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Union Instability as an Engine of Fertility? A Micro-simulation Model for France

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Abstract

Micro-level relationships between union formation or dissolution and childbearing have implications for fertility that have not been thoroughly examined. In this paper, we suggest that these relationships comprise an 'engine' that produces variation and change around replacement level fertility. On the one hand, union dissolution reduces opportunities for conceiving and bearing children. At the same time, it produces a pool of persons who may enter new partnerships and produce 'extra' children. The balance between these two opposing forces and their implications for fertility levels is unknown and will depend in part on the timing of union formation and parenthood. In this paper, we estimate the parameters of these micro-level relationships for female respondents to the 1999 French `Etude de l'Histoire Familiale´. We use those parameters to simulate the implications of non-union childbearing, union dissolution and re-partnering for completed family size. We also investigate the extent to which links between union formation or dissolution and childbearing depend on the timing of unions and births.

Keywords

Union instability, fertility, France

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1. Introduction

The so-called Second Demographic Transition is less a story about fertility than about the changing nature of intimate unions. Young adults live together and have children later in life than ever before. They are increasingly less likely to marry, even when children come along, and more likely to experience separation and re-partnering during the childbearing years. The instability of intimate unions, especially those in which children are born, is by far a more life-changing experience than having one or two children rather than three or four in a stable relationship.

The nature of the relationship between dramatic changes in union formation and dissolution and fertility levels has not, however, been fully explored in studies of the Second Demographic Transition. 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 at the same time increasing the probability of 'extra' children in a new union. The balance between these two opposing effects and the relative proportion of the populations at risk may make the difference between above- or below-replacement fertility.

Until the Second Demographic Transition, union formation was considered a proximate determinant of childbearing. Thus, delays in union formation and marriage in particular were considered part of the explanation for delayed childbearing. Even in the context of the SDT, formation of a stable union remains for most young adults a necessary condition for having children (Hobcraft and Kiernan 1995). Although childbearing in cohabiting unions or out of unions has increased in many European countries, fertility rates remain much higher in marriage than in cohabitation and in cohabitation than during periods without a coresident partner. Several studies using simultaneous models have demonstrated that some portion of the association between cohabitation, marriage and childbearing is due to common unobserved predispositions to enter partnerships and have children. Controlling for such predispositions, however, does not eliminate the positive 'effect' of cohabitation or marriage on childbearing or vice-versa (Baizan, Arnstein and Billari 2002, 2003; Brien, Lillard and Waite 1999; Le Goff 2002).

Childbearing is also positively associated with union stability, at least during the period when children are young (Steele et al. 1995). Lillard and Waite (1993) were the first to demonstrate with simultaneous hazard models that unions most likely to dissolve also produced fewer children. Effects were particularly pronounced for the risk of having a first child. Negative associations between the unobserved risk of childbearing and separation have also been found in several European countries (Henz & Thomson 2004; Coppoloa and Di Cesare 2008). Delayed and unstable unions are therefore a negative force in terms of completed fertility.

On the other hand, union dissolution produces a pool of persons at risk of new partnerships and further childbearing. And when the dissolved partnerships have already produced children, new partnerships have the potential for producing more children than would have been born had the first parental union remained intact. Most research on childbearing in stepfamilies simply estimates effects of previous children on childbearing in new unions and finds a negative effect as might be expected from the larger number of children a stepfamily birth would produce (Bumpass 1984; O'Keeffe 1988; Wineberg 1990; Haurin 1992; Lillard & Waite 1993; Loomis & Landale 1994; Toulemon & LaPierre-Adamcyk 1995; Toulemon 1997; Buber & Prskawetz 2000; Olah 2001; Stewart 2002).[1] In some studies, however, the high family size associated with stepfamily births did not deter couples from having at least one shared child (Griffith et al. 1985; Vikat, Thomson & Hoem 1999; Toulemon 1997). Two studies of Swedish fertility (Hoem 1995; Vikat et al. 1999) demonstrated that 'extra' children were produced by re-partnering. Both showed that the risk of having a second or third child in one's lifetime was significantly greater when that birth was the first in a union; that is, new unions produce 'extra' births that would not otherwise occur. Vikat et al. (1999) found also that the risk of a third lifetime birth was higher if the individual's third birth was only the second in the union, i.e., if it was the couple's second rather than third shared birth. Using more complete data – including that on both partners' children – Thomson and her colleagues (Thomson et al. 2002; Thomson & Li 2002) found that stepfamily couples with no shared child or only one shared child had an elevated birth risk, net of the effects of the couple's combined number of children. When children live with a re-partnered couple, the likelihood of 'extra' births is reduced but not removed (Vikat, Thomson & Prskawetz 2004). Henz & Thomson (2005) showed that the stepfamily effect on childbearing was larger when controlling for the higher risk of dissolution in stepfamily than non-stepfamily unions.

The overall implications of union instability for fertility depend on the relative strength of these two opposing forces. Much of the evidence suggests that combined effects are neutral or negative – that is, the 'extra' births to stepfamilies in their childbearing years compensate (or do not quite compensate) for the 'lost' births from unions that dissolved. Early studies showed that women who remained in stable marriages had more children than those who divorced and did not remarry, fewer children than those who divorced and remarried, producing no net difference between ever-divorced and continuously married women (Cohen and Sweet 1974; Lauriat 1969; Thornton 1978; Kalwat 1983; Kucera 1983; Wineberg 1988; Clarke et al. 1993). The patterns were most consistent for U.S. white women. Among ethnic minority U.S. women, for example, stable marriages produced on average one more child than disrupted marriages, with or without remarriage (Thornton 1978; see also Wineberg 1988). Beaujouan and Solaz (2008) replicate these findings for somewhat younger cohorts in France, including cohabitation as well as marriage. Among those born in 1939-54, completed family size was higher for women and men whose first union remained intact than for those who had ended the first union. Women who formed a second union 'recaptured' most of the 'lost' childbearing, and men who formed a second union slightly exceeded the family size of men who remained in the first union. Women and men who did not re-partner had significantly

[1] Coppola and Di Cesare (2008) report a negative effect of the dissolution of first union on women's subsequent childbearing, but do not take into account differences between women who do and do not form new unions.

fewer children. Jansen, Wijckmans & Bavel (2008) reported for several European countries that those who had experienced divorce had about the same number of children as those who had not. As in other studies, those who re-partnered had more children, those who did not had fewer, in comparison to the stably married.

