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New insights from sequence analysis

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Abstract:
This study investigates how the association between union dissolution and childlessness depends on life course context. Data on union histories and fertility are taken from the Norwegian GGS. To observe union histories up to age 45, I include men and women born 1927-1962, giving a study sample of 3862 men and 3956 women. To grasp the life course context of union dissolutions, I group union histories similar in timing, occurrence and ordering of events together using sequence analysis. Union histories involving at least one dissolution are sorted into two groups: In the first group, a short first union is followed by quick repartnering, and the second union is still intact at age 45 for the majority. In this group, childlessness is low. In the second group, individuals spend more time as single before and after unions, and dissolving more than one union is common. This group displays high levels of childlessness. The association between a complex union history and childlessness is substantially and significantly stronger among men than among women. Among women, union histories involving a dissolution is more strongly linked to childlessness for the highly educated.

Keywords: Childlessness, Union dissolution, Partnership dynamics, Sequence Analysis

JEL classification: J12, J13, J16

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Sammendrag

Denne studien undersøker hvordan sammenhengen mellom samlivsbrudd og sannsynligheten for å forbli barnløs henger sammen med plasseringen av samlivsbruddet i livsløpet. Data om samliv, fruktbarhet og utdanningsnivå er hentet fra den norske spørreundersøkelsen LOGG. For å beskrive samlivshistorier fram til fylte 45 år, inkluderer jeg kvinner og menn født 1928-62 (til sammen 3862 menn og 3956 kvinner).

For å fange opp helheten av samlivshistorier – heller enn å undersøke hver overgang inn og ut av samliv separat – grupperes samlivshistorier som likner hverandre sammen ved hjelp av sekvensanalyse. Jeg finner to grupper der individer har mer enn ett samliv: I den ene gruppen er det første samlivet tidlig og kort, og det andre samlivet langt. Her er svært få barnløse. I den andre gruppen tilbringer individene mer tid som singel før og mellom samliv, og barnløsheten er høy. Sammenhengen mellom å ha en kompleks samlivshistorie og sannsynligheten for å forbli barnløs er sterkere for menn enn for kvinner. For kvinner er sammenhengen mellom en kompleks samlivshistorie og sannsynligheten for å forbli barnløs sterkest blant dem som har fullført høyere utdannelse.

1 Introduction

Union formation and -dissolution and childbearing are strongly interdependent processes (Brien et al 1999). Before the second demographic transition, non-marriage strongly increased the probability of remaining childless (Shorter et al 1971), and remaining unpartnered still does (Keizer et al 2008; Koropeckyj-Cox and Call 2007). The links between union dissolution and childlessness is potentially more complex: On one hand, union dissolutions are found to hinder the realisation of fertility intentions (Hayford 2009), and number of unions dissolved correlates positively with the probability of remaining childless (Keizer et al 2008). However, complex union histories have also been linked to early unintended childbearing (Guzzo and Hayford 2012). Our understanding of these heterogenous linkages could improve by taking the life course context of the union dissolution – the age of dissolution, time spent as single and number of dissolutions – into account.

Studies on "serial co-residence" – the experience of at least two co-residential unions – have considered how union dissolutions correlate with other life course events. With union dissolution and repartnering on the rise, serial co-residence has become increasingly common (see Cohen and Manning (2010) (US), Dommermuth and Wiik (2014) (Norway)). Previous studies found that serial co-residence is linked to lower SES in the UK and US (Bukodi 2012; Lichter and Qian 2008), while Dommermuth and Wiik (2014) find indications that living with multiple partners correlates positively with educational attainment in Norway. However, the relationship between serial co-residence and fertility histories remains surprisingly unexplored. Using US data, Jokela et al (2010) finds that serial co-residence correlates with higher completed fertility among men only. However, whether serial co-residence also reduces the probability to remain childless remains an empirical question.

This study explores patterns in complex union histories in Norway, and their interlinkings with childlessness. I use union and fertility histories for Norwegian men and women born 1927-1962, taken from the Norwegian GGS (N study sample = 3862 men and 3956 women). The union histories are constructed based on retrospectively reported, monthly updated information on union status for ages 18-45. As cohabiting unions increasingly take on functions earlier reserved for marriage, and cohabitation in Norway is comparatively

"marriage-like" (Wiik et al 2012), I refrain from distinguishing between marriage and cohabitation for comparability across cohorts.

I use sequence analysis to uncover patterns in union histories – in terms of occurrence, sequencing and timing of entry and dissolution of unions. The use of sequence analysis to study the link between union histories and childlessness bears resemblance to Mynarska et al's (2015) study of work histories, union histories and childlessness among Polish and Italian women. However, while Mynarska et al (2015) provide valuable new knowledge on union histories and childlessness, they do not divert explicit attention to union dissolution and how this event is situated in the life course. Hence, the current study in novel in that aspect, and in comparing union histories and childlessness across sex.

I find two distinct types of union histories including at least one dissolution: In the first type, *Trial Union*, repartnering is quick and universal, and a large majority live with their second partner at age 45. In the second group, *Complex*, individuals spend longer spells as single before and between unions. In this group, the experiences following the first union dissolution are more diverse – ranging from no repartnering to multiple unions. The link between union history and childlessness is assessed in a logistic regression model of childlessness on cluster membership (net of cohort). The link between union disruption and childlessness depends on how the union dissolution is situated in the life course: A stable second union is linked to low childlessness, while childlessness is substantially and significantly higher in the *Complex* cluster. Hence, the life course context of the union dissolution matters for its link with fertility behaviour. The correlation between a complex union history and the probability to remain childless tends to be stronger for men than for women.

While studies from the US indicate a nexus of lower socioeconomic status, complex union histories and childlessness for men, I find little evidence of this in my data. Among women with a complex union history, the propensity to remain childless increases significantly with educational attainment. I suggest that women with higher educational attainment may be particularly reluctant to have a child in a fragile union. Such reluctance could be due to ideals "intensive parenting", hard to attain outside a co-residential relationship, being more widespread among the highly educated (Lareau 2000; Stefansen 2008), or that highly educated women are

more concerned of the potential time cost of single parenting. Further research on educational patterns in attitudes and practices regarding childbearing in fragile unions is called for.

2 Theoretical framework and empirical background

2.1 The surge in union dissolutions and new patterns in union histories

As union dissolution rates surge, new patterns in union histories emerge. The emergence of "serial cohabitation" – experiencing at least two spells of unmarried co-residence – has attracted considerable attention in the US and UK. In these contexts, serial cohabitation is strongly linked to economic marginalisation (Bukodi 2012; Lichter and Qian 2008), a pattern likely driven by individuals with lower socioeconomic status both having a lower threshold for entering unions (Sassler and Miller 2011), and a higher risk of union dissolution (Lyngstad and Jalovaara 2010). By counting number of union spells, regardless of union type, Dommermuth and Wiik (2014) documents the rise of serial co-residence in Norway. In contrast to findings from US and UK, they find that among individuals with union experience, serial co-residence is positively related to educational attainment. This pattern is in line with the expectations from the second demographic transition theory, where highly educated "forerunners" are the first to take to new family forms (Lesthaeghe 2010).

A union dissolution can be followed by very different life course trajectories: It could mark the start of a complex union history (Lichter and Qian 2008), as an early union dissolution could have a destabilising *effect* on subsequent life course events, and people who experience union dissolutions early may be a select group (Poortman and Lyngstad 2007). However, as union dissolution becomes common, individuals who experience a short spell of "co-residential dating" (Heuveline and Timberlake 2004) are likely to be a less select group, and need no longer have a higher dissolution risk if they repartner.

In other words, as union dissolution rates increase, those who have ever experienced a union dissolution become an increasingly heterogenous group. To group individuals who share relatively similar union experiences together, one must simultaneously take into account the time of first union entry, number of unions entered,

and time spent as single between unions. Such heterogeneity may be of particular importance when exploring the links between complex union histories and childbearing.

2.2 Union dissolution and parenthood

Individuals who have ever dissolved a co-residential union are more likely to remain childless (Keizer et al 2008). Previous studies point to several mechanisms that could drive this association: Union dissolutions increase childlessness by hindering realisation of fertility intentions (Hayford 2009; Liefbroer 2009). Disagreement over childbearing plans may both lead to postponed or forgone births (Thomson 1997), and tension and union dissolution. Furthermore, to the extent that common children stabilise unions, childless couples may be more likely to break up as they lack this "protective effect" (Andersson 1997; Lillard and Waite 1993; Vinberg et al 2015). Finally, as having and raising children remain among the core functions of unions, individuals with strong childbearing desires may be less likely to leave their partner, all else equal.

