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Union Instability as an Engine of Fertility? A Microsimulation Model for France

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Abstract Opportunities for conceiving and bearing children are fewer when unions are not formed or are dissolved during the childbearing years. At the same time, union instability produces a pool of persons who may enter new partnerships and have additional children in stepfamilies. The balance between these two opposing forces and their implications for fertility may depend on the timing of union formation and parenthood. In this article, we estimate models of childbearing, union formation, and union dissolution for female respondents to the 1999 French Etude de l'Histoire Familiale. Model parameters are applied in microsimulations of completed family size. We find that a population of women whose first unions dissolve during the childbearing years will end up with smaller families, on average, than a population in which all unions remain intact. Because new partnerships encourage higher parity progressions, repartnering minimizes the fertility gap between populations with and those without union dissolution. Differences between the two populations are much smaller when family formation is postponed—that is, when union formation and dissolution or first birth occurs after age 30, or when couples delay childbearing after union formation.

Keywords Fertility · Union stability · France · Microsimulation

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Introduction

During the last century, virtually every wealthy society experienced long-term declines in fertility and the formation and stability of intimate unions. Both trends have been attributed to a combination of shifts in economic organization and ideology (Lesthaeghe 1995), but the nature of their interrelationship has not been fully explored. We argue here that declines in union formation and union stability have made it more difficult for individuals to attain their desired number of children in a single union while increasing the probability of additional children in a new union. The balance between these two opposing effects may make the difference between above- or below-replacement fertility.

In this article, we investigate the implications of changes in union formation and dissolution for a population's fertility. We estimate models of birth and union events for French women born in the 1930s through the 1970s. Model parameters are applied in a microsimulation to generate hypothetical populations of women with different union and childbearing histories. Through microsimulation it is possible to identify the population-level implications of the individual-level family processes.

Partnerships and Parenthood

Most young adults consider a stable partnership to be the optimal context for childbearing and childrearing (Hobcraft and Kiernan 1995; Thornton and Young-DeMarco 2001). A stable partnership lowers childrearing costs for each parent and may enhance the benefits of children through mutual enjoyment and caring. Children also benefit from stable partnerships (Amato 2001), providing additional motivation to avoid or postpone childbearing when one has no partner or union stability is in doubt.

The importance of partnership for parenthood is evidenced in much higher childbearing risks in cohabitation or marriage than in singlehood, even with controls for common unobserved predispositions to enter partnerships and have children (Aassve et al. 2006; Baizán et al. 2003, 2004; Brien et al. 1999). Among those who want or intend to have a child, single persons are much less likely than cohabiting or married persons to do so (Heaton et al. 1999; Spéder and Kapitány 2009). Childbearing is also inhibited if a partnership is of low quality or is likely to dissolve (Coppola and Di Cesare 2008; Lillard and Waite 1993; Myers 1997; Rijken and Liefbroer 2009). The fact that cohabiting unions are less stable than marriages (Andersson 2002a,b) is a potential explanation for higher birth rates in marriage.

Union instability may also, however, increase fertility by producing a pool of persons at risk of new partnerships and further childbearing. The value of a shared child is unique, signaling the couple's status as a family and their commitment to each other (Griffith et al. 1985). Birth intentions and birth risks in new partnerships are higher than would be predicted from the number of children partners already have (Thomson 2004; Thomson et al. 2002; Vikat et al. 1999).[1]

[1] The many studies that show a negative effect of stepchildren on childbearing do not consider whether such effects are simply the effect of higher combined parity. See the review and discussion by Thomson et al. (2002).

The overall implications of union instability for fertility depend on the relative strength of the two opposing forces: decreased childbearing risk during periods out of union or in an unstable union and increased risk of new partnerships where additional children may be desired. A few studies based on cumulative fertility have found that additional births within stepfamilies compensate to some degree for births lost when prior unions dissolve (e.g., Beaujouan and Solaz 2008; Cohen and Sweet 1974; Jansen et al. 2009; Lauriat 1969; Meggiolaro and Ongaro 2010; Thornton 1978).

The combined result of fewer children in unstable unions and additional children in new partnerships could depend to some extent on the timing of first births and union dissolution. When these events occur at younger adult ages, women have more time to form new partnerships and have additional children. Wu and Martin (2002) found that U.S. women whose first birth occurred before first marriage subsequently had more births than women whose first birth occurred in marriage, consistent with a scenario of separation, repartnering, and additional stepfamily births. But the difference in total births was considerably attenuated when they controlled for age at first birth. Beaujouan and Solaz (2008) showed that, were it not for increasing sterility, new partnerships formed during the latter part of the childbearing years would produce even more additional children than is observed. That is, the later the first birth (and subsequent dissolution of a fertile union), the smaller the positive force of repartnering on completed fertility.

Our purpose in this article is to examine the micro-level processes underlying the connections between union stability and childbearing in France and to consider the implications of these processes for the population's fertility. Our empirical models and theoretical simulations assume that childbearing is conditional on union status and stability, rather than the reverse, consistent with most theory and evidence reviewed above. Our models and simulations also, however, take into account potential effects of children already born on union formation and dissolution. We estimate models of birth risk up to the fourth birth as a function of union status and experience in relation to past births, and models of first and most recent union formation and dissolution as a function of prior births and the unions in which they were born. We then apply the parameter estimates to simulate the implications of observed relationships for completed fertility in populations with different union histories. Simulation enables us to "trace out the evolution of states over time" (Aassve et al. 2006) and thereby produce comparative estimates of completed fertility that could not be generated by observations of older cohorts. Our models and simulation focus on the demographic components of fertility, ignoring more distal common causes of union formation, union dissolution, and births. In other words, we investigate how the internal "engine" works, not the source of its fuel.