The combined result of inhibiting childbearing in unstable unions and 'extra' children in new partnerships will depend to some extent on the timing of first births and union dissolution. For example, Kalwat (1983) found that late marriage produced fewer children even for those who had divorced and remarried, compared to late but stably married couples. Using an estimate of sterility based on age and parity, Beaujouan and Solaz (2008) conclude that, were it not for increasing sterility, new partnerships formed during the latter part of the childbearing years would produce even more 'extra' children than is observed. That is, the later the first birth (and subsequent dissolution of a parental union), the smaller the positive force of re-partnering on completed fertility.

Macro-level analyses suggest a shift across Europe in the relative impact of the two micro-level processes. Billari and Kohler (2004) reported a negative association between total fertility rates and total divorce ratios in 1975, a neutral or slightly positive association in 2001/02. They interpret the shift as arising from the disconnection between marriage and childbearing. That is, the rise in cohabitation makes marriage and divorce rates poor indicators of intentions for or exposures to the risk of pregnancy and birth. Whether fertility is no longer associated with the formation and dissolution of coresident unions (including both cohabitation and marriage), is an open question. And whether the association is driven more by under-achieved fertility in unstable unions or over-achievements through new partnerships is another.

Our purpose in this paper is to examine the micro-level processes underlying the connections between union timing and stability and the risk of first, second, third and fourth births in France. We estimate models of the birth risk as a function of union status and experience in relation to past births; and models of union formation and dissolution as a function of prior births and the unions in which they were born. These models are much more detailed than earlier studies in their investigation of relationships between unions and births. We then apply the parameter estimates to simulate their implications for completed fertility. Simulation enables us to estimate the fertility implications of shifts in key parameters and/or the composition by union experience and status of women in the childbearing years, i.e., to go beyond the observed relationships reported in previous research.

2. Data

The data for this study come from the French `Etude de l'Histoire Familiale´ (EHF) 1999, which was conducted together with the census in March 1999 (Cassan, Héran, Toulemon 2000). In this study, 235 000 women and 145 000 men completed an additional questionnaire on their origin, children, partnerships, working life, social origin and languages spoken in the family. We limit our analysis to women born in 1930-1978 i.e. ages 20-68 by the time of interview. Immigrants were included only if they arrived in metropolitan France before they reached age 15, i.e. they underwent their transition to

adulthood in France. Moreover, we excluded observations where the event took place before the age of 15.

About 171 400 women remained in our sample, of whom 73% reported a first birth, 53% a second birth, 24% a third birth and 9% a fourth birth. Respondents were also asked about their union histories (marriage or living in a union, defined as sharing the same household for six months or longer). If respondents reported more than two unions, entry and ending dates were recorded only for the first and most recent (including union ongoing at the survey). First unions were reported by 83% of the sample up to age 50, of which 23% had ended within the reproductive years. Among those experiencing union dissolution, 52% had formed at least one subsequent union by age 50. Of the most recent unions, 19% had ended by the time of the 1999 survey[2]. The primary advantage of the French data for our purposes is the sample size, enabling us to distinguish between a wide variety of birth and union trajectories.

In this analysis we have chosen not to distinguish marital from cohabiting unions. It is well known that childbearing risks are higher and the risk of separation is lower for marital than non-marital cohabiting unions. Both associations are in large part due to unobserved characteristics of married and cohabiting couples (Baizan et al. 2003, 2004). Marriage may also result from (be endogenous to) a couple's decision to have children together, consistent with findings that conceptions increase dramatically shortly after a marriage, but to a much less extent after cohabitation (Baizan et al. 2003, 2004). We therefore prefer a more general approach that does not consider a union's legal status but only its stability.

Table 1 provides an initial indication of relationships between unions and births across cohorts. We are able to observe four cohorts to age 30 (1930s to 1960s), the first three of which can be observed to age 40. Shifts in the timing of childbearing and in union stability are evident. By age 30, 81 percent of the oldest cohort but only 70 percent of the youngest cohort had born a child. The 1950s cohort caught up by age 40, about 88 percent having become mothers. We cannot tell from these data whether the youngest cohort will have caught up with their elders by age 40.

The proportion of first births occurring out of a union remained quite stable across cohorts while the proportion occurring in cohabitation increased quite dramatically. Younger cohorts experienced much higher likelihood of dissolving their first parental union by age 30 or age 40. And the proportion of 2nd and 3rd births occurring after the first parental union, though small, increased steadily across cohorts.

3. Modeling Birth and Union Intensities

We identified eight processes from which we need parameters to adequately simulate the contributions of union stability to fertility: conception of the 1st, 2nd, 3rd, and 4th birth, formation and dissolution of the first and most recent higher-order union. We model only the components of our 'engine', i.e., relationships between union status and parity. In order to observe changes over time we additionally control for the birth cohort of the respondent.

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

In the following sections, we describe the models for each event, but present only parameters that link unions and births. Full model parameters are available on request.

3.1 Birth intensities

We model first birth intensity as a function of mother's age, union status and birth cohort. Table 2 shows parameter estimates for five categories of union status, union order and duration, and interactions between union duration and birth cohort. Birth risks are lowest for women not in a coresident union, especially for women never in a union. Some of the observations between the first and latest union may have occurred in unions that were not identified in the survey. The fact that birth risks for the period between a first and latest union ('after first') are very similar for those after the latest union ('after last')– where we know that no union occurred – suggests that very few of the 'after first' segments included additional unions. Birth risks by union duration are very similar in first and higher-order unions. The negative effect of union duration is stronger for the older cohorts; among the younger cohorts, birth risks even increase slightly after the first two years in a first union.

Parameters not shown include the usual bell-shaped pattern for single years of age. We also modeled an interaction between ten-year birth cohorts and age using a linear spline with a node at age 21. The node was selected according to the BIC statistic and how well the model replicated the first birth intensities, when estimated separately for cohorts who had completed their reproductive career by the time of the survey. As expected, more recent cohorts show much steeper slopes in first birth risks at older ages.