The effect of dissolving a union on fertility outcomes can be alleviated by quick repartnering (Thomson et al 2012). The propensity to repartner is in itself likely to be correlated with childbearing desires, as individuals who have not yet reached their completed family size will gain more from (quick) repartnering. Following this logic, individuals who are undecided or negative towards having (more) children will be more likely to either remain single following a union dissolution, or experience a string of shorter unions.

Previous studies have found that women's childbearing intentions slightly exceed men's (Lyngstad and Noack 2005). Even among co-residential couples, men express considerable more reluctance towards entering parenthood than do women (Carmichael and Whittaker 2007; Reneflot 2006). If disagreement over fertility plans destabilises unions, (multiple) union dissolution(s) and childlessness should correlate more strongly among men than among women. A related but distinct mechanism is that some men could be found unsuitable as fathers by (a series of) partners, and hence remain childless with union experience. Zabin et al (2000) find that viewing the current partner as unsuited for fatherhood is a common reason for postponing (further) child-

bearing among low-income women. From this mechanism, one should expect that union dissolution(s) relate most strongly to childlessness among men with lower socioeconomic status.

Union histories and fertility choice emerge jointly over the life course, and fertility behaviour may also influence the probability of experiencing (repeated) union dissolutions. Studies from the US suggest that unplanned pregnancies at young ages lead to "shotgun cohabitation", and subsequent union instability (Guzzo and Hayford 2012). Having a child significantly weakens women's position in the partner market, and single mothers will thus often face the choice with a partner of "lesser quality" and remaining single (Qian et al 2005; Graefe and Lichter 2007). Bzostek et al (2012) find that economic resources slow down repartnering among single mothers in the US, suggesting economic necessity as a motivation for repartnering. This would lead to a nexus of early childbearing, very complex union histories and lower socioeconomic status, found repeatedly in US studies (Furstenberg 2014). However, in contexts such as the Norwegian, where institutional support to single mothers is more generous (Kjeldstad 1998; Tjøtta and Vaage 2008), this pattern need not emerge: Like own economic resources, institutional support may keep single women from repartnering due to economic necessity.

The theories and patterns described above outline mechanisms that could link union dissolution to childlessness among men with lower socioeconomic status in particular – while a nexus of serial co-residence, early childbearing and low socioeconomic status is suggested for women. In contrast to the mechanisms outlined above, the theory of the second demographic transition suggests a nexus of serial co-residence and childlessness among individuals with *higher* educational attainment (Lesthaeghe 2010). According to this theory, a shift towards preferences for autonomy and self realisation happens first among the highly educated. Such value change is again expected to cause men and women to dissolve unions they no longer find emotionally and intellectually fulfilling, and prefer a childfree life (see also Giddens (1993) for a similar argument). In sum, predictions of the socioeconomic variation in the relationship between union history and childlessness remain ambiguous, and empirical evidence from contexts outside the US remain scarce.

3 Data and variables

The analysis are based on data from the Norwegian Generations and Gender Survey (∼15 000 respondents) (Bjørshol et al 2010). To ensure that union histories and fertility is observed throughout the stages of the life course where most childbearing takes place, the study sample is limited to men and women who were at least 45 years old at the time of the interview (i.e. the birth cohorts 1927-1962). After further restricting the sample to individuals born in Norway (i.e. excluding immigrants), I am left with a study sample of 3 862 men and 3 956 women.[1]

I construct variables describing union histories (Section 3.1) and the transition to parenthood (Section 3.2). For comparability across cohorts, all measures of union and fertility behaviour are censored at age 45. I also include information on highest educational attainment at the time of the interview, based on information from administrative registers. This latter measure is coded as a dummy variable, taking 1 if the respondent has completed a higher education degree (BA level or more), and 0 otherwise.

3.1 Variables describing union histories

Information on (co-residential) union histories is mainly self-reported, and combined with register data on the time of marriage and divorce. All self reported information is collected in 2007-2008, meaning that the union histories are retrospective. Importantly, while the reconstruction of union histories is prone to recall error, the fertility measure is not. This could explain why a surprisingly large proportion of those who report to never have lived with a partner have become parents age 45 (Section 6, see also Section 6.4 for a discussion of this).

Based on union histories, I construct a set of 324 variables, recording union status and order monthly from the month the respondent turns 18, to the month before the respondent turns 45. As I am interested in transitions in and out of partnerships, rather than transitions between union types with the same partner, I do not distinguish between cohabiting unions and marriages. The values of the 324 month-specific variables are defined as single without union experience (0), in first union (1), in second union (2), in third union (3), in fourth union (4) and

[1] For a total of 105 unions in this sample, the previous union was reported as dissolved after the next union was entered. For these unions, the time of union dissolution was set to two months before entry into the next union.

in fifth or higher order union (5), and single with union experience (6). These 324 variables are then combined into one sequence variable (cf. Section 4.1).

After unions that are similar are grouped together using sequence analysis (see Section 4.1), I give a detailed description of the patterns that emerge. For this purpose, I construct six variables. *Ever in union* is a dummy variable coded 1 for respondents who have entered a union between age 18 and 45, 0 otherwise. *Number of unions* is a continuous variable giving the total number of unions the respondents has entered from age 18 up to turning 45, including current union, if any. The variable takes 0 for respondents with no union experience. *Ever dissolved union* is a dummy coded 1 if the respondent has experienced a union dissolution between ages 18 and 45, otherwise 0. *Number of union dissolutions* gives the total number of unions the respondent has dissolved before 45. *Years as single with union experience* gives the sum of (completed) years the respondent has spent living alone after the dissolution of a union. The variable does not distinguish between number of previous unions. For respondents who have never dissolved a union, the variable is coded 0. The means of these variables are shown separately by cluster membership in Table 1.

3.2 Measures of the transition to parenthood

Respondents in the GGS are presented with a list of birth dates of children ever born linked to them in the administrative registers, and allowed to supplement and correct this information (Bjørshol et al 2010).[2] The U-shaped cohort pattern in male childlessness could not be explained along similar lines. Based on the birth date of the first born child, I define respondents as childless if they have not had a first child at age 45, and otherwise as parents.[3] For individuals defined as parents, I utilise the birth date of the first born child, as well

[2] Appendix Figure A.1 displays the proportion men and women childless at age 45, comparing results from GGS with official register estimates. Discrepancy between the two sources is most likely due to selective non-response in the GGS, but could also in theory be driven by unregistered births being included in the GGS through self-reporting. Despite some noise in the GGS estimates due to relatively low sample size, the two measures are in accordance. The increase in childlessness in the younger cohorts estimated by GGS data is mirrored in official statistics. For the oldest cohorts (for whom there are no official register estimates) GGS data revel comparatively high childlessness, making for a curvilinear pattern in childlessness across cohorts. This corresponds with other studies from other Western countries finding a relatively high level of childlessness for cohorts born in the inter-war period (Rowland 2007). There are also indications that childlessness was higher among Norwegian women in these cohorts (Rowland 2007, p. 1314), see also Noack (2010, p. 39). Among women, the high level of childlessness in the oldest cohorts could also potentially be an artifact of selective non-response: Highly educated women, who have a particularly elevated level of childlessness in the older cohorts (Andersson et al 2009), are overrepresented in the GGS (Bjørshol et al 2010).

[3] While completed fertility at higher ages is available for older cohorts, censoring information at this age ensures comparability across cohorts.

as union histories (see below) to construct categorical variable describing the union context of the transition to parenthood. The variable takes the values *Before 1st union* if the first child is born before the first union is entered, *In first union* for respondents who have a first child in or after the month they enter a first union, but before the first union is dissolved, and *After first union* respondents who dissolve their first union before they have a first child. I also calculate mean age at the transition to parenthood conditional on being a parent at age 45. The distribution of respondents on the values of these variables is shown separately by cluster in Table 4.

4 Methods

4.1 Sequence analysis: Finding patterns in union histories

Data are organized into clusters using sequence analysis. A distance between all pairs of sequences is quantified using the Dynamic Hamming Distance (DHD) matching algorithm (Lesnard 2010).[4] To ensure that the results are not driven by the cost-setting schemes, all clusterings are also done using Optimal Matching with empirically based transition costs.[5] Reassuringly, the results are largely similar across cost-setting schemes. A similar taxonomy also emerged when clustering was done separately for men and women.

After pairwise distances are calculated, groups of similar union histories are identified using hierarchical clustering with the agglomerative nesting (AGNES) algorithm (Kaufman and Rousseeuw 2005), an algorithm recommended for clustering of sequence variables (Gabadinho et al 2011).[6] All analysis were performed in R, using TraMineR for specific sequence analysis algorithms (Gabadinho et al 2011). A six cluster solution was chosen using a combination of the within-between ratio and theoretical validation (Aisenbrey and Fasang 2010).