Data

We use data from the 1999 French Etude de l'Histoire Familiale (EHF) (Cassan et al. 2000). These data have two key advantages for our purposes. First, French family patterns have changed in ways that are typical or in between those observed in other wealthy countries. France's total fertility rate and cohort completed fertility has been near replacement and stable since the 1970s, though not quite as high as for the

United States and sometimes the Nordic countries (Sardon 2006a,b). Marriage rates declined and divorce rates increased, but both remained moderate in comparison with other countries (Sobotka and Toulemon 2008). Cohabitation increased, below rates for the Nordic countries but well above eastern and southern Europe (Härkönen and Dronkers 2006). Andersson and Philipov (2002: appendix) estimated that French cohabiters married more often than those in several European countries but less often than cohabiters in the United States, Austria, and Finland. As in other countries, separation rates are much higher in France for cohabiting than for married couples, but its total separation rates are between those of the Mediterranean countries and the United States (Andersson 2002b). Nonmarital childbearing increased dramatically in France after 1980 but remained below that in Sweden, Norway, and Denmark and above that in the United States (Sobotka and Toulemon 2008). Lone motherhood has been more common in France than in the Nordic and Mediterranean countries but less common than in the United States and United Kingdom (Andersson 2002a).

The second major advantage of the EHF is sample size. The survey was conducted in conjunction with the census in March 1999. A sample of 235,000 women and 145,000 men aged 18 and older completed an additional questionnaire that included birth and union histories. The large sample size enables us to generate transition parameters for many more unique combinations of birth and union events than would be possible with a smaller sample, better capturing the complexity of family lives in the latter part of the twentieth century.

A primary disadvantage of these data is that information on the children of previous partners is incomplete, collected only for children who were raised by the respondent. Because the couple's combined parity reduces birth risks, suppressing the net positive force on fertility of repartnering, incomplete information on partner's children may bias downward our estimate of the repartnering effect on aggregate fertility (Thomson 2004; Thomson et al. 2002).

A less serious disadvantage is that some information is missing on respondents' union histories. First, respondents were asked to report only the first and most recent or current union, defined as marriage or as sharing the same household for six months or longer. No information is available on number of unions, so we do not know whether any unions occurred between the first and the most recent/current. In the 1992 French Fertility and Family Survey, less than 3% of women reported three or more unions by age 35 (Fürnkranz-Prskawetz et al. 2003). Second, of the women who reported unions in the EHF, about 5% did not provide complete information on start and end dates. Mazuy and Lelièvre (2005) matched data from 1,306 respondents who participated in both the EHF and the *Biographies et entourage*, conducted in the Paris region in 2000, and found that respondents omitting union history dates did not exhibit any particular profile. Following Prioux (2003), we imputed the missing union dates from the known distribution of ages at union events for the woman's birth cohort and marital status.

We limit our analysis to women born in 1930–1978, who were ages 20–68 at the time of interview. Men's reports of union and birth histories appear to be less accurate than women's reports, especially with respect to children born out of unions or in unions that ended before the interview (Klijzing and Cairns 2000; Rendall et al. 1999). Of course, the implications of men's union history for their fertility may differ from those for women. We consider this point further in the Discussion section.

Immigrants were included only if they arrived in France before they reached age 15; later immigrants might not report births or unions prior to immigration. We excluded respondents who experienced a first birth or first union before age 15. About 171,400 women remained in our sample.

We do not distinguish marital from cohabiting unions in the analysis. As noted earlier, childbearing risks are higher and the risk of separation is lower for marital than for nonmarital cohabiting unions. It is not cohabitation itself, however, that is the critical factor in childbearing, but rather the stability of the union. The fact that conceptions peak shortly after marriage—much more so than after cohabitation (Baizán et al. 2003, 2004)—suggests that marriage is a marker of the decision to have children and should not be viewed as having an effect on the birth risk. Our models control for union duration as an indicator of the union's stability, rather than for union type.

As shown in Table 1, we observe four birth cohorts to age 30 (1930s to 1960s), the first three of which can be observed to age 40. By age 30, 81% of the 1930s cohort but only 70% of the 1960s cohort had borne a child. The 1950s cohort caught up by age 40, about 88% having become mothers. The proportion of first births occurring out of a union remained quite stable across cohorts, while the proportion occurring in cohabitation increased quite dramatically.[2] Younger cohorts experienced much higher likelihood of dissolving their first childbearing union by age 30 or age 40.[3] And the proportion of second and third births occurring after the first childbearing union, though small, increased steadily across cohorts. We cannot tell from these data whether the 1960s cohort will have caught up with their elders by age 40 or whether the 1970s cohort will differ from their elders by age 30 or 40. That is the point of our simulation analysis.

Modeling Birth and Union Intensities

We estimate transition rates for conception of live births, up to the fourth live birth, and for the formation and dissolution of the first and the most recent higher-order union. Conception is determined to occur at nine months prior to a reported birth.[4] We use a piecewise constant exponential model:

$$h(t) = \exp(\alpha_{l(t)} + \mathbf{A}(t)\boldsymbol{\beta}),$$

where $l(t)$ is the number of the interval of constancy that contains time t, and α_k is a constant associated with the kth time interval. $\mathbf{A}(t)$ denotes a row vector of categorical covariates (including time-varying covariates), and $\boldsymbol{\beta}$ represents the associated column vector of coefficients assumed not to vary across time intervals. Covariates

[2] Because we do not have information on unions between the first and the most recent, we may slightly overestimate the number of non-union births.