In models for higher-order births, union status is classified in relation to previous birth(s), consistent with previous research on childbearing in stepfamilies. As shown in Table 3, second- and third-birth intensities are lowest for women not in a union, but the difference is not as great as for first-birth intensities. Fourth-birth intensities are even *higher* for women not in a union than for women in a union with three children. These patterns could arise in part from the 'middle' unions not observed in the survey where higher-order births would be more likely to occur. They are also consistent with 'extra' children desired in new partnerships, even non-resident partnerships. The value of such 'extra' children is also evidenced by the higher risks of second-, third- and fourth-birth intensities for unions that did not produce all of the prior births. The relative risk is especially high when the birth is the first in the union.

All of these models included the younger/youngest child's age in single years to age 9, 10-14, 15-19 and 20-35. Because the pattern of birth spacing following the birth of the first child remained fairly stable across cohorts, we assume cohort- and age-specific birth intensities to be proportional for higher order births. Parameters not shown in Table 3 demonstrate peaks in second- and third-birth intensities when the younger/youngest child is age two; but a peak in fourth-birth intensities when the youngest of three children is one year old. Higher-order birth intensities decline rapidly with mother's age but only fourth-birth intensities are greatly reduced among the younger cohorts.

3.2 Union formation and dissolution

We estimated separate models for the formation and dissolution of first and the most recent higher-order union. (Recall that union histories include no information about possible unions between the first and most recent.) The left-hand columns of Table 4 show that pregnancy considerably increases the risk of entering a first union, particularly if it is the first pregnancy carried to term. Compared to childless women, mothers experienced higher intensities of first union formation if they had one child under age 3 or more children with the youngest age 7 or older. Only mothers with three children, the youngest under age 7, had significantly lower intensity of first union formation compared to childless, non-pregnant women. For the most part, therefore, children are not a barrier to first union formation.

The model for first union formation also included birth cohort, age splines with nodes at 20 and 24, and the cohort-age interaction. Parameters not shown in Table 4 describe a clear hump shape pattern of the intensity of union formation where the clock is the number of years since age 15. We included an age-cohort interaction using linear age splines with nodes at age 20 and 24. Similarly to first births, the slope for first union intensities at older ages were steeper for more recent cohorts, but the differences are much smaller compared to first birth risks.

In the right-hand columns of Table 4 we see that pregnancy also significantly increases the risk of entering a higher-order union, except for women who had a prior birth while not in a coresident union. The presence of children significantly reduces higher-order union formation rates, independent of whether the children were born outside a union or in a previous union. The negative effect of children on higher-order union formation lessens as children age. Parameters not shown in Table 4 indicate that intensity estimates decrease monotonically by duration since the end of the first union and by the woman's age, with steeper slopes for younger cohorts.

We model dissolution of first and most recent higher-order union as a function of union duration, births in and prior to the union, age of the youngest child and respondent's age. In Table 5, we see that pregnancy greatly reduces the risk of union dissolution in comparison to being childless, except when the woman experiences a first union pregnancy and has two children prior to the current union.[3] Having children also reduces the risk of dissolution, except when all children were born prior to a first union. In general, dissolution intensities are lower when children are young and born in the union. The most notable exception to this pattern is the relatively high (same as childless women) risk of first-union dissolution for women with three births, two of which preceded the first union.

Parameters not shown indicate that dissolution risks increase over the first two years of partnership, remain steady and eventually decline, but the differences by duration are quite small. First unions show no strong age patterns in the dissolution risk, while later unions are much less stable at older ages. Consistent with well-known patterns, the intensities for union dissolution are much higher for younger cohorts.

[3] In a few other circumstances, coefficients are not significantly different from 1, but they remain quite small.

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 and out of a coresident union 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 re-partnering and we find considerable evidence of higher birth intensities in new unions, especially when the child is the first in the union. In order to understand the implications of these complex interrelationships for completed fertility, we turn to microsimulation.

4. The Microsimulation Model

We use a competing risk cohort micro-simulation model, applying the parameters estimated in the hazard models. We used *Modgen*, developed at Statistics Canada, to simulate the completed fertility of five birth cohorts, each encompassing one million women, representing women born in 1930-1939, 1940–49, 1950–59, 1960–69, and 1970–79. The simulated data enable us to compare the completed fertility of women with different types of birth and union histories. We present comparisons that focus on the implications for fertility of births before the first union, dissolution of the first union, and re-partnering.

Note that the simulations for each cohort have some elements in proportion, i.e., those for which our model does not include cohort interactions. For example, in simulating first births, we use the same parameters for the birth risk by union status for all cohorts while varying the specification of age and union duration effects. Furthermore, simulations for the youngest cohort must rely to a greater extent on the experience of older cohorts at older ages because we have observed these women only to age 30.

4.1 Non-union births and completed fertility

Our first set of comparisons considers the contribution of non-union births to completed fertility. We compare completed family size for women whose first birth occurred before or in the first union, separately for each cohort. The first panel in Table 6 shows that women who experience a first birth before their first union end up with more children. This result holds for all cohorts, although the gap diminishes for the younger cohorts.

The higher completed fertility of women with non-union births is, however, entirely due to their young age at first birth. We compared expected number of additional births for quartiles of women according to their age at first birth (including those who did not have a first birth). Only the women who were in the first quartile (below age 22 for the older cohorts, age 23 for those born in the 1960s or later) had more children if their first birth occurred prior to a first union than in a first union. These women, however, accounted for the vast majority of the non-union births. For all cohorts, women who had a first birth prior to a first union were on average three years younger than those who had their first birth in a first union. Moreover among women with a first non-union birth, around one third to one half had their first birth before age 20 compared to between four and thirteen

percent among those who had their first birth in a first union. (Analyses available on request.)

These results suggest that moderate levels of pre-union childbearing (in France, just under 10 percent 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 have more children. It is early childbearing, however, not childbearing out of union that is the likely driving force.

4.2 Union dissolution and completed fertility

The middle panel of Table 7 presents estimates of completed family size for women with different union experience, separately by cohort. First, we compare expected family size for women whose first union dissolved when they were still childless, compared to expected family size for women whose first union did not dissolve. In the second and third rows, we limit the comparison to women who had at least one child in the union or women who had at least two children in the union. Among all childless women in a first union, dissolution of that union significantly reduced eventual completed family size; differences ranged from 0.34 to 0.49, larger for the oldest and most recent cohorts. Among women who had at least one child in the first union, differences were smaller, from 0.21 to 0.37 children, but in the same direction and larger only for the oldest cohort. Women who had two children in their first union also ended up with fewer children altogether if their first union dissolved. Differences were even smaller, however, from 0.11 children for the youngest cohort to 0.27 for the oldest.