[4] The distance between two sequence variables is the sum of the distances between each of the positions in the two variables. When the same state is found in the same position, the distance is zero. For different states in the same position, the distance is inversely proportional to the frequency of transitions between these two states at the time point indicated by the position of the state (Lesnard 2010, p.401). Hence, the DHD algorithm is particularly suited to capture similarity and difference in terms of timing.

[5] In contrast to Lesnard's (2010) algorithm, this allows for insertion and deletion of states, allowing for temporal distortion, and shifting emphasis toward whether, rather than when, states occur (Aisenbrey and Fasang 2010).

[6] In general, AGNES algorithms start with N clusters, merging clusters stepwise until it reaches one cluster with N observations (Kaufman and Rousseeuw 2005, p.199). For calculation of dissimilarity between clusters, the Ward method is applied, as suggested for sequence analysis (Gabadinho et al 2011). The Ward method first finds the "centroid" in each cluster, i.e. the observation that has the lowest average dissimilarity compared to all other observations in the cluster (Kaufman and Rousseeuw 2005, p.40). Using a scaled measure of Euclidian distance, it then merges the two clusters whose centroids are least dissimilar (Kaufman and Rousseeuw 2005, p.230).

Sequence analysis is a data mining technique, and does not belong to the family of stochastic methods (Aisenbrey and Fasang 2010). This has the advantage of not invoking any assumptions of the underlying data generating process, but comes at the cost of not providing any straightforward quantitative measures for statistical generalisation. In other words, one may risk giving meaningful interpretation to patterns stemming purely or chiefly from sampling variability. Importantly, sequence analysis will *by construction* discover patterns. Hence, the fact that groups emerge alone does not lend itself to interpretation. However, the *characteristics* of the groupings may be of substantive interest.

4.2 Descriptive statistics and regression techniques

I give in-depth descriptions of the characteristics of the groups that emerged from the sequence analysis using simple means calculations (Table 1). I also describe how the union context of childbearing varies with cluster using simple mean calculations (Table 4). The mean calculations give a transparent exposition of patterns in data when no control variables are required.

To assess how groups of union histories are linked to the propensity to have completed higher education and to remain childless, both dichotomous outcomes, a series of logistic regression models are estimated (Long 1997). As there is marked cohort change in both the dependent variables (educational attainment and childlessness) and the predictors of interest (union history and educational attainment), controls for birth cohorts are included as a set of dummy variables.[7] With one exception, results are presented on odds scale.

Model 1 (Table 2) takes the probability of having completed higher education (lower degree or more) as the dependent variable. Cluster membership is the explanatory variable of interest, and the models control for cohort, included as a set of dummy variables.

The probability of remaining childless at age 45 is the dependent variable of **Model 2**. Model 2 is built stepwise, starting with cluster only (2a), adding cohort dummies (2b) and finally their interaction (2c) (Appendix Table A.1). To show the absolute level of childlessness within each cluster, results from Model 2a and

[7] Birth cohorts are grouped into 5 year categories, with two exceptions: The oldest cohorts (1927-1934) are grouped together for statistical power, and the youngest cohort (1960-1962) has a narrower range.

2b are presented as predicted probabilities (Table 3). **Model 3** (Table 5) also takes the probability of remaining childless as the dependent variable, and includes cluster, educational attainment, cohort, and an interaction between educational attainment and cluster as predictors.

All regression models and mean calculations were done separately by sex to allow for heterogenous patterns. Estimations were done in R.

5 Patterns of union histories: Results from sequence analysis

This section describes the groups of union histories that emerged from the sequence analysis. I present results for a six-cluster solution, chosen by a combination of inspection of within-between-ration and theoretical validation (see Section 4.1). Based on the patterns in union histories, the clusters are named *Trial Union*, *Complex*, *Unpartnered*, *Early Standard*, *Standard* and *Late Standard*. The distribution by state within each cluster for each month is displayed visually in Figures 1-3. Furthermore, Table 1 shows various characteristics of union histories by cluster (variable descriptions in Section 3.1).

In two clusters, *Trial Union* and *Complex*, all members have experienced a union dissolution at age 45 (i.e. the proportion who has experienced a union dissolution is precisely estimated to be 1). Nearly all union histories containing one or more union dissolutions sort into one of these groups. The life course context of union dissolution differs markedly between the two clusters: In the cluster *Trial Union*, most individuals have a long second union, as shown by the mean number of unions being two, the mean number of union dissolutions is one, and the time spent as single between unions is relatively short. This pattern is further illustrated in Figure 1 (upper panel), which shows that more than 90% were living with their second partner at age 45 in this cluster. In the cluster *Complex*, on the other hand, a lower proportion repartners (the average number of unions is 1.77 for men and 1.69 for women), but higher-order unions are more often dissolved (average number of union dissolutions is 1.34 for men and 1.33 for women). Unsurprisingly, members in the *Complex* cluster spend substantially more time as single with union experience than those in the *Trial Union* cluster on average.

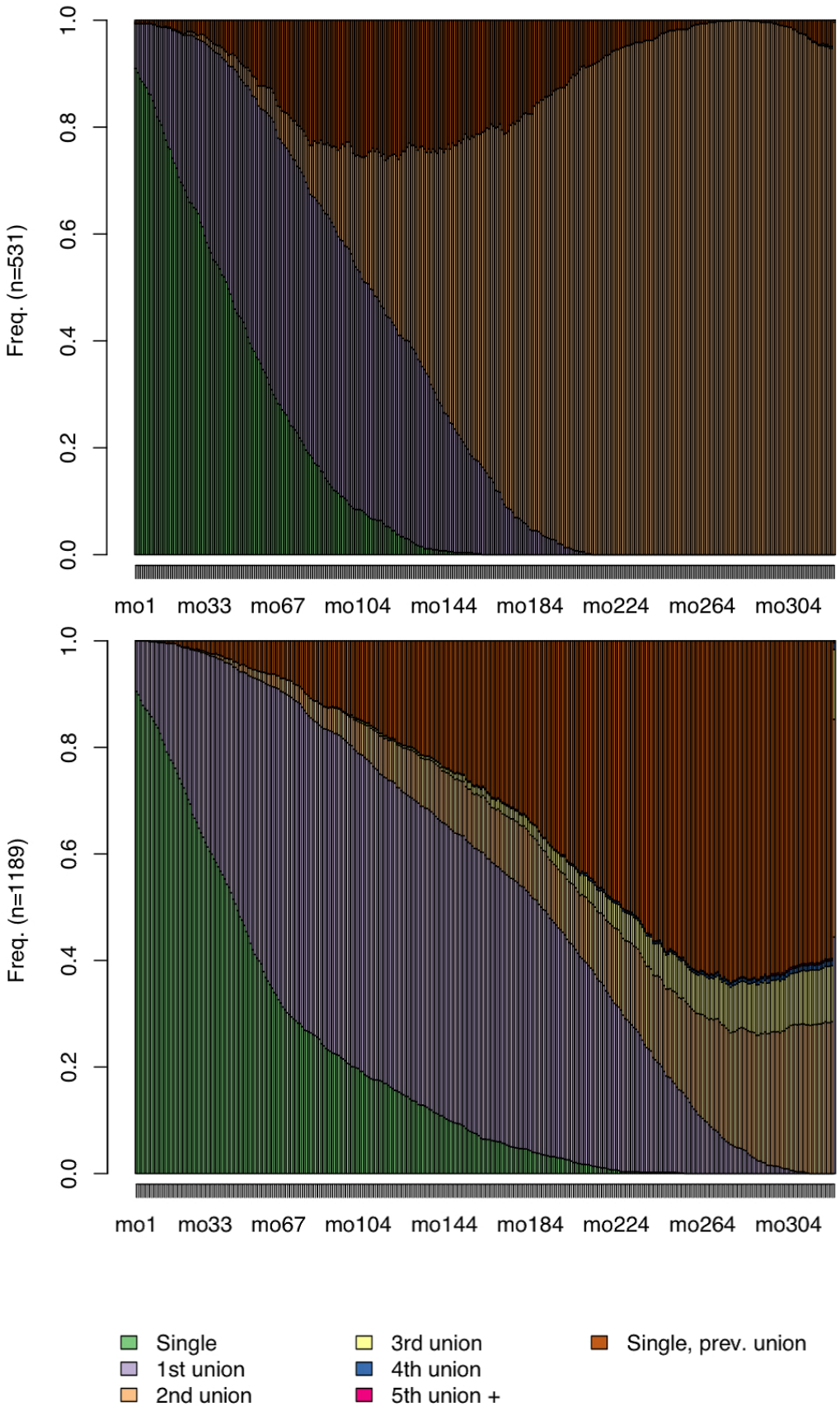

Fig. 1: Distribution of states by month, clusters *Trial Union* (upper panel) and *Complex* (lower panel). Results displayed for men and women jointly. The x-axis shows age in months, counting from the 1st month in the 18th year to the 12th month in the 44th year. The y-axis shows proportions in each state in the current month.