[3] Union dissolution figures do not include unions that ended at the partner's death.

[4] All methods of controlling fertility—contraception, sterilization, and abortion—are ignored in our analysis because we have data only on live births. We therefore assume that only pregnancies that will be carried to term influence the risk of union formation or dissolution. During pregnancy, of course, women are assumed not to be at risk of conception.

Table 1 Unions and births to French women born in 1930–1968

	Birth Cohort			
	1930–1939	1940–1949	1950–1959	1960–1968
Birth and Union Histories to Age 30				
1st birth				
Not in union	9.45	9.45	8.73	8.00
Cohabiting union	2.35	2.68	6.44	19.28
Marriage	68.79	69.80	62.49	42.22
1st childbearing union				
Intact	69.09	68.61	62.63	54.50
Dissolved	2.05	3.87	6.31	7.00
2nd birth				
In 1st childbearing union	48.15	48.14	43.04	34.09
After 1st childbearing union	0.40	0.52	1.12	1.50
3rd birth				
In 1st childbearing union	22.92	17.15	12.15	8.79
After 1st childbearing union	0.34	0.38	0.62	0.85
	Birth Cohort			
	1930–1939	1940–1949	1950–1958	
Birth and Union Histories to Age 40				
1st birth				
Not in union	10.02	10.02	9.96	
Cohabiting union	2.64	3.56	8.68	
Marriage	75.58	75.56	69.28	
1st childbearing union				
Intact	71.88	67.59	61.74	
Dissolved	6.35	11.52	16.22	
2nd birth				
In 1st childbearing union	61.62	60.53	58.08	
After 1st childbearing union	0.74	1.30	2.57	
3rd birth				
In 1st childbearing union	35.67	26.44	22.90	
After 1st childbearing union	0.79	1.20	2.47	
4th birth				
In 1st childbearing union	17.25	8.86	5.55	
After 1st childbearing union	0.64	0.69	1.11	

Source: Authors' analyses of data from 1999 Etude de l'Histoire Familiale.

include only the demographic components of the "engine": age, cohort, and detailed combinations of past unions and births.[5]

[5] It is theoretically possible to model unobserved heterogeneity in each process, along with a limited number of correlations between heterogeneity components. Such models provide stronger inferences about causal relationships between union and birth events but do not alter the fundamental associations that are the basis for our microsimulations.

For conceptions of the first live birth, the baseline duration dependency ("clock") is the age of the woman; for higher-order births, it is the age of the youngest child. For first union formation, the baseline clock is again the woman's age; for the most recent union, it is time since the first union ended. The baseline clock for union dissolution, whether the first or most recent, is union duration. To account for cohort differences in timing of first birth and first union, we include an age-cohort interaction using linear age splines:

$$h(t) = \exp(\alpha_{l(t)} + \mathbf{A}(t)\boldsymbol{\beta} + \Sigma_i \gamma_i z_i(t)),$$

where $z_i(t)$ denotes the ith age spline, and γ_i is the coefficient associated with its slope. According to BIC statistics, the best fit to observed age-specific rates for cohorts that had completed their fertility was produced with two age splines having a node at age 21 for the conception of the first live birth, and three age splines having nodes at ages 20 and 24 for the first union. All models were estimated by maximum likelihood as implemented in STATA (StataCorp 2007).

Observations are censored by June 1, 1998, or by the respondent's 50th birthday. Sample weights are used to correct for the higher nonresponse rates of certain population groups. To produce consistent estimates of parameter variances and likelihood ratios, we normalize the weights to sum to 1.

Birth Intensities

Tables 2 and 3 show several well-known patterns: birth risks are generally much lower out of union than within cohabitation or marriage; they decline within unions over time; and they are higher in stepfamilies, that is, when the prospective child is the first or second in a new partnership.[6] Taking advantage of the large sample, we are able to show further that first-birth risks are lower before the first union than during other periods of singlehood and that being single reduces the first-birth risk more than the risk of a higher-order birth. Fourth-birth risks are even *higher* for women not in a union than for women in a union. Some of these differences could arise from the small number of unobserved unions (between the first and most recent) in which higher-order births are more likely to occur, especially additional births associated with having a new partner. We are also able to show that duration-dependence for first births is essentially the same in first and higher-order unions but that younger cohorts waited longer after union formation to have a first birth compared with older cohorts.

Union Formation and Dissolution

In Tables 4 and 5, we again find several well-known patterns. Pregnancy stimulates union formation and inhibits dissolution. Children born to a couple reduce the risk of separation, especially when they are young, and couples with only shared children

[6] In addition, the first-birth risk shows the usual bell-shaped pattern by woman's age, with a steeper slope at older ages for the younger cohorts. Higher-order birth risks peak at 2–3 years after the previous birth. (Parameter estimates available on request.)

Table 2 First birth risk by union history and birth cohort

Union History	exp(β)	SE(β)
Union Status		
Never in union	0.085***	(0.001)
First union	1	
After first union	0.199***	(0.007)
Last union	1.001	(0.030)
After last union	0.224***	(0.038)
Union Duration: First Union		
First union <2 years	1	
First union >2 years	0.799***	(0.013)
Union duration: last union		
Last union <2 years	1	
Last union >2 years	0.803**	(0.057)
Birth Cohort		
1930–1939	1.785***	(0.027)
1940–1949	1.618***	(0.024)
1950–1959	1	
1960–1969	0.568***	(0.009)
1970–1979	0.365***	(0.009)
Union Duration × Birth Cohort		
First Union		
1930–1939	0.550***	(0.016)
1940–1949	0.716***	(0.019)
1950–1959	1	
1960–1969	1.412***	(0.030)
1970–1979	1.582***	(0.049)
Last Union		
1930–1939	0.525**	(0.117)
1940–1949	0.756	(0.116)
1950–1959	1	
1960–1969	1.221*	(0.104)
1970–1979	1.166	(0.164)
Observations	2,173,994	
df	57	
Log-Likelihood	–95,860	
BIC	192,551	

Note: Also in the model is mother's age in single years 15–44 plus 45–49 and interaction of age (splines from 15 to 21 and 21 to 49) and birth cohort.