We conclude from these analyses that the net effect of union instability is to reduce completed family size. We note, however, that differences are smaller for younger cohorts, including those for whom our parameters are based on observations to age 40. Among women who do and do not dissolve their first unions, completed family size remains below the replacement level of 2.11 children per woman.

4.3 Re-partnering and completed fertility

Third, we consider the implications of re-partnering for completed fertility among women who had a child in a previous union or before the first union. In the bottom panel of Table 6, we present estimates of completed family size for women who are single after having one or two children. Women who form new partnerships have from .22 to .55 more children than those who do not. Differences are larger for those with one child than with two, at the time of exposure to the risk of a new partnership; and the differences decrease somewhat across cohorts. Expected family size for the re-partnered women remains, however, below that for women whose first and/or first two children were born in a union that remained intact.

4.4 Timing matters

We already noted that timing matters. Additional births to women whose first birth occurred before their first union can be attributed almost entirely to the women's relatively young age at first birth and greater years of exposure to the possibility of new partnerships and 'extra' births. In this section, we investigate two aspects of timing as they interact with union dissolution and re-partnering. First, we consider the age at initiation or exposure to risk.

In the top half of Table 7 we see that union dissolution reduces completed childbearing more for those who formed unions before age 30 than for those who delayed. If a woman had one or two children in the first union, union disruption produced a bigger difference in completed family size if the births occurred before rather than after age 30. This result seems counter-intuitive because the younger women have more time to compensate for fewer births in a first union by re-partnering and having children. On the other hand, among those who delay partnership, a disproportionate number may desire smaller families or not wish to have children at all. And delayers are also more likely to run out their 'biological clock', i.e. have difficulty conceiving at older ages (Beaujouan & Solaz 2008).

The bottom half of Table 7 shows a more expected pattern for re-partnering. The largest increases in childbearing occur with re-partnering when the woman has one child in the first union and the union ends before age 30. Women with two children in the first union or whose union ends after age 30 have only slightly larger family sizes if they re-partner compared to women who do not. Women forming new partnerships at longer durations after age 30 are increasingly likely to have difficulty conceiving or not wish to 'start over' with a new infant.

The second dimension of time that matters is the length of exposure to risk of childbearing in different union states. Figure 1 shows the difference in expected completed family size for women who were childless and ended their first union at a given duration, compared to women who remained in the union *and were still childless* at that duration. Especially for the older cohorts, the difference associated with dissolution is smaller, the longer women are observed in the childless state. This result can be explained by the increasing selection of women who remain childless at longer union durations. Women who are able to conceive and want to have children are selected out of the comparison at earlier union durations. The women whose unions eventually dissolve may have delayed childbearing because they sensed the union's instability and go on to have children with a new partner, while those whose unions remained intact are more likely to be subfecund or childless by choice.

Figure 2 presents parallel estimates, but for women who had two children in their first union. The time dimension here is now the younger child's age. Compared to women who separated at a given age of the child, women whose unions remained intact and who had not yet had a third child ended up with *fewer* children. The difference becomes much smaller, however, at older ages of children. This pattern is similar across cohorts. These estimates differ from those presented in Table 6 because the figure compares women in unions that end with those in stable unions *of the same duration* who have not had a third birth. The latter group is likely more select for not intending a third birth, while the former group will be at risk of forming a new partnership and having an 'extra' child.

A similar pattern is shown in Figure 3 for re-partnering at varying durations since the end of a first union with one child. At each duration of singlehood, women who then re-partner end up with more children than those who do not, but the differences are smaller the longer it takes to re-partner.

5. Discussion

So what are the implications of union instability for fertility? Our analyses of observed family events in France confirm a number of key associations between unions and births. First, unions produce births. First birth rates are five times as high, second birth rates twice as high in cohabiting or marital unions than during periods of singlehood. Only among the select group of women who are single with three children are birth rates high relative to women with all children in the same union; and they are lower than for three-child mothers with new partners. 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 couple of 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, much greater when all of the woman's children were born with previous partners, i.e., the re-partnered 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.

Childbearing does not appear to inhibit formation of a first coresident union, in fact somewhat the reverse. Women with one child under three years of age are more rather than less likely to enter a first union compared to childless women. Some if not all of these unions may, of course, be with the father of the first child. But older children also do not appear to inhibit the woman's finding a first coresident partner. Women with two or three children, the youngest of whom is at least seven years old, have relatively high rates of first union formation. We noted above that such women begin childbearing at a relatively early age. Their high rates of union entry increase the pool of stepfamilies that may produce 'extra' children but they are a very small minority of French women.

The likelihood of forming a higher-order union is, however, reduced by motherhood, with little difference between women whose children were born out of union or in a previous union and little difference depending on the number of children or age of youngest child. The relatively small differences between mothers and childless women and the relatively higher rates of first partnerships among mothers means that in France, the pool of re-partnered women with children is relatively high, providing considerable opportunity for having at least two and likely more children.

We also confirm previous research showing that children contribute to union stability, particularly when they are very young. Couples with step-children are more likely to separate, however. The 'extra' children some stepfamilies could produce may therefore be offset by higher rates of dissolution and reduced time in a union.

The associations between union and birth events presented herein are the most comprehensive that have been produced for any population and are of interest in and of themselves. But our primary goal was to understand the implications of these patterns for the overall association between union instability and fertility. The simulations show us what would happen under different scenarios, given the relationships we observed in the data between childbearing and union formation and dissolution.

We first investigated the implications for completed childbearing of a birth before the first union. For older cohorts, non-union childbearing was part of the production of larger family sizes, but for the most recent cohorts no differences are observed between those who had children before or in/after the first union. Of course, no policy maker or citizen would think it sensible to encourage young single women to have children simply to increase the birth rate. The timing of first births – which accounts in large part for the non-union births – is another issue to which we return below.

In France during the last half of the 20th century, stable unions produced more children altogether than unstable unions, between a third and a half of a child across cohorts. Even women who formed a new partnership had fewer children than those who had the same number of births in the first parental union and whose unions remained intact. Re-partnering did produce additional births compared to women who did not re-partner, but not in sufficient numbers to compensate for 'lost' births in stable parental unions.