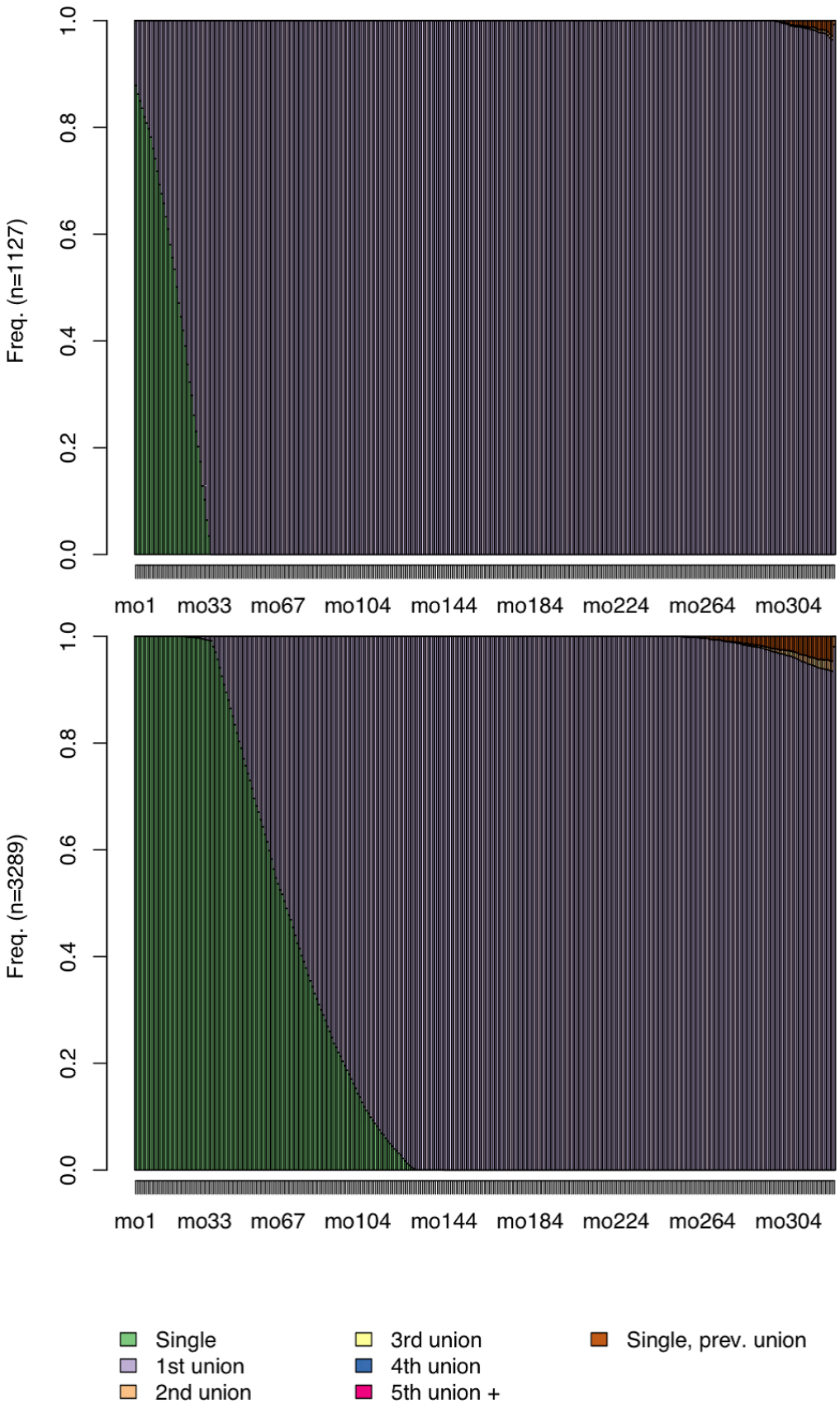

Fig. 2: Distribution of states by month, clusters *Early Standard* (upper panel) and *Standard* (lower panel). Results displayed for men and women jointly. The x-axis shows age in months, counting from the 1st month in the 18th year to the 12th month in the 44th year. The y-axis shows proportions in each state in the current month.

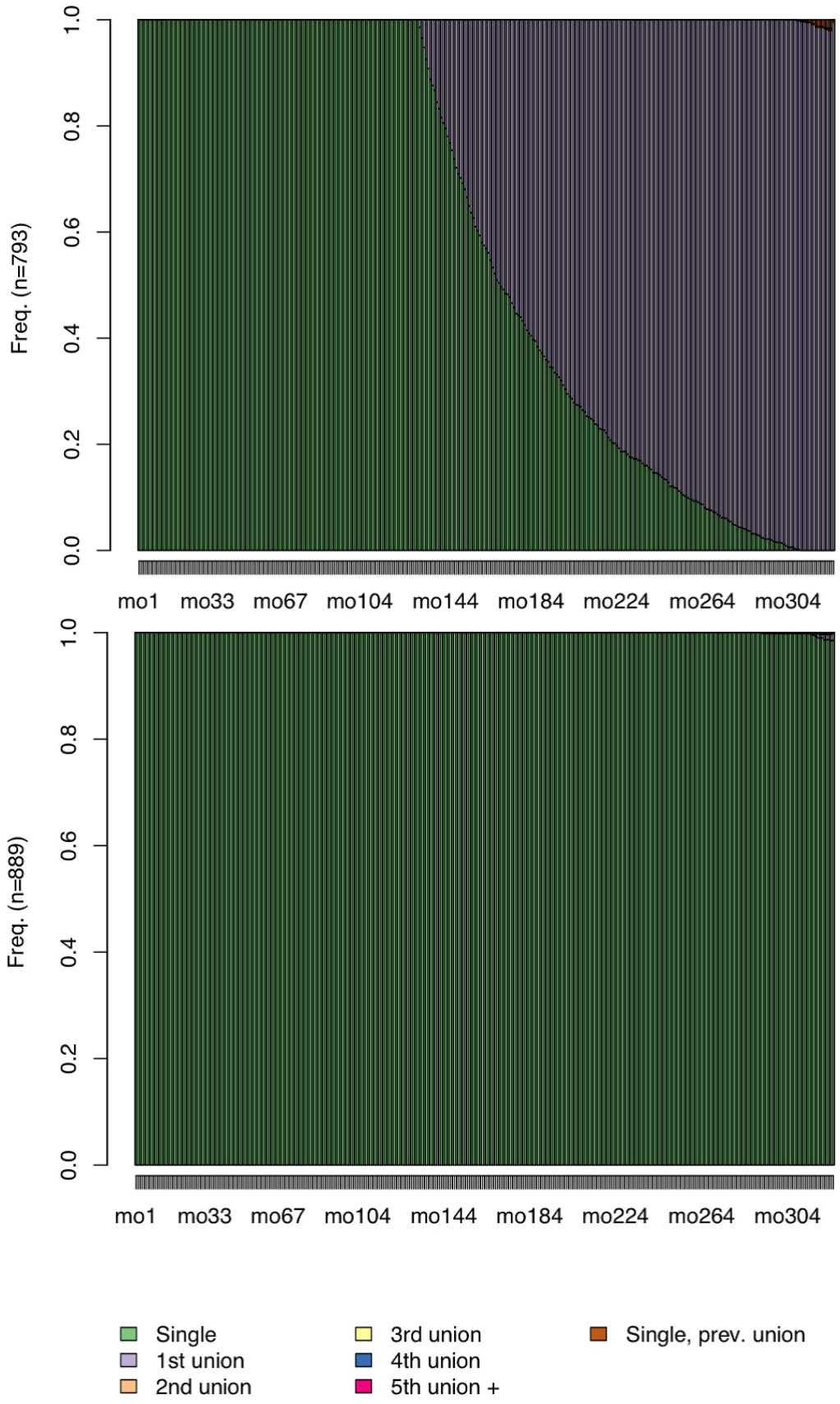

Fig. 3: Distribution of states by month, clusters *Late Standard* (upper panel) and *Unpartnered* (lower panel). Results displayed for men and women jointly. The x-axis shows age in months, counting from the 1st month in the 18th year to the 12th month in the 44th year. The y-axis shows proportions in each state in the current month.