Source: Authors' analyses of data from 1999 *Etude de l'Histoire Familiale*.

*$p < .05$; **$p < .01$; ***$p < .001$

Table 3 Higher-order birth risks by union history and birth cohort

	Second Birth		Third Birth		Fourth Birth	
Union/Birth History	exp(β)	SE(β)	exp(β)	SE(β)	exp(β)	SE(β)
Not in Union	0.451***	(0.007)	0.888***	(0.028)	1.162***	(0.046)
One Child						
In first-birth union	1					
In union, 1st birth before union	1.181***	(0.021)				
In union, 1st birth in previous union	1.995***	(0.062)				
Two Children						
In first-birth union			1			
In 2nd-birth union, 1st birth non-union			1.204***	(0.026)		
In 2nd-birth union, 1st birth in previous union			1.497***	(0.070)		
In union, all births before current union, one or more out of union			1.800***	(0.073)		
In union, all births in previous union			4.537***	(0.205)		
Three Children						
In first-birth union					1	
In 2nd-, 3rd-birth union, 1st birth before union					1.294***	(0.042)
In 3rd-birth union, 1st and 2nd before current union					1.579***	(0.072)
In union, all births before union					3.117***	(0.190)
Observations	751,616		818,681		385,434	
df	26		27		26	
Log-Likelihood	–171,008		–104,056		–39,294	
BIC	342,368		208,480		78,922	

Notes: Also in the models are age of youngest child in single years 0–9 plus 10–14, 15–19, and 20–35; mother's age 15–19 plus five-year categories to age 49; and birth cohort.

Source: Authors' analyses of data from 1999 Etude de l'Histoire Familiale.

*$p < .05$; **$p < .01$; ***$p < .001$

have a lower risk of separation than couples with stepchildren.[7] Again, with the large sample size, we are able to show that the effect of prior births on union formation is less negative for first unions than for higher-order unions—in fact, the effect for first unions is sometimes positive. We also find that if the couple has no common children, stepchildren are associated with higher likelihood that the first union will end but with lower likelihood that a higher-order union ended.

Our results are consistent with speculations and previous research on the relationship between union stability and fertility. While it may seem obvious, the large gap in birth risks between women in or out of a coresident union

[7] Dissolution risks increase during the first four years of partnership, and remain steady thereafter for first unions; for later unions, the risk declines slightly after 11 years. Overall, however, differences by duration are quite small. First unions show no strong age patterns in the dissolution risk, whereas later unions are much less stable at older ages. The risk of union dissolution declines with age and is much higher for younger cohorts. (Parameters available on request.)

Table 4 Risk of union formation by birth and union history

Union/Birth History		First Union exp(β)	First Union SE(β)	Most Recent Union exp(β)	Most Recent Union SE(β)
No Births	Not pregnant	1		1	
	Pregnant	10.475***	(0.120)	1.785***	(0.142)
One Birth, Not in Union	Age 0–3 yrs.	1.376***	(0.025)	0.513***	(0.041)
	Age 3–7 yrs.	0.960	(0.030)	0.853*	(0.065)
	Age >7 yrs.	1.054	(0.046)	0.793**	(0.057)
	Pregnant	2.060***	(0.091)	0.884	(0.163)
One Birth in Previous Union	Age 0–3 yrs.			0.637***	(0.033)
	Age 3–7 yrs.			0.786***	(0.029)
	Age >7 yrs.			0.760***	(0.028)
	Pregnant			1.880***	(0.167)
Two Births Before First Union	Age 0–3 yrs.	1.016	(0.038)		
	Age 3–7 yrs.	0.918	(0.058)		
	Age >7 yrs.	1.463***	(0.100)		
	Pregnant	1.316**	(0.124)		
Two Births, One or Both out of Union	Age 0–3 yrs.			0.623***	(0.042)
	Age 3–7 yrs.			0.750***	(0.056)
	Age >7 yrs.			0.843*	(0.056)
	Pregnant			1.190	(0.203)
Two Births in Previous Union	Age 0–3 yrs.			0.623***	(0.044)
	Age 3–7 yrs.			0.693***	(0.032)
	Age >7 yrs.			0.755***	(0.029)
	Pregnant			2.106***	(0.262)
Three Births Before First Union	Age 0–3 yrs.	0.837*	(0.061)		
	Age 3–7 yrs.	0.772*	(0.088)		
	Age >7 yrs.	1.751***	(0.179)		
Three Births, One or More out of Union	Age 0–3 yrs.			0.701***	(0.060)
	Age 3–7 yrs.			0.756**	(0.072)
	Age >7 yrs.			0.840*	(0.069)
Three Births in Previous Union	Age 0–3 yrs.			0.687**	(0.082)
	Age 3–7 yrs.			0.780***	(0.056)
	Age >7 yrs.			0.840***	(0.044)
Observations		1,541,408		218,731	
df		59		43	
Log-Likelihood		–137,231		–45,316	
BIC		275,303		91,162	

Notes: In the first-union model are age of woman in single years, birth cohort and an interaction between cohort and age (splines from 15–20, 20–24, 24+). In the model for most recent union are time since first union in single years, age (15–24; five-year categories), and birth cohort.