The Second Demographic Transition has been not only about the changing nature of intimate partnerships but also about their timing in the life course. Although biological clocks have become a little 'later' with improved health and reproductive technology, they remain a constraint on opportunities for forming fertile partnerships. And while social clocks may no longer care about minutes, they continue to keep track of the hours. Thus, the later young people enter into unions and become parents, the less flexibility they have to achieve the normative two-child family, and the more they and their peers may settle for or learn to prefer childlessness or one-child parenthood (Goldstein, Lutz & Testa 2003).

Our simulations demonstrate 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 'extra' births these women produce can be attributed in part to the time they have left 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 to women who delay childbearing into later years and unions. As Lutz and Skirbekk (2006) suggest, making it easier for relatively young couples to become parents could contribute as well to higher-order childbearing.

On the other hand, we find that union instability reduces childbearing more for women who are relatively young when their first union ends. Among the youngest cohort, women in first unions that were stable to age 30 ended up with above-replacement fertility while those whose first union dissolved earlier had 1.62 children on average. We might

have expected only a small difference because women have at least 10 years within which to find a new partner and have additional children. When partnered women delayed childbearing until after age 30, the union's end made very little difference – about one-tenth of a child. Even in stable unions, women who are childless at age 30 have very few children, thus accounting for the small difference associated with dissolution.

Re-partnering, however, operates in the opposite and expected direction. Women who re-partner before age 30 have more time to produce the 'extra' births with a new partner. Those who re-partner later have less time, and their older children may also inhibit additional childbearing. Thus, the difference between women who re-partner or do not before age 30 is about twice that between women who do and do not re-partner after age 30.

When it comes to the second timing factor, long birth or union intervals also reduce the influence of union disruption or re-partnering on completed fertility. This is due in part 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.

We do not deny that relationships between union and birth processes affecting our results may arise from common exogenous conditions. For example, education may produce conditions that enable couples to have more children, resolve conflicts and maintain the relationship, or conditions that offer alternatives to both partnership and parenthood. We do not use the term 'engine' to suggest that union formation and dissolution are causes of childbearing but as a metaphor for their complex interactions. We think it is important to identify the implications of potential causal 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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Table 1
Unions & Births to French Women Born 1930-1979

Parental and Union Status	Birth cohort			
By Age 30, percentage of all women	1930-39	1940-49	1950-59	1960-68
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 parental union				
Intact	69.09	68.61	62.63	54.50
Dissolved	2.05	3.87	6.31	7.00
2nd birth				
in 1st parental union	48.15	48.14	43.04	34.09
After 1st parental union	0.40	0.52	1.12	1.50
3rd birth				
in 1st parental union	22.92	17.15	12.15	8.79
After 1st parental union	0.34	0.38	0.62	0.85

Parental and Union Status	Birth cohort		
By Age 40, percentage of all women	1930-39	1940-49	1950-58
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 parental union			
Intact	71.88	67.59	61.74
Dissolved	6.35	11.52	16.22
2nd birth			
In 1st parental union	61.62	60.53	58.08
After 1st parental union	0.74	1.30	2.57
3rd birth			
In 1st parental union	35.67	26.44	22.90
After 1st parental union	0.79	1.20	2.47
4th birth			
In 1st parental union	17.25	8.86	5.55
After 1st parental union	0.64	0.69	1.11

Source: Authors' analyses of data from 1999 French `Etude de l'Histoire Familiale´

Table 2
Estimated coefficients and standard errors, intensity of conception leading to a first birth

Covariate	exp(β)	se(β)
Union status		
never in union	0.085***	(0.001)
first union	1	
after first	0.199***	(0.007)
last union	1.001	(0.030)
after last union	0.224***	(0.038)
Union duration: first union		
first union<2y	1	
first union>2y	0.799***	(0.013)
Union duration: last union		
last union<2y	1	
last union>2y	0.803**	(0.057)
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 x 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	2173994	
Degrees of freedom	57	
Log-likelihood	-95860	
BIC	192551	

Note: Also in the model is mother's age in single years 15-44 plus 45-49 and interaction of age (splines from 15-21 and 21-49) and birth cohort.
Source: Authors' analyses of data from 1999 French `Etude de l'Histoire Familiale´
*p < .05, **p < .01, ***p < .001.

Table 3
Estimated coefficients and standard errors, intensity of conception leading to higher-order births

	Second birth		Third birth		Fourth birth	
Covariate	exp(β)	se(β)	exp(β)	se(β)	exp(β)	se(β)
Union status: current and of prior birth						
Not in union	0.451***	(0.007)	0.888***	(0.028)	1.162***	(0.046)
Union with first birth	1					
In union, 1st birth before union	1.181***	(0.021)				
In union, 1st birth in previous union	1.995***	(0.062)				
Union with 1st and 2nd births			1			
Union with 2nd birth, 1st birth out of union			1.204***	(0.026)		
Union with 2nd birth, 1st birth in previous union			1.497***	(0.070)		
In union, all births before current union, at least one out of union			1.800***	(0.073)		
In union, all births in prior union			4.537***	(0.205)		
Union with 1st, 2nd and 3rd births					1	
Union with 2nd, 3rd births, 1st birth before union					1.294***	(0.042)
Union with 3rd birth, 1st and 2nd before current union					1.579***	(0.072)
In union, 1st, 2nd and 3rd births before union					3.117***	(0.190)
Observations	751616		818681		385434	
Degrees of freedom	26		27		26	
Log-likelihood	-171008		-104056		-39294	
BIC	342368		208480		78922	

Note: 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 French `Etude de l'Histoire Familiale´
*p < .05, **p < .01, ***p < .001