Table 1: Characteristics of union histories by cluster. Means calculated separately for men (upper panel) and women (lower panel). 95% C.I. in brackets.

MEN						
	Trial Union	Complex	Unpartnered	Early Std.	Std.	Late Std.
Ever in union	1.00	1.00	0.02	1.00	1.00	1.00
	[1.00; 1.00]	[1.00; 1.00]	[0.01; 0.03]	[1.00; 1.00]	[1.00; 1.00]	[1.00; 1.00]
Number of unions	2.00	1.77	0.02	1.00	1.02	1.00
	[2.00; 2.01]	[1.70; 1.84]	[0.01; 0.04]	[1.00; 1.00]	[1.02; 1.03]	[1.00; 1.01]
Age first union entry	22.40	24.13	43.75	19.33	24.06	32.82
	[22.01; 22.80]	[23.70; 24.56]	[43.26; 44.24]	[19.21; 19.45]	[23.97; 24.16]	[32.51; 33.14]
Ever dissolved union	1.00	1.00	0.01	0.02	0.06	0.02
	[1.00; 1.00]	[1.00; 1.00]	[0.00; 0.01]	[0.00; 0.03]	[0.05; 0.07]	[0.01; 0.03]
No. of union diss.	1.05	1.34	0.01	0.02	0.06	0.02
	[1.02; 1.07]	[1.29; 1.39]	[0.00; 0.01]	[0.00; 0.03]	[0.05; 0.07]	[0.01; 0.03]
Yrs single w/ union exp.	2.62	7.26	0.00	0.01	0.08	0.00
	[2.33; 2.91]	[6.82; 7.70]	[0.00; 0.01]	[0.00; 0.03]	[0.06; 0.11]	[0.00; 0.01]
N	249	505	452	298	1820	538
Prop.	0.06	0.13	0.12	0.08	0.47	0.14
WOMEN						
	Trial Union	Complex	Unpartnered	Early Std.	Std.	Late Std.
Ever in union	1.00	1.00	0.01	1.00	1.00	1.00
	[1.00; 1.00]	[1.00; 1.00]	[0.00; 0.02]	[1.00; 1.00]	[1.00; 1.00]	[1.00; 1.00]
Number of unions	2.00	1.69	0.01	1.01	1.02	1.00
	[2.00; 2.01]	[1.63; 1.74]	[0.00; 0.02]	[1.00; 1.02]	[1.01; 1.02]	[1.00; 1.01]
Age first union entry	20.72	21.44	44.00	18.91	23.26	33.24
	[20.37; 21.06]	[21.12; 21.75]	[44.00; 44.00]	[18.81; 19.00]	[23.16; 23.37]	[32.75; 33.72]
Ever dissolved union	1.00	1.00	0.00	0.04	0.07	0.03
	[1.00; 1.00]	[1.00; 1.00]	[0.00; 0.00]	[0.03; 0.06]	[0.06; 0.08]	[0.01; 0.05]
No. of union diss.	1.06	1.31	0.00	0.04	0.07	0.03
	[1.03; 1.08]	[1.26; 1.35]	[0.00; 0.00]	[0.03; 0.06]	[0.06; 0.08]	[0.01; 0.05]
Yrs single w/ union exp.	2.62	8.61	0.00	0.01	0.09	0.01
	[2.32; 2.93]	[8.21; 9.01]	[0.00; 0.00]	[0.00; 0.02]	[0.07; 0.11]	[0.00; 0.02]
N	282	684	437	829	1469	255
Prop.	0.07	0.17	0.11	0.21	0.37	0.06

As expected, the proportion belonging to the *Complex* and *Trial Union* clusters increases over cohort (results available upon request, but see Hart and Lyngstad (2015) for a similar analysis). Hence, these clusters are examples of new union patterns that emerge as the second demographic transition unfolds.

Three variations of the "standard biography" – characterised by entry into one union only – emerged. The variation between the standard unions mainly stems from time of entry into the first union: In the *Early Standard* cluster, union entry on average happens before age 20, while average age of union entry in the *Late Standard* cluster is above 30 years. With average union entry in the mid 20s, the *Standard* cluster takes a position in between. In total, about 70 per cent of men and 65 per cent of women belong to one of these clusters (Table 1).

In the sixth and final cluster, the vast majority never enters a union (the probability of union entry is 0.02 across sex). The minority who enters unions, do so late: The mean age of union entry is 44 years across sex (Table 1), and union entries happen exclusively in the 40s (Figure 3, lower panel). This cluster is denoted *Unpartnered*, capturing that the respondents spend the vast majority of the observation period not living with a partner.

5.1 Educational attainment and union history

In the US and the UK, complex union histories in general – and serial co-residence in particular – is consistently linked to lower socioeconomic status (Bukodi 2012; Lichter and Qian 2008). This section describes how educational attainment varies between the groups of union histories presented in the previous section, by way of estimates from a logistic regression model of the probability to have completed higher education on union history and cohort (Table 2). Educational attainment is obtained from administrative registers at the time of the interview (i.e. when the respondent was 45 or older). Hence, the estimated correlation reflects how education and union history have developed jointly over the life course, rather than the impact of one outcome on the other.

As shown in Table 2, the proportion with higher education does not differ significantly (at conventional levels) between the *Trial Union* cluster (reference category) and the *Complex* cluster. However, for women, there is a tendency of a lower proportion highly educated in the *Complex* cluster ($p<0.1$). In this sample, there is no consistent evidence that the life course context of union dissolution varies with educational attainment.

Also using data from the GGS, Dommermuth and Wiik (2014) finds tendencies of a positive association between number of unions at age 35 and educational attainment among men and women with union experience. My findings indicate an interplay between timing and number of unions when it comes to educational attainment: The lower educational attainment of those who have lived with one partner only is concentrated solely among those who entered a first union relatively early.[8]

[8] Another explanation for the diverging findings could be that Dommermuth and Wiik (2014) includes somewhat younger cohorts.

Table 2: **Model 1:** Probability of having completed higher education (lower degree or more) by cluster membership. Estimates from separate logistic regression models for men and women. Odds ratios, 95% C.I. in brackets. Dummies for birth cohort (five-year categories) included but not reported. Likelihood Ratio tests done towards a model including cluster and cohort, but excluding educational attainment and its interaction with cluster.

	Men	Women
Intercept (ref Trial Union)	0.52*	0.72*
	[0.37; 0.72]	[0.53; 0.96]
Complex	0.96	0.78
	[0.68; 1.34]	[0.58; 1.04]
Unpartnered	1.10	1.23
	[0.77; 1.56]	[0.88; 1.72]
Early Standard	0.41*	0.34*
	[0.27; 0.63]	[0.25; 0.47]
Standard	1.05	1.23
	[0.78; 1.41]	[0.93; 1.61]
Late Standard	1.32	1.58*
	[0.95; 1.84]	[1.10; 2.26]
N	3862	3956
LR(Df)	26.50(6)	173.47(6)
P(LR)	0.00	0.00

6 Union history and the transition to parenthood

I now turn attention to how the union histories are linked to the probability of remaining childless. Importantly, information on fertility histories is *not* taken into account in the construction of the clusters. If the proportion childless varies significantly between the clusters, this is due to union histories and the transition to parenthood influencing each other mutually – or both life course trajectories being influenced by some underlying preferences. This section first presents the main results of the paper: How the proportion childless varies with union history. I then describe how the union context of parenthood varies with union history for the subsample who has become parents at age 45.

6.1 Union history and childlessness

Model 2 a and b (Table 3) assesses the link between union history and the probability to remain childless at age 45 using logistic regression.[9] The results show that childlessness is almost solely concentrated in three types of union histories: *Unpartnered*, *Late Standard* and *Complex*. Each of these clusters correspond to one of the well

[9] I do not present simple means for this outcome, as predicted probabilities in a model with no controls (Model 2a) is an equivalent measure.

Table 3: **Model 2a and b:** Predicted probability of childlessness by cluster. Estimations done separately by sex. 95% C. I. in brackets. Predicted probabilities are obtained from a logistic regression of the probability to remain childless on dummies for cluster membership only (Model 2a) and dummies for cluster membership and cohort (Model 2b). LR tests are done against a null model (for Model 2a) and Model 2a (for Model 2b).