Source: Authors' analyses of data from 1999 Etude de l'Histoire Familiale.

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 5 Risk of union dissolution by birth and union history

Union/Birth History		First Union exp(β)	First Union SE(β)	Most Recent Union exp(β)	Most Recent Union SE(β)
No Birth in Union	No births at all	1		1	
	Pregnant	0.256***	(0.017)	0.664	(0.140)
	One or more births out of union			0.976	(0.088)
	All births in prior union			0.691***	(0.052)
	All births < union	1.272***	(0.047)		
	One birth < union, pregnant	0.662*	(0.124)	0.318**	(0.132)
	Two births < union, pregnant	1.319	(0.553)	0.445*	(0.172)
One Birth in Union	Age 0–3 yrs.	0.469***	(0.012)	0.651***	(0.077)
	Age 3–7 yrs.	0.756***	(0.022)	0.902	(0.133)
	Age >7 yrs.	0.711***	(0.025)	0.690	(0.141)
	Pregnant	0.202***	(0.015)	0.127***	(0.066)
Two Births, One in Union	Age 0–3 yrs.	0.820*	(0.063)	0.540***	(0.079)
	Age 3–7 yrs.	0.841*	(0.072)	0.547***	(0.090)
	Age >7 yrs.	0.782**	(0.059)	0.914	(0.137)
	Pregnant	0.569*	(0.134)	0.455	(0.268)
Two Births in Union	Age 0–3 yrs.	0.310***	(0.010)	0.328***	(0.068)
	Age 3–7 yrs.	0.451***	(0.015)	0.739	(0.136)
	Age >7 yrs.	0.554***	(0.019)	0.877	(0.192)
	Pregnant	0.218***	(0.026)	0.000***	(0.000)
Three Births, One in Union	Age 0–3 yrs.	1.034	(0.174)	0.535***	(0.100)
	Age 3–7 yrs.	1.081	(0.200)	0.525**	(0.106)
	Age >7 yrs.	1.163	(0.177)	0.707	(0.142)
Three Births, Two in Union	Age 0–3 yrs.	0.598***	(0.074)	0.427***	(0.110)
	Age 3–7 yrs.	0.755*	(0.091)	0.598*	(0.139)
	Age >7 yrs.	0.949	(0.091)	0.694	(0.170)
Three Births in Union	Age 0–3 yrs.	0.280***	(0.014)	0.370*	(0.157)
	Age 3–7 yrs.	0.392***	(0.019)	0.268**	(0.132)
	Age >7 yrs.	0.538***	(0.023)	0.103**	(0.077)
Observations		2,419,060		121,187	
df		43		42	
Log-Likelihood		–93,915		–8,046	
BIC		188,461		16,583	

Note: Models also include union duration (two-year splines), woman's age (15–24 plus five-year categories), and birth cohort.

Source: Authors' analyses of data from 1999 Etude de l'Histoire Familiale.

$^*p < .05$; $^{**}p < .01$; $^{***}p < .001$

means that delayed union formation and union instability are part of the low-fertility equation. On the other hand, non-union births and union dissolution produce a pool of persons at risk of repartnering, and we find considerable evidence of higher birth intensities in new unions, especially when the child is the first in the union.

The Microsimulation Model

To compare the completed fertility women would experience under different birth-union regimes, we developed a continuous-time, competing-risk microsimulation model. We assume a population of women with no more than two unions and no more than four births, with all events occurring between ages 15 and 50 and transition rates between union and birth statuses as estimated earlier.

Competing-risk microsimulation is based on the same assumptions underlying our regression models—namely, the independence of processes and constant hazard rates within modeled time intervals—resulting in exponentially distributed waiting times. We draw separate random waiting times to all events for which a woman is at risk and censor processes for drawing new random durations whenever the first event occurs or hazard rates change without affecting expected waiting times of processes whose hazard has not changed. The model was implemented in Modgen, a generic microsimulation programming language developed and maintained at Statistics Canada (2009b). Modgen is freely available and widely used for demographic, socioeconomic, and health models (Statistics Canada 2009a). Our model is a variant of the RiskPaths model, developed for training purposes and as a template for demographic competing-risk cohort models. RiskPaths and its code are documented in Spielauer (2009a,b).

The microsimulation model generates 1 million synthetic life courses for each cohort, each based on the cohort-specific and common parameters generated from the regression analyses. For example, in simulating first births, we use the same parameters for the birth risk by union status for all five simulated cohorts, while varying parameters for age and union duration. Simulations of events at later ages depend on parameters observed only for older cohorts. Once the population has been generated, we simply compare the completed fertility of simulated cases with one or another type of union history. Microsimulation allows us to incorporate much more complex sets of transitions than can be accommodated by multistate life tables, a traditional method for generating hypothetical life paths (e.g., Andersson 2002a,b; Bumpass and Lu 2000; Bumpass et al. 1995; Raley and Wildsmith 2004).

Non-union Births and Completed Fertility

The first panel in Table 6 shows that a population in which all first births occur before the first union produces more children, generally above replacement levels, than a population in which all first births are union births. This result holds under the age-specific first-birth and first-union rates for all cohorts, although the gap is smaller under the age-specific rates for younger cohorts, for whom first births and unions are spread out at older ages.