Table 4
Estimated coefficients and standard errors, intensity of union formation

Covariate		First Union exp(β)	se(β)	Most Recent Union exp(β)	se(β)
Births and Unions					
No births	Not pregnant	1		1	
	Pregnant	10.475***	(0.120)	1.785***	(0.142)
One birth out of union	age 0-3y	1.376***	(0.025)	0.513***	(0.041)
	age 3-7y	0.960	(0.030)	0.853*	(0.065)
	age >7y	1.054	(0.046)	0.793**	(0.057)
	Pregnant	2.060***	(0.091)	0.884	(0.163)
One birth in previous union	age 0-3y			0.637***	(0.033)
	age 3-7y			0.786***	(0.029)
	age >7y			0.760***	(0.028)
	Pregnant			1.880***	(0.167)
Two births out of union	age 0-3y	1.016	(0.038)		
	age 3-7y	0.918	(0.058)		
	age >7y	1.463***	(0.100)		
	Pregnant	1.316**	(0.124)		
Two births, one or both out of union	age 0-3y			0.623***	(0.042)
	age 3-7y			0.750***	(0.056)
	age >7y			0.843*	(0.056)
	Pregnant			1.190	(0.203)
Two births in previous union	age 0-3y			0.623***	(0.044)
	age 3-7y			0.693***	(0.032)
	age >7y			0.755***	(0.029)
	Pregnant			2.106***	(0.262)
Three births out of union	age 0-3y	0.837*	(0.061)		
	age 3-7y	0.772*	(0.088)		
	age >7y	1.751***	(0.179)		
Three births, one or more out of union	age 0-3y			0.701***	(0.060)
	age 3-7y			0.756**	(0.072)
	age >7y			0.840*	(0.069)
All births in previous union	age 0-3y			0.687**	(0.082)
	age 3-7y			0.780***	(0.056)
	age >7y			0.840***	(0.044)
Observations		1541408		218731	
Degrees of freedom		59		43	
Log-likelihood		-137231		-45316	
BIC		275303		91162	

Note: In the first-union model are age of woman in single years, birth cohort and an interaction between cohort and age (splines 15-20, 20-24, 24+). In the model for most recent union are time since first union in single years, age (15-24; 5-year categories), birth cohort.
Source: Authors' analyses of data from 1999 French `Etude de l'Histoire Familiale´
*p < .05, **p < .01, ***p < .001.

Table 5
Estimated coefficients and standard errors, intensity of union dissolution

Covariate		First Union exp(β)	First Union se(β)	Most Recent Union Exp(β)	Most Recent Union se(β)
Union status of prior births					
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 0-3y	0.469***	(0.012)	0.651***	(0.077)
	Age 3-7y	0.756***	(0.022)	0.902	(0.133)
	Age >7y	0.711***	(0.025)	0.690	(0.141)
	Pregnant	0.202***	(0.015)	0.127***	(0.066)
Two births, one in union	Age 0-3y	0.820*	(0.063)	0.540***	(0.079)
	Age 3-7y	0.841*	(0.072)	0.547***	(0.090)
	Age >7y	0.782**	(0.059)	0.914	(0.137)
	Pregnant	0.569*	(0.134)	0.455	(0.268)
Two births in union	Age 0-3y	0.310***	(0.010)	0.328***	(0.068)
	Age 3-7y	0.451***	(0.015)	0.739	(0.136)
	Age >7y	0.554***	(0.019)	0.877	(0.192)
	Pregnant	0.218***	(0.026)	0.000***	(0.000)
Three births, one in union	Age 0-3y	1.034	(0.174)	0.535***	(0.100)
	Age 3-7y	1.081	(0.200)	0.525**	(0.106)
	Age >7y	1.163	(0.177)	0.707	(0.142)
Three births, two in union	Age 0-3y	0.598***	(0.074)	0.427***	(0.110)
	Age 3-7y	0.755*	(0.091)	0.598*	(0.139)
	Age >7y	0.949	(0.091)	0.694	(0.170)
Three births in union	Age 0-3y	0.280***	(0.014)	0.370*	(0.157)
	Age 3-7y	0.392***	(0.019)	0.268**	(0.132)
	Age >7y	0.538***	(0.023)	0.103**	(0.077)
Observations		2419060		121187	
Degrees of freedom		43		42	
Log-likelihood		-93915		-8046	
BIC		188461		16583	

Note: Models also include union duration (two-year splines), woman's age (15-24 plus 5-year categories) and birth cohort.
Source: Authors' analyses of data from 1999 French `Etude de l'Histoire Familiale´
*p < .05, **p < .01, ***p < .001.

Table 6
Expected Births by Union Experience

Union Experience		Cohort 1930-39	1940-49	1950-59	1960-69	1970-79
First birth union status						
Before first union		2.74	2.48	2.35	2.26	2.04
In first union		2.54	2.30	2.18	2.14	1.99
First union parity & stability						
Childless	Separated	1.90	1.83	1.75	1.69	1.54
	Union intact	2.39	2.19	2.09	2.06	1.95
One birth in union	Separated	2.20	2.09	2.03	2.02	1.90
	Union intact	2.57	2.34	2.24	2.22	2.11
Two births in union	Separated	2.59	2.46	2.43	2.42	2.39
	Union intact	2.86	2.62	2.55	2.55	2.50
Re-partnering						
One child	No re-partnering	1.25	1.19	1.15	1.15	1.12
	Re-partnering	1.80	1.69	1.61	1.63	1.53
Two children	No re-partnering	2.19	2.10	2.08	2.08	2.07
	Re-partnering	2.51	2.36	2.33	2.32	2.29

Note: Estimates from life histories of one million women in each cohort using *Modgen*

Table 7
Expected Births by Unions or Births before or after Age 30

Union Experience		Cohort 1930-39	1940-49	1950-59	1960-69	1970-79
First unions and births < age 30						
Childless	Separated	1.97	1.89	1.82	1.77	1.62
	Union intact	2.49	2.28	2.20	2.22	2.17
One birth in	Separated	2.26	2.13	2.08	2.11	2.02
union	Union intact	2.66	2.41	2.34	2.38	2.34
Two births in	Separated	2.61	2.48	2.45	2.46	2.43
union	Union intact	2.90	2.65	2.59	2.61	2.59
First unions and births age 30+						
Childless	Separated	0.49	0.41	0.45	0.55	0.69
	Union intact	0.65	0.56	0.57	0.68	0.81
One birth in	Separated	1.57	1.49	1.47	1.50	1.47
union	Union intact	1.70	1.63	1.58	1.61	1.58
Two births in	Separated	2.21	2.13	2.14	2.15	2.15
union	Union intact	2.25	2.17	2.15	2.16	2.16
Re-partnering < age 30						
One child	No re-partnering	1.83	1.62	1.56	1.63	1.56
	Re-partnering	2.23	2.00	1.95	2.01	1.91
Two children	No re-partnering	2.94	2.60	2.54	2.60	2.61
	Re-partnering	3.04	2.77	2.72	2.76	2.73
Re-partnering age 30+						
One child	No re-partnering	1.06	1.05	1.05	1.06	1.06
	Re-partnering	1.25	1.20	1.20	1.25	1.25
Two children	No re-partnering	2.07	2.04	2.03	2.04	2.04
	Re-partnering	2.26	2.16	2.15	2.17	2.17

Note: Estimates from life histories of one million women in each cohort using *Modgen*

Figure 1
Expected number of births for childless women by union duration in years.