	Men		Women	
	a)	b)	a)	b)
Trial Union	0.06	0.07	0.08	0.08
	[0.03; 0.09]	[0.03; 0.11]	[0.05; 0.11]	[0.04; 0.12]
Complex	0.22	0.26	0.15	0.16
	[0.18; 0.25]	[0.20; 0.32]	[0.12; 0.17]	[0.11; 0.20]
Unpartnered	0.48	0.60	0.34	0.37
	[0.44; 0.53]	[0.52; 0.67]	[0.30; 0.39]	[0.29; 0.45]
Early Standard	0.03	0.04	0.03	0.04
	[0.01; 0.05]	[0.02; 0.07]	[0.02; 0.05]	[0.02; 0.05]
Standard	0.05	0.07	0.05	0.06
	[0.04; 0.06]	[0.05; 0.09]	[0.04; 0.06]	[0.04; 0.07]
Postponed	0.17	0.23	0.26	0.28
	[0.14; 0.20]	[0.17; 0.29]	[0.21; 0.32]	[0.20; 0.36]
N	3862	3862	3956	3956
AIC	2580.13	2558.76	2424.94	2435.41
LR (Df)	542.77(5)	33.36(6)	353.02(5)	1.53(6)
P(LR)	0.00	0.00	0.00	0.96

known pathways to childlessness – remaining unpartnered, postponing parenthood, and experiencing a union dissolution.

Of main interest in this study is the interlinking between the life course context of union dissolution and the probability of remaining childless. Of the two clusters where union dissolution is nearly universal, only *Complex* stands out with a high proportion childless. After control for cohort, the predicted proportion childless women in the *Trial Union* cluster is 0.08, while the predicted proportion in the *Complex* cluster is twice as large (Model 2b, Table 3). For men, the differences are even more substantial, with a predicted proportion childless of 0.07 in the *Trial Union* cluster, and 0.26 in the *Complex* cluster. Across sex, the difference in proportion childless between these two clusters is statistically significant. The higher childlessness of men in the *Complex* cluster, as compared to women in this cluster, is in accordance with expectations of gender differences outlined in Section 2.2. The gender difference is statistically significant at the 5 per cent level before cohort control, and borders statistical significance at this level after ($p<0.1$). The differences in proportion childless between

the *Trial Union* and *Complex* cluster illustrate that the life course context of union dissolution matters for its linkages with the transition to parenthood.

The *Unpartnered* cluster displays by far the highest childlessness across sex, consistent with previous studies showing that remaining unpartnered is by far the strongest correlate of remaining childless (Keizer et al 2008; Koropeckyj-Cox and Call 2007). Among men, the raw proportion childless is 0.48 (Model 2a). When cohort dummies are added as controls (Model 2b), the proportion childless in this cluster increases to 0.6. For women, the proportion childless in the *Unpartnered* cluster is substantially and significantly lower, at 0.34 (0.38) before (after) cohort controls are added.

Childlessness is also high in the cluster *Late Standard*. Female postponers are significantly more likely to remain childless than male postponers, a finding likely related to the variation in age limits of biological fertility across sex. Among women, belonging to the cluster *Late Standard* is a significantly stronger correlate of childlessness than being classified as *Complex*. For men, there is no such statistical difference.

The clusters *Early Standard* and *Standard* stand out with very low childlessness across sex. Again, this finding is in accordance with previous research (Koropeckyj-Cox and Call 2007). Forming a union (relatively) early facilitates the transition to parenthood, and individuals who form unions early are also likely to be selected on a preference for childbearing. It is more striking that the proportion childless in the *Trial Union* cluster – where all respondents have dissolved at least one union – does not differ significantly from the proportion in the *Early Standard* and *Standard* clusters. The latter finding indicates that ever experiencing a union dissolution need not increase the probability of remaining childless.

The cohorts included in this study faced very different norms and practices regarding union formation and parenthood as young adults, and the association between union history and the transition to parenthood may as such vary over cohort. In Model 2c (Appendix Table A.1), I explore this by adding an interaction between cohort and cluster to Model 2b. As there are no significant changes in the proportion childless within the *Complex* and *Trial Union* clusters across cohorts, I conclude that these union histories are stable correlates of childlessness over time. Compared to the *Standard* cluster, the *Unpartnered* cluster displays elevated childlessness in all cohorts, but to a somewhat lesser extent in the oldest cohorts. As the proportion of births outside unions has

Table 4: The union context of and age at first birth. Means and 95% C. I. Separate estimations for men and women. The sample consists of men and women who had a first child before age 45. Due to rounding, proportions may not sum to 1.

MEN						
	Trial Union	Complex	Unpart.	Early Std.	Std.	Late Std.
Union context						
Before 1st union	0.09	0.09	0.09	0.03	0.07	0.17
	[0.05; 0.12]	[0.06; 0.12]	[0.05; 0.12]	[0.01; 0.06]	[0.06; 0.09]	[0.14; 0.20]
In 1st union	0.49	0.75	0.91	0.97	0.93	0.83
	[0.43; 0.56]	[0.71; 0.79]	[0.88; 0.95]	[0.94; 0.99]	[0.91; 0.94]	[0.80; 0.86]
After 1st union	0.42	0.15	0.00	0.00	0.00	0.00
	[0.36; 0.49]	[0.12; 0.19]	[0.00; 0.00]	[0.00; 0.00]	[0.00; 0.00]	[0.00; 0.00]
Age 1st birth	27.55	26.93	27.12	22.31	26.53	33.25
	[26.79; 28.30]	[26.37; 27.49]	[26.49; 27.75]	[21.90; 22.73]	[26.38; 26.69]	[32.84; 33.65]
N	234	395	233	288	1729	447

WOMEN						
	Trial Union	Complex	Unpart.	Early Std.	Std.	Late Std.
Union context						
Before 1st union	0.11	0.13	0.07	0.05	0.07	0.28
	[0.07; 0.15]	[0.10; 0.15]	[0.04; 0.10]	[0.04; 0.07]	[0.05; 0.08]	[0.21; 0.34]
In 1st union	0.49	0.77	0.93	0.95	0.93	0.72
	[0.43; 0.55]	[0.73; 0.80]	[0.90; 0.96]	[0.93; 0.96]	[0.92; 0.95]	[0.66; 0.79]
After 1st union	0.40	0.10	0.00	0.00	0.00	0.00
	[0.34; 0.46]	[0.08; 0.13]	[0.00; 0.00]	[0.00; 0.00]	[0.00; 0.00]	[0.00; 0.00]
Age at 1st birth	25.10	23.35	24.68	21.49	25.70	31.57
	[24.40; 25.80]	[22.95; 23.75]	[24.16; 25.19]	[21.28; 21.69]	[25.53; 25.87]	[30.77; 32.38]
N	260	583	288	801	1395	188

been relatively stable over time, this latter difference is likely due to the increased postponement of fatherhood seen particularly in the youngest cohorts.

6.2 Union history and the context of parenthood

The previous section showed that the link between union dissolution and the probability to remain childless varied substantially and significantly with life course context. In the cluster *Trial Union*, where repartnering was quick and nearly universal, childlessness was low. In this section, I explore whether repartnering contributed to the low childlessness in the *Trial Union* cluster, by investigating the union contexts of parenthood by cluster. For the subsample that did become parents, I distinguish between three "union contexts": Before first union, in first union, and after first union. Results for all clusters are shown in Table 4.

Across sex, nearly half the members of the *Trial Union* cluster have their first child after their first union. As the individuals in this cluster spend little time as single between unions, and childbearing rates in general are much higher for individuals living with a partner, this indicates that a large proportion in this cluster have a first child with their second partner. In comparison, only a proportion of 0.1 of the women and 0.15 of the men in the *Complex* cluster had a first child after their first union. Hence, repartnering alleviates the negative effect of union dissolution on fertility to a much larger extent in the *Trial Union* cluster, than it does in the *Complex* cluster. In sum, it seems that the differences in childlessness between these two clusters are related to the nature of the entry and stability of higher-order unions.

Previous studies from the US have suggested early (non-union) childbearing as a driver of serial co-residence (Guzzo and Hayford 2012). In the Norwegian data, I find little evidence of this. In both clusters *Trial Union* and *Unpartnered*, where individuals who experience serial co-residence are grouped, the proportion that has a first child before they enter a union revolved around 0.1 across sex. Furthermore, the *Trial Union* cluster, where the proportion who remain childless is low, neither stands out with a very low age at parenthood, nor with a high proportion births before union entry (Table 4).