The higher completed fertility of the populations with pre-union births is, however, entirely due to the younger ages at which such births occur. Under the age-specific fertility rates of each cohort, the simulated population of women with a first pre-union birth was, on average, three years younger at first birth than the population simulated

Table 6 Expected births in populations with varying union experience

		By Cohort Age-Specific First-Birth/First-Union Rates				
		1930–1939	1940–1949	1950–1959	1960–1969	1970–1979
All 1st Births Before First Union		2.74	2.48	2.35	2.26	2.04
All 1st Births in First Union		2.54	2.30	2.18	2.14	1.99
Separations Occur…						
Before 1st birth	Separated	1.90	1.83	1.75	1.69	1.54
	Union intact	2.39	2.19	2.09	2.06	1.95
Between 1st and 2nd birth	Separated	2.20	2.09	2.03	2.02	1.90
	Union intact	2.57	2.34	2.24	2.22	2.11
Between 2nd and 3rd birth	Separated	2.59	2.46	2.43	2.42	2.39
	Union intact	2.86	2.62	2.55	2.55	2.50
Parental Status at Separation						
One child	No repartnering	1.25	1.19	1.15	1.15	1.12
	Repartnering	1.80	1.69	1.61	1.63	1.53
Two children	No repartnering	2.19	2.10	2.08	2.08	2.07
	Repartnering	2.51	2.36	2.33	2.32	2.29

Note: Estimates from life histories of 1 million women in each cohort using Modgen.

to have first births in a union. We compared expected number of additional births for quartiles of the population according to age at first birth (including the segment simulated to have no children). If all women had children above age 22 (older cohorts' age schedules) or 23 (1960s and younger cohorts' age schedules), we would expect no difference in completed fertility under the pre-union versus in-union scenario. (Results available on request.)

These results suggest that moderate levels of pre-union childbearing (in France, just under 10% of women) contribute to some extent to higher completed fertility. Because almost all pre-union childbearing occurs at relatively young ages, young mothers have plenty of opportunity to form subsequent partnerships, coresident or not, and to have more children. It is early childbearing, however, not childbearing before a first union, that is the driving force.

Union Dissolution and Completed Fertility

The middle panel of Table 6 compares populations in which all first unions dissolve before the first birth to populations in which first unions do not dissolve. The first row shows that dissolution of all first unions prior to a first birth would produce significantly lower fertility compared with populations without union dissolution; differences range from 0.34 to 0.49 child, with larger differences when first births and first unions occur at the youngest and oldest ages (corresponding to rates for the oldest and youngest cohorts). If dissolutions occurred after the first union birth, differences between populations would be smaller, from 0.21 to 0.37 children, but in the same direction and larger only under the birth and union rates observed for the oldest cohort. If unions dissolved after the second union birth, completed family size would be reduced by only 0.11 children under rates observed in the youngest cohort to 0.27 under rates observed for the 1930s cohort. Only populations in which all first unions end before first birth would have fertility levels substantially below replacement.

We conclude from these analyses that the net effect of union instability is to reduce completed family size but that the reduction is smaller in populations (such as the younger cohorts) with delayed union formation and childbearing and with higher rates of union dissolution.

Repartnering and Completed Fertility

In the bottom panel of Table 6, we see that if all women who become or remain single after having one or two children formed new partnerships within their childbearing years, they would have from 0.22 to 0.55 more children than if none of them did so. Differences are larger for populations in which dissolution always occurs after the first birth than after the second, and differences associated with repartnering decrease somewhat as first births and first unions are delayed, as is the case for younger cohorts. Expected family size for populations with 100% repartnering remains, however, below that for populations in which unions producing the first child or the first two children remain intact.

Timing Matters

We already noted that higher fertility in populations with all first births before the first union is due almost entirely to the relatively young age at which pre-union births occur. And differences in the fertility implications of union dissolution and repartnering are smaller in populations with later union formation and childbearing and higher risks of dissolution (i.e., the younger cohorts). In this section, we investigate timing more explicitly by varying the age at which unions and births occur or the length of birth intervals.

In the top of Table 7, we see that union dissolution reduces completed childbearing to a greater degree if unions are formed before rather than after age 30. This result seems counterintuitive because unions and births occurring at younger ages allow more time to compensate for fewer births in a first union by repartnering and having additional children. On the other hand, a population in which unions are formed after age 30 may be selective of those who desire smaller families or no children at all. Populations of women with delayed union formation and childbearing are also more likely to run out their "biological clocks" and have difficulty conceiving at older ages (Beaujouan and Solaz 2008). Thus, regardless of whether these postponed unions endure or are dissolved during what remains of the childbearing years, fertility is low, and little difference is observed between populations with and those without union dissolution.[8]

The bottom portion of Table 7 shows a more expected pattern for repartnering. The largest increases in childbearing associated with repartnering occur in populations in

[8] Toulemon et al. (2008) showed that fluctuations in mean age at birth have not produced changes in completed family size in France, but the mean age at birth has always been close to or under 30. Our analyses suggest that if mean age at birth were well above age 30, smaller family sizes would result.