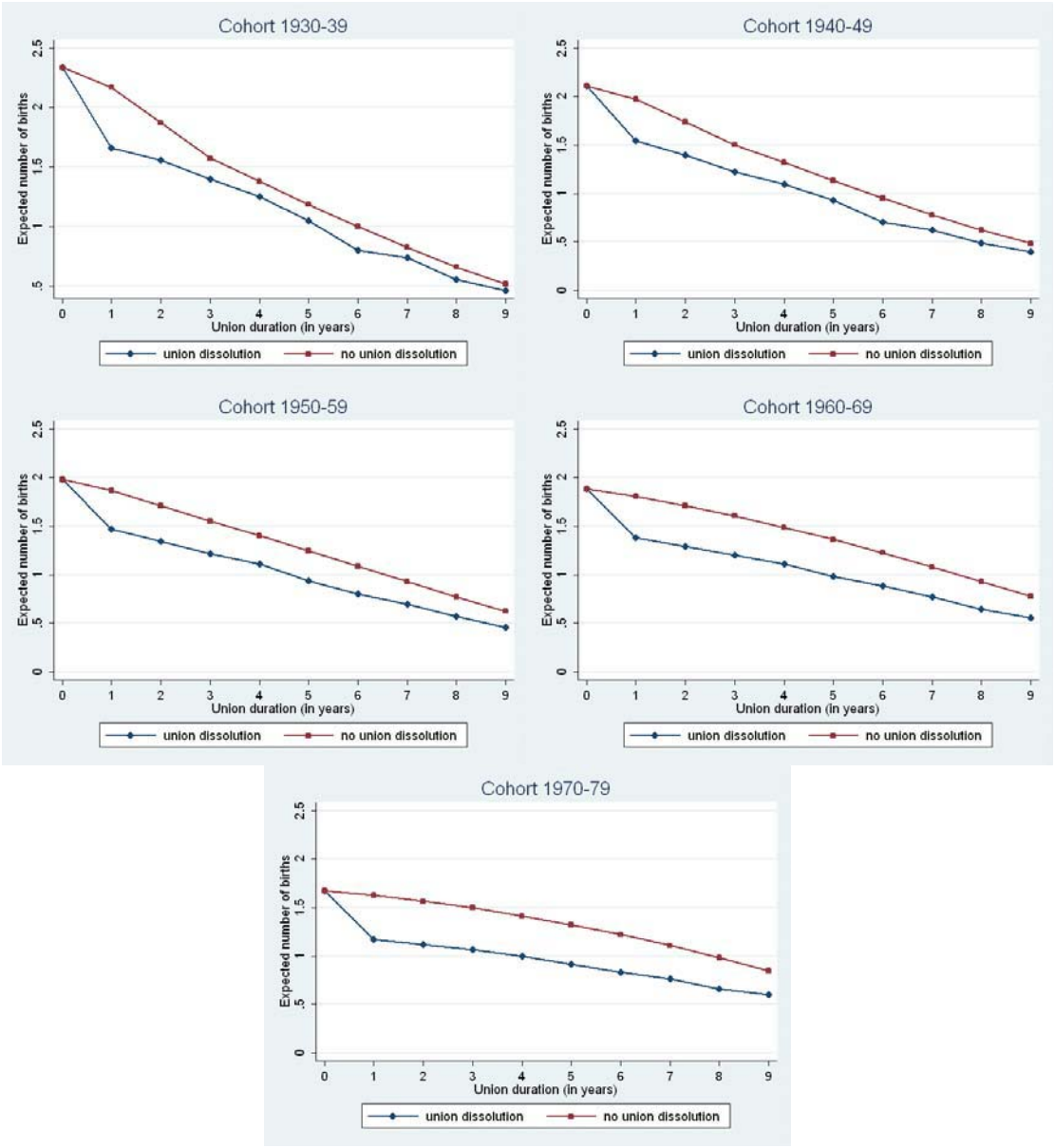


Figure 2
Expected completed family size for women at parity 2 by years since conception of second child.