6.3 Union history, childlessness and educational attainment

In Section 2.2, two expectations on socioeconomic variation in the relationship between union history and childlessness were laid out. First, if men with lower earnings potential more often are considered unsuitable as co-parents by their partners, the link between union instability and childlessness should be strongest among men with lower educational attainment. Second, studies from the US indicate a nexus of lower socioeconomic status, early childbearing and union complexity for women. This would imply a less positive association between union complexity and childlessness for women with lower educational attainment. To test these hypotheses I estimate a logistic regression model taking the probability to remain childless as the dependent variable,

Table 5: **Model 3**: Logistic regression of the probability to remain childless on cluster, educational attainment and their interaction. Estimations done separately by sex. Results on odds scale. 95% C.I. in parenthesis. * 1 outside the confidence interval. LR tests are done towards a model including cohort, educational attainment and cluster, but omitting the interaction between the two latter variables. Estimates are net of cohort dummies.

	Men	Women
Intercept	0.08 [0.06; 0.11]*	0.06 [0.04; 0.10]*
Cluster membership (ref=Standard)		
Trial Union	0.73 [0.34; 1.55]	1.30 [0.69; 2.46]
Complex	4.24 [2.98; 6.05]*	2.15 [1.44; 3.21]*
Unpartnered	23.37 [16.68; 32.74]*	6.37 [4.37; 9.28]*
Early Standard	0.61 [0.30; 1.24]	0.56 [0.34; 0.92]*
Postponed	3.82 [2.63; 5.54]*	6.89 [4.40; 10.77]*
Completed higher education (ref=No)		
Yes	0.73 [0.45; 1.20]	0.67 [0.40; 1.14]
Completed higher education ∗		
Trial Union	3.07 [0.96; 9.84]	1.79 [0.64; 5.01]
Complex	1.57 [0.80; 3.09]	3.31 [1.67; 6.54]*
Unpartnered	0.63 [0.33; 1.21]	3.92 [1.99; 7.71]*
Early Standard	0.82 [0.10; 7.01]	1.90 [0.62; 5.81]
Postponed	1.28 [0.64; 2.53]	1.03 [0.47; 2.26]
N	3862	3956
AIC	2553.47	2411.02
LR	17.30(6)	36.39(6)
P(LR)	0.01	0.00

and including dummy variables for union history, completion of higher education, and their interaction.[10] The parameters of interest are the interaction terms between higher education and cluster membership.

Results are shown in Table 5. The parameter estimates for each of the clusters go in the same direction as before the interaction terms were added. Hence, also among men and women without a university degree, the probability to remain childless is significantly higher in clusters *Complex*, *Unpartnered* and *Late Standard* than it is in the cluster *Standard*. Net of union histories, the association between educational attainment and the probability to remain childless is not statistically significant.

The interaction estimates show that complex union histories are most strongly linked to childlessness for men and women with higher educational attainment in the Norwegian context. However, only the interaction between cluster *Complex* and educational attainment in the female sample yields statistical significance at the 5 per cent level. (For the interaction between *Trial Union* and higher educational attainment in the male sample, $p<0.1$). There is no evidence that men with lower earnings potential are selected out of parenthood through a

[10] While interesting patterns in childlessness have emerged using a more fine grained classification (Lappegård and Rønsen 2005), this operationalisation is chosen for parsimony.

series of union dissolutions. This socioeconomic patterns in union histories and childlessness stands in contrast to findings from the US, and will be discussed in detail below.

6.4 Study limitations

Two important caveats should be noted. The first regards data quality: As the research question requires data on cohabitation, union histories by necessity must be self-reported (rather than constructed based on data from administrative registers). Using self-reported union histories invokes the familiar problems of recall error, generally found to lead to under-reporting of life events (Lin et al 1997), and known to be most severe among individuals of relatively old age at the time of the interview (Kreyenfeld et al 2013). As such, one risks underestimating the complexity of union histories in the older cohorts. In addition, studying change over time based on data collected at one time point implies that data are left truncated. Childless individuals have higher mortality rates than peers who have started a family (see e.g. Grundy and Kravdal (2008)), and may thus be underrepresented in the sample. Reassuringly, the comparison with official statistics shown in Appendix Figure A.1 shows no such indication of underrepresentation.

The second caveat regards the methodological approach. Sequence analysis allows for considering the life course as a whole. This necessarily comes at the price of not being able to study the impact of each union formation and -dissolution event separately. However, there is already a rich literature addressing the impact of union entry and dissolution on fertility behaviour in general and the transition to parenthood in particular (for overviews see Balbo et al (2013); Lyngstad and Prskawetz (2010)). Still, studies that provide more holistic descriptions of the (typical) life courses that emerge from these transitions have so far been scarce. As such, studies based on sequence analysis neatly complement previous studies of separate parity transitions.

7 Concluding discussion

Outside the US context, knowledge is limited on how the life course context of a union dissolution shapes its relationship with childlessness. This study contributes to the literature on union dissolutions and childlessness

by using sequence analysis to group together union histories similar in timing, occurrence and sequencing of events. I identify two groups of union histories where experience of union dissolution before age 45 is (nearly) universal. In the first group, *Trial Union*, a short first union is followed by a stable second union. Here, the proportion childless is very low. In the second group, *Complex*, union entry happens later, and more time is spent as single between unions, or in third and higher-order unions. The *Complex* group stands out with high childlessness, second to individuals with little or no union experience only.

Previous research suggest that union dissolutions are more likely to hinder the transition to parenthood if they happen late, much time is spent between unions, or if they happen repeatedly (Keizer et al 2008; Thomson et al 2012). The *Complex* cluster displays all these characteristics, the *Trial Union* cluster none. While long spells as single before and between unions reduces the time under risk of conceiving a first child within a union, selection mechanisms may also contribute to this pattern: As union formation and dissolution is in part driven by own choice, individuals with below-average childbearing desires will more often have union trajectories less compatible with childbearing. However, as union dissolutions become increasingly common, ever having experienced a union dissolution need not in itself signal weaker family orientation or childbearing desires.

If disagreement on childbearing plans drives union dissolution, and men on average have lower childbearing desires than women, one should expect that the proportion childless among those with a complex union history is higher among men than among women. In accordance with this expectation, I find that the proportion childless in the *Complex* cluster is significantly and substantially higher among men than among women. Using data from the US, Jokela et al (2010) find that serial co-residence correlates positively with number of children among men only. As correlates of serial co-residence vary substantially between Norway and the US, it remains an empirical question whether the same pattern would emerge using Norwegian data. If so, these results indicate that serial co-residence is linked to high variance in fertility outcomes – correlating both with a higher probability to remain childless, and a higher number of children for men who become fathers.

Previous studies on serial co-residence in the US have found a link between early unintended childbearing and subsequent union instability (Guzzo and Hayford 2012). To explore whether a similar pattern is present in the Norwegian context, I look at the union context of the first birth by cluster. Also among those who ever

experienced a union dissolution, only about 10% had a first child before entering a union. Hence, pre-union childbearing seems an unlikely driver of union instability in the Norwegian context.

From both the US and UK, there is firm evidence that "serial co-residence" – closely related to union dissolution – is linked to lower socioeconomic status. In this sample, individuals in the *Complex* and *Trial Union* cluster do not differ significantly from the individuals with a *Standard* biography with respect to educational attainment. The finding that serial co-residence is not related to lower socioeconomic status is consistent with previous studies from the Norwegian context (Dommermuth and Wiik 2014), but contrasts the pattern found in the US. In conjunction with previous research, this indicates that the "'two tier family system" in the US (Furstenberg 2014) – where union instability is strongly related to lower socioeconomic status – is less pronounced in Norwegian context. Variation in economic security and institutional support for families, as well as differences in culture and norms regarding the family, are possible explanations for these differences.

I further explore whether the link between union history and childlessness depends on educational attainment. Across sex, those in the clusters *Trial Union* and *Complex* are more likely to remain childless if they have higher education. Hence, the suggestion that men with lesser "provider abilities" (as captured by lower educational attainment) are found to be unsuitable as co-parents by their co-residential partners, received no support in these data. It is perhaps not surprising that this concept, being developed to explain fertility decisions of inner city women in the US, does not travel well to the Norwegian context. However, the proportion childless is comparatively higher among Norwegian men with lower educational attainment, suggesting that lesser provided abilities increases the probability to remain childless (Lappegård et al 2011). I do not find evidence that more unstable unions explain the higher childlessness among Norwegian men with lower education.

At first glance, the variation in the linkages between union history and fertility by educational attainment are consistent with expectations derived from the second demographic transition theory: It could indicate that highly educated men and women are "forerunners", with a preference for self-realisation, more transitory unions, and a childfree life. Before such a conclusion is drawn, further research into the motivations and processes that link union dissolution and childlessness is called for. If the pattern is indeed driven by a preference for a "'free" life style and self realisation, the choice of forming (and then potentially dissolving) unions is in

itself somewhat surprising: Among the highly educated, economic necessity will rarely drive union formation, and in the Norwegian context, there are few or no normative hindrances towards "Living Apart Together". Hence, it seems likely that union formation means at least an attempt to test the possibility of a long-term future together – with or without joint children.