Table 7 Expected births in populations by timing of births and union events

		By Cohort Age-Specific 1st Birth, 1st Union Rates				
		1930–1939	1940–1949	1950–1959	1960–1969	1970–1979
First Unions and Births at Age <30						
Separations Occur…						
Before 1st birth	Separated	1.97	1.89	1.82	1.77	1.62
	Union intact	2.49	2.28	2.20	2.22	2.17
Between 1st and 2nd birth	Separated	2.26	2.13	2.08	2.11	2.02
	Union intact	2.66	2.41	2.34	2.38	2.34
Between 2nd and 3rd birth	Separated	2.61	2.48	2.45	2.46	2.43
	Union intact	2.90	2.65	2.59	2.61	2.59
First Unions and Births at Age 30+						
Separations Occur…						
Before 1st birth	Separated	0.49	0.41	0.45	0.55	0.69
	Union intact	0.65	0.56	0.57	0.68	0.81
Between 1st and 2nd birth	Separated	1.57	1.49	1.47	1.50	1.47
	Union intact	1.70	1.63	1.58	1.61	1.58
Between 2nd and 3rd birth	Separated	2.21	2.13	2.14	2.15	2.15
	Union intact	2.25	2.17	2.15	2.16	2.16
Separation at Age <30						
Parental Status at Separation						
One child	No repartnering	1.83	1.62	1.56	1.63	1.56
	Repartnering	2.23	2.00	1.95	2.01	1.91
Two children	No repartnering	2.94	2.60	2.54	2.60	2.61
	Repartnering	3.04	2.77	2.72	2.76	2.73
Separation at Age 30+						
Parental Status at Separation						
One child	No repartnering	1.06	1.05	1.05	1.06	1.06
	Repartnering	1.25	1.20	1.20	1.25	1.25
Two children	No repartnering	2.07	2.04	2.03	2.04	2.04
	Repartnering	2.26	2.16	2.15	2.17	2.17

Note: Estimates from life histories of 1 million women in each cohort using Modgen.

which women have one child in their first union and the union ends before age 30. In populations in which women have two children in the first union or union dissolution occurs after age 30, it does not matter much for completed fertility whether these women repartner. Women forming new partnerships after age 30 are increasingly likely to have difficulty conceiving or not to wish to combine rearing of older children with a new infant.

The second dimension of time that matters is the length of exposure to risk of childbearing in different union states. We use the simulated 1950s cohort for comparisons presented, but the patterns are the same as those generated for other cohorts. Figure 1 shows that fertility differences associated with dissolution are smaller, the longer childbearing is delayed in a first union. This result can be explained by

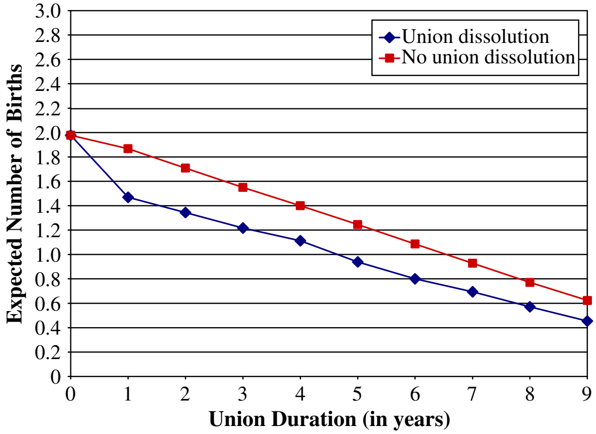

Fig. 1 Expected births for populations by union duration at first birth or union dissolution, 1950s birth cohort

differential propensity in the populations to produce any children at all. A population of childless couples at lengthy union durations is presumably one with low propensity for childbearing. Thus, regardless of whether such couples separate or remain together, women will have few children.

Figure 2 presents parallel estimates for populations in which women always have two children in their first union. The time dimension here is the second child's age. If such unions dissolve early in the child's life, mothers will end up with more children than if all such unions remain intact. The difference becomes much smaller, however, when unions dissolve at older ages of children. These estimates differ from those presented in Table 6 because the figure limits the comparison to populations in which women do not have a third birth by second child's age X; within those constraints, more children are produced when such unions dissolve at child's age X than if they continue (with or without additional births). In the subpopulation with union dissolution, women will be at risk of forming a new partnership and having additional children.

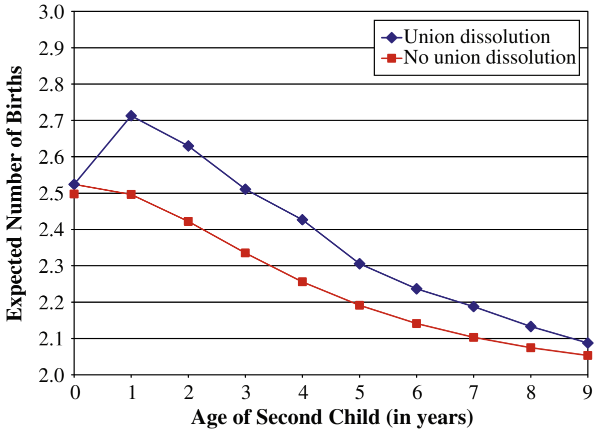

Fig. 2 Expected births for populations by second child's age at third birth or union dissolution, 1950s birth cohort

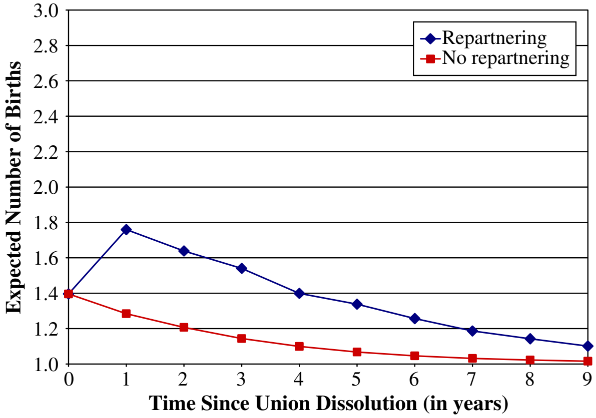

Fig. 3 Expected births for populations with separation between first and second births by duration to repartnering, 1950s birth cohort

Figure 3 shows the implications of delay in repartnering for populations of women who separated after the first child's birth. At each duration of singlehood, populations with repartnering end up with more children than those that do not, but the differences are smaller the longer it takes to repartner.

