794*	0.190	0.190*	0.035	-0.901*	0.195	0.203*	0.042
Exclusionary restriction								
Father living in countryside					-1.937*	0.174		
Other variables								
Relationship number	-0.096	0.061	0.259*	0.022	-0.068	0.065	0.371*	0.030
Female between 15-20	0.179	0.319	0.117	0.084	0.401	0.334	0.029	0.099
Female between 21-25	0.091	0.300	-0.031	0.072	0.297	0.312	-0.064	0.085
Female between 26-30	0.110	0.290	-0.110*	0.065	0.315	0.301	-0.154	0.074
Male between 15-20	0.251	0.216	0.055	0.076	0.374	0.228	0.111	0.087
Male between 21-25	0.125	0.185	-0.005	0.060	0.274	0.193	0.084	0.070
Male between 26-30	0.052	0.173	-0.001	0.051	0.183	0.178	0.073	0.058
Female more than 4 years older	-0.063	0.196	0.500*	0.068	-0.047	0.213	0.657*	0.087
Male more than 4 years older	-0.233	0.110	0.187*	0.040	-0.175	0.117	0.293*	0.050
Vocational education, male	-0.485*	0.076	-0.271*	0.033	-0.494*	0.086	-0.360*	0.042
Short cycle further edu., male	0.105	0.129	-0.241*	0.065	0.211	0.141	-0.322*	0.081
Medium cycle further edu., male	-0.011	0.122	-0.414*	0.065	0.058	0.135	-0.506*	0.080
Long cycle further edu., male	1.081*	0.101	0.011	0.068	1.358*	0.141	0.120	0.086
Couple has same level of edu.	-0.187*	0.074	0.222*	0.045	-0.172*	0.080	0.137*	0.040
Male more educated	0.122	0.099	0.108*	0.033	0.145	0.108	0.271*	0.055
Female income	0.269*	0.102	-0.166*	0.043	0.338*	0.110	-0.166*	0.050
Male income	-0.126*	0.065	-0.242*	0.028	-0057	0.068	-0.268*	0.032
Sickness, female	-0.060	0.109	-0.018	0.035	-0.087	0.116	-0.039	0.038
Sickness, male	-0.623	0.107	0.040	0.036	-0.117	0.115	0.028	0.040
Unemployment degree, female	-0.935*	0.171	0.147*	0.049	-0.946*	0.182	0.176*	0.056
Unemployment degree, male	-0.243	0.162	0.433*	0.056	-0.180	0.173	0.471*	0.065
Mass points (v_m^2, v_r^2)	-1.000*	0.258	-4.523*	0.741	2.157*	0.526	-2.352*	0.082
$p_1(v_r^1, v_m^1)$	0.762*	0.088			0.223*	0.090		
$p_2(v_r^2, v_m^1)$	0.114	0.067			0.482*	0.106		
$p_3(v_r^1, v_m^2)$	0.047	0.089			0.157	0.086		
$p_4(v_r^2, v_m^2)$	0.077	0.076			0.138	0.109		
$\mathrm{Corr}(v_r, v_m)$	0.413	0.284			0.222*	0.086		

Note: * denotes significance at the 5 % level.The standard error for the correlation coefficient and probabilities has been calculated based on 1,000 drawings from the multivariate normal distribution with mean and covariance matrix set equal to the estimated parameter vector and covariance matrix.

Appendix

A 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, $e = r, m$ 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:

$$P(T_e > t_{k,e} | T_e > t_{k-1,e}, x_{k,e}, v_e) \quad = \exp\left[-\int_{t_{k-1,e}}^{t_{k,e}} h_e(t|x_{e,t}, v_e)dt\right] \tag{2}$$

where $\Lambda_{e,k_e} = \int_{t_{k-1,e}}^{t_{k,e}} \lambda_e(t)dt$. The interval-specific survivor expression (2) is henceforth denoted by 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.

Imposing the mixed proportional hazard formulation (1) and assuming that the observed covariates are time-invariant within intervals (i.e. years) – which implies that we only have to integrate over the baseline hazard – we can now express the interval-specific survival probabilities as

$$\alpha_{r,k_r} = \exp\left[-\exp\left[\beta_r' x_{r,k_r} + \delta D(t_m) + v_r\right] \cdot \Lambda_{r,k_r}\right]$$

and

$$\alpha_{m,k_m} = \exp\left[-\exp\left[\beta_m' x_{m,k_m} + v_m\right] \cdot \Lambda_{m,k_m}\right].$$

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. This corresponds to estimating a piecewise constant baseline hazard for each interval.

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

$$\mathcal{L}_r = (1 - \alpha_{r,k_r})^{j_r} \alpha_{r,k_r}^{1-j_r} \prod_{l_r=1}^{k_r-1} \alpha_{r,lr},$$

where $j_r = 1$ if the relationship is not right-censored and 0 otherwise. Uncompleted durations therefore only contribute to the survivor probabilities. The interval indicator here runs monotonically from 1 up to the end of the relationship or is right-censored at k_r. The contribution for a given relationship is then $(1 - \alpha_{m,k_m})$ in intervals with a move and α_{b,k_b} in intervals without moves. Let the indicator variable, j_m, take the value 1 if a move occurs in a given interval and 0 otherwise. The contribution to the likelihood function from a move alone is then

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

Combining the two expressions yield the full likelihood function

$$\mathcal{L} = \int \int \mathcal{L}_r \mathcal{L}_m dG(v_r, v_m),$$

where $G(v_r, v_m)$ is the joint distribution of the unobserved heterogeneity components. We use a flexible and widely applied specification of the distribution of the unobservables; it is assumed that v and v_m each can take two values, where one of the support points in each destination specific hazard is normalized to zero (i.e., $v_{r1} = 0$ and $v_{m1} = 0$), because the baseline hazard acts as a constant term in the hazard rates. Thus, there are four possible combinations of this bivariate unobserved heterogeneity distribution, each with an associated probability[8]. For more details on this class of mixture distributions in duration models, see e.g., van den Berg (2001).

[8]The four probabilities are: $P_1(v_r = 0, v_m = 0)$, $P_2(v_r = v_{r2}, v_m = 0)$, $P_3(v_r = 0, v_m = v_{m2})$, and $P_4(v_r = v_{r2}, v_m = v_{m2})$.