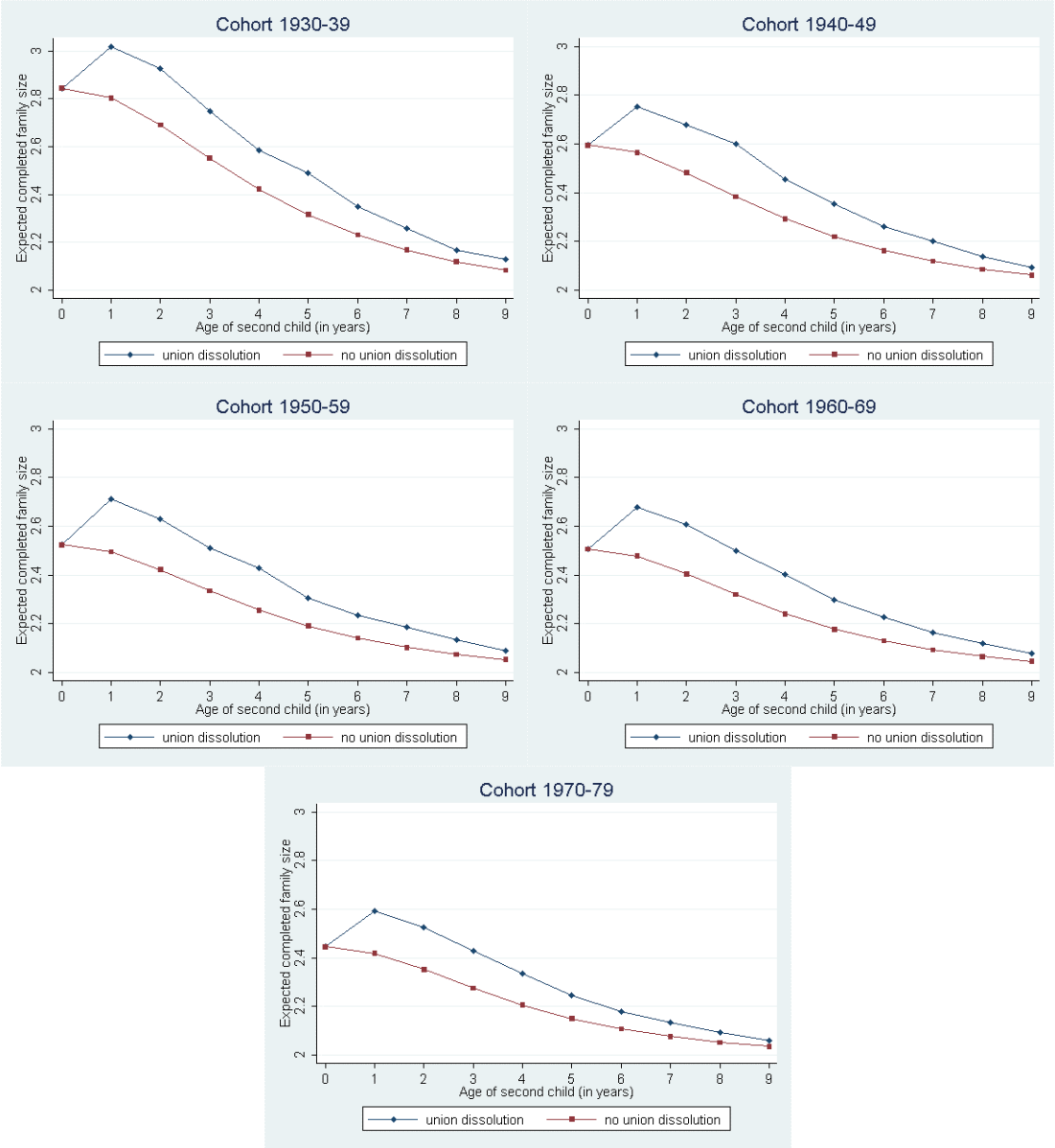
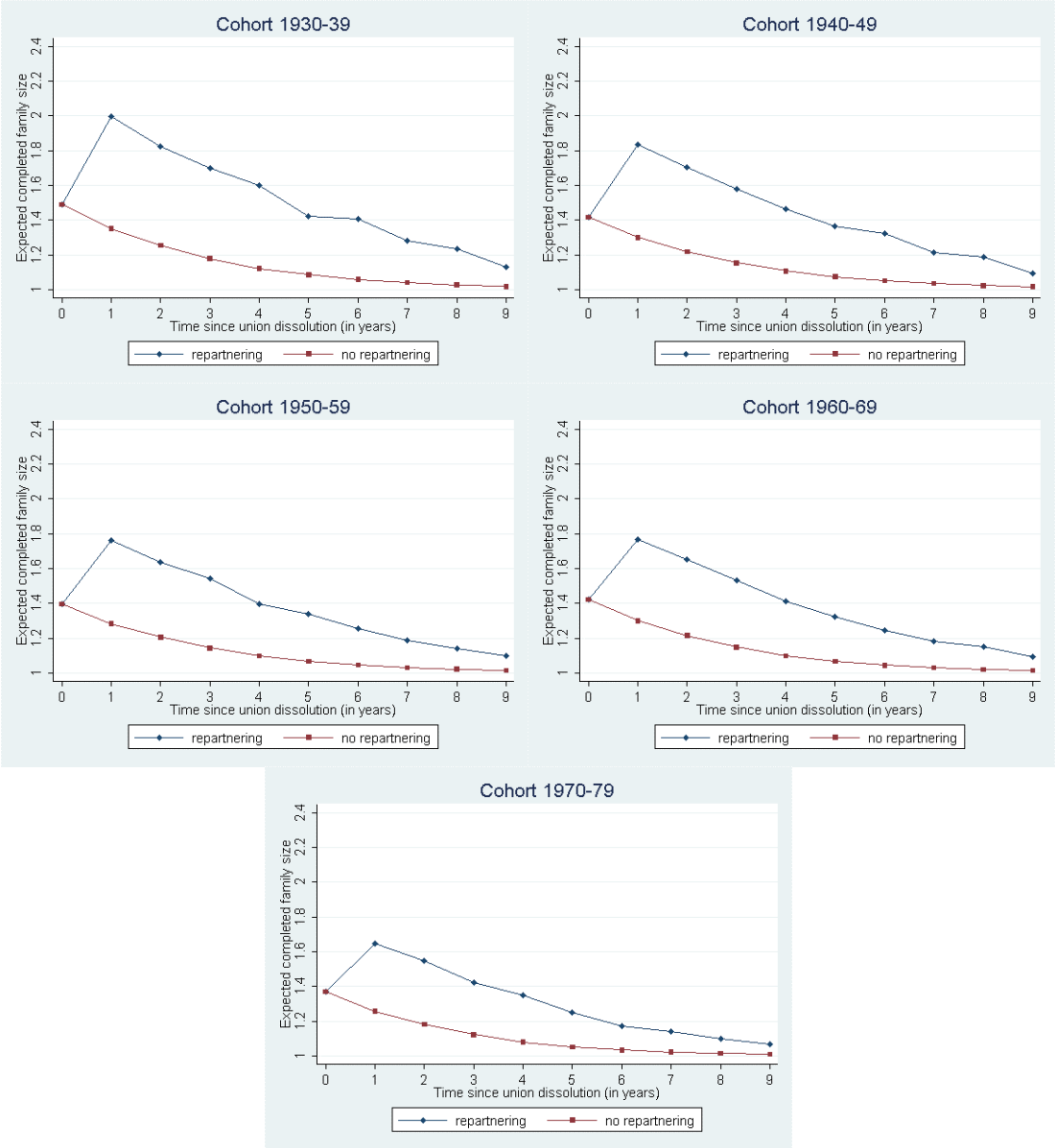


Figure 3
Expected number of births of women who had one child in or before a first union by years since end of first union, cohort.



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