Discussion

So what are the implications of union instability for fertility? Our analyses of observed family events in France confirm the pathways through which union formation and dissolution may influence completed family size. First, unions produce births. First-birth rates are five times as high and second-birth rates are twice as high in coresident unions than during periods of singlehood. The longer women spend out of union during their childbearing years, the lower their expected number of children. This isn't a particularly new or startling result, but we emphasize it as one of the key mechanisms through which union stability is related to fertility. The fact that it makes more difference for first and second births, when such births constitute the vast majority of all births, means that periods out of union remain important for replacement-level fertility, despite the fact that it theoretically takes only a few years to produce two children.

We also confirm the now well-documented stepfamily effect. At all parities, women whose children were born in a single union have lower birth rates than women who have had children with a previous (resident or nonresident) partner. The incremental risk of childbearing is much greater when all the woman's children were born with previous partners—that is, when the repartnered couple has no shared children. Because first-time parents are highly likely to have two children together, new partnerships are particularly significant for third and fourth births.

The potential for stepfamily births is somewhat moderated by lower rates of repartnering for women with children from their first union and by higher rates of dissolution for stepfamily unions compared with unions with only shared children. That is, the additional children some stepfamilies might produce is offset by higher rates of dissolution and reduced time in the union (Henz and Thomson 2005).

Our primary goal was to understand the implications of these patterns for a population's fertility. We found that fertility would be higher in a population in which first births occurred before rather than in the first union. We also found that a population with stable unions would produce more children than one in which all unions dissolved, between one-third and one-half of a child per woman. Even if all women repartnered, fewer children would be born. Billari (2005) suggested, tongue-in-cheek, that replacement-level fertility in a context where couples have one child together requires that each person form two partnerships during the childbearing years. Our simulations suggest that populations with patterns of union formation and dissolution found in France will not quite achieve this goal.

Our simulations demonstrate further that timing is critical to the relationship between union stability and fertility. As we noted, almost all pre-union births in France occur to relatively young women. The additional births these women produce can be attributed to the time remaining after the first birth to find a partner and produce additional children, as well as to their likely greater interest in intimate relationships and parenthood compared with women who delay childbearing into later years and unions. As Lutz and Skirbekk (2005) suggest, making it easier for relatively young couples to become parents could contribute to higher-order childbearing; of course, at very young ages, such effects might be countered by higher rates of separation.

On the other hand, we find that union instability reduces childbearing more when first unions dissolve at earlier rather than later ages. We might have expected only a small difference because early dissolution allows time to find a new partner and have additional children. What seems to be in play here is that women in stable unions who are childless at age 30 have very few children. As Goldstein et al. (2003) suggest, delayed partnering and childbearing may produce a normative context in which more couples accept or come to prefer childlessness or one-child parenthood.

Repartnering, however, operates in the opposite and expected direction. Populations with early dissolution and repartnering produce more births in stepfamilies than populations in which dissolution and repartnering occurs later in the childbearing years. Later dissolution allows less time to find new partners, and children born in previous relationships become older and potentially have greater negative effects on additional childbearing.

Long birth or union intervals also reduce the influence of union disruption or repartnering on completed fertility. This finding is likely due to the selectivity of women who remain in intact partnerships without having third and higher-order births or who take longer to form new partnerships after a separation. If we imagine a population in which everyone experiences longer intervals between births or unions, however, such selectivity may not apply so that differences remain in completed fertility depending on the level of union stability.

An important part of the picture is missing from our analyses and simulations: the experience of men. First, the EHF did not provide complete information on a woman's stepchildren, the children her first or most recent partner had before the couple lived together. This means that the stepfamily effect put into the microsimulation could be underestimated because men's responsibility for children further reduces the risk of stepfamily births. If we had full information on the couple's prior children, our models might have produced a smaller difference in fertility between populations with no dissolution and those in which all first unions dissolved and were followed by repartnering.

Second, our simulations are based on union and birth histories of women. The primary difference we might expect between parameter estimates for men and women is that men's children—who are less likely to live with them after separation or divorce—may be less of an impediment to repartnering and/or childbearing in stepfamilies (de Graaf and Kalmijn 2003). Thus, a population of men with high rates of separation and repartnering might produce as many or more children than a population in which men do not separate or repartner.

Third, we do not consider the market of men with whom a population of separated women may repartner. If repartnering is with fathers, stepfamily couples will already have at least two children and therefore will be less likely to have an additional child together (Thomson 2004; Thomson et al. 2002). That is, the population-level stepfamily effect will be larger, the more random is repartnering with respect to parental status.

Finally, our models do not include common sources of union and birth transitions, such as education, ethnicity, and community. A number of exogenous conditions may enable couples to have more children, resolve conflicts and maintain the relationship, or offer alternatives to both partnership and parenthood. We use the term *engine* as a metaphor for the reciprocal relationships between union and birth histories. We argue that it is important to identify the implications of potential mechanisms in the partnership-parenthood connection through simulation only of their demographic components. An extension of our work would consider whether a variety of common conditions account for or interact with relationships between union and birth processes.

We also note that our simulations depend on the parameters generated in a setting with relatively high fertility and union instability. It remains to be seen whether the same engine with different inputs in terms of levels of union formation and dissolution can account for cross-national variation between "highest-low" and "lowest-low" fertility.

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