Conditional on a complex union history, highly educated women are more likely than women with no completed higher education to remain childless. One interpretation of this pattern is that women with higher education are more reluctant to have a child in a union they consider fragile. The instability of parental and childless unions has increase in parallel in Norway (Vinberg et al 2015), and an increasing numbers of children are born to parents who acknowledge that their union is fragile (Kravdal 1997). This implies that single parenthood is often a realistic future outcome at the time the fertility decision is made. There are three important reasons to expect educational differences in how women view this prospect.

First, births to highly educated women are more likely to be planned (Finer and Henshaw 2006), and low relationship quality correlates negatively with plans to enter parenthood (Rijken and Thomson 2011). Second, qualitative studies show a commitment to "intensive parenting", requiring the efforts of two co-residential adults, among highly educated parents (Stefansen (2008) for Norway, Lareau (2000) for the US). If the threshold for what is considered to be a satisfactory upbringing increases with education, men and women with higher education may also hesitate to have children in a fragile union. Third, while support schemes substantially reduce the monetary cost of single parenting in Norway (Kjeldstad 1998), the time cost of single parenting remains high. As the time cost of raising a child is known to impact the fertility choices of highly educated women the most, this may also hold for the decision of whether to have a child in a fragile union. However, these explanations remain tentative, and most of all underline the need for further qualitative and quantitative studies on the interplay between fertility plans, union commitment and socioeconomic status.

The increase in childlessness has gained considerable attention from demographers (Tanturri et al 2015). My results indicate that the increased acceptance of union dissolution and repartnering may contribute to increase in childlessness. When parenthood becomes more of a choice, and less normatively prescribed within

unions, this may shape union and fertility choices. This development may also strengthen the gender differences in union histories and fertility, as men and women could use this freedom of choice differently.

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Appendix

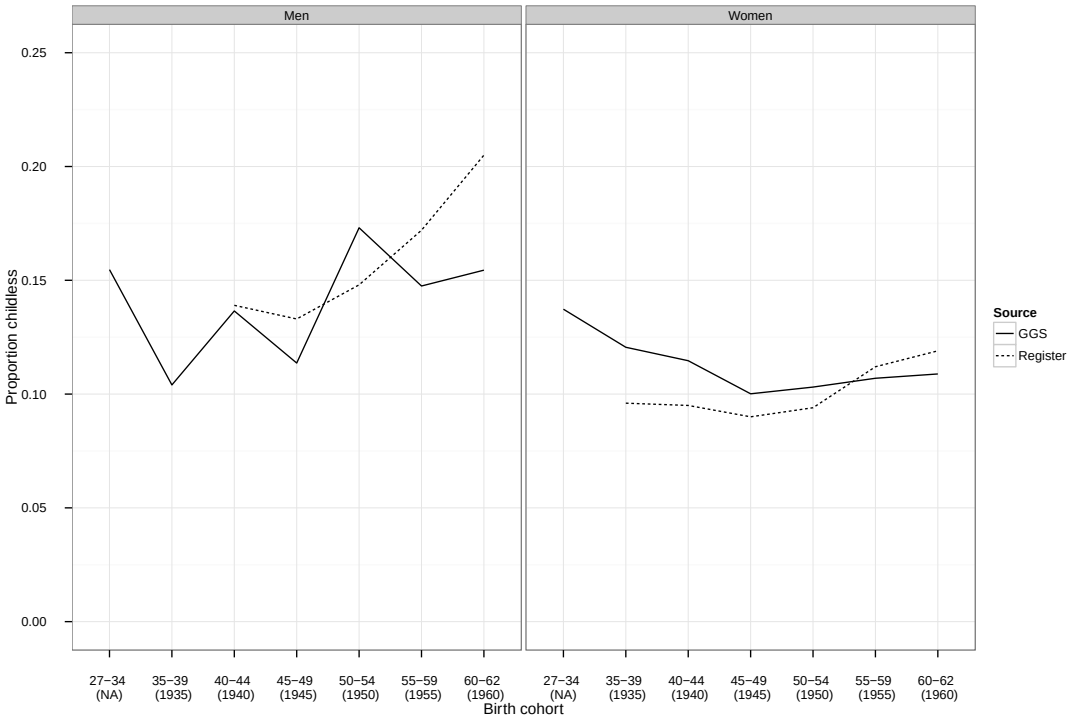

Fig. A.1: Childlessness at age 45 by cohorts. Estimates from population registers and Norwegian GGS. GGS estimates are own calculations based on the study sample. Register data are obtained from Statistics Norway, www.ssb.no/Statbank, Table 07870. To ensure comparability with the GGS data, I use official statistics on completed fertility measured in 2008. For GGS data, I use the cohort grouping applied throughout the paper (x-axis, upper line labels). Estimates from population registers are available for every 5th birth cohort (lower line of x-axis labels, in parenthesis).

Table A.1: **Model 2c**: Logistic regression of the probability to remain childless on cluster, cohort and their interaction. Estimations done separately by sex. Results on odds scale. 95% C. I. in brackets. * 1 outside the confidence interval. LR tests are done towards a model including cohort and cluster, but omitting their interaction (i.e. Model 2b, Table 3). *a*) Indicates that the parameter could not be estimated due to quasi-complete separation of data points.

	Men	Women
Intercept	0.04 [0.02; 0.08]*	0.05 [0.02; 0.09]*
Cluster (ref=Standard)		
Trial Union	4.93 [1.53; 15.88]*	1.76 [0.52; 5.96]
Complex	7.67 [3.40; 17.31]*	4.99 [2.19; 11.34]*
Unpartnered	62.49 [25.53; 152.96]*	22.14 [8.24; 59.53]*
Early Standard	2.06 [0.61; 6.95]	0.62 [0.19; 2.06]
Postponed	5.90 [2.31; 15.05]*	2.85 [0.82; 9.86]
Birth cohort (ref = 1950-54)		
1927-34	2.13 [0.93; 4.88]	1.94 [0.86; 4.40]
1935-39	1.12 [0.44; 2.88]	1.63 [0.67; 3.97]
1940-44	1.72 [0.77; 3.85]	1.10 [0.45; 2.72]
1945-49	0.97 [0.42; 2.22]	0.66 [0.26; 1.65]
1955-59	0.88 [0.35; 2.21]	0.78 [0.29; 2.05]
1960-62	1.80 [0.71; 4.54]	0.84 [0.28; 2.57]
Birth cohort 1927-34 $*$		
Trial Union	*a)*	0.67 [0.06; 7.75]
Complex	0.58 [0.14; 2.37]	0.61 [0.16; 2.26]
Unpartnered	0.07 [0.02; 0.22]*	0.12 [0.04; 0.39]*
Early Standard	*a)*	0.75 [0.13; 4.26]
Postponed	0.47 [0.15; 1.53]	2.18 [0.49; 9.58]
Birth cohort 1935-39 $*$		
Trial Union	*a)*	1.03 [0.08; 12.47]
Complex	0.23 [0.04; 1.37]	0.16 [0.03; 0.91]*
Unpartnered	0.13 [0.04; 0.44]*	0.20 [0.06; 0.70]*
Early Standard	*a)*	1.37 [0.29; 6.61]
Postponed	0.63 [0.17; 2.35]	1.23 [0.25; 5.96]
Birth cohort 1940-44 $*$ Trial Union	0.15 [0.01; 1.64]	0.93 [0.13; 6.75]
Complex	0.62 [0.20; 1.98]	0.38 [0.11; 1.33]
Unpartnered	0.17 [0.06; 0.53]*	0.48 [0.14; 1.69]
Early Standard	0.46 [0.08; 2.61]	1.46 [0.29; 7.36]
Postponed	0.55 [0.17; 1.80]	4.11 [0.84; 20.16]
Birth cohort 1945-49 $*$		
Trial Union	0.36 [0.06; 2.03]	1.24 [0.20; 7.54]
Complex	0.53 [0.18; 1.56]	1.10 [0.36; 3.42]
Unpartnered	0.92 [0.29; 2.91]	1.36 [0.38; 4.93]
Early Standard	0.16 [0.01; 1.68]	0.58 [0.08; 4.01]
Postponed	0.67 [0.20; 2.25]	5.02 [1.11; 22.77]*
Birth cohort 1955-59 $*$		
Trial Union	0.21 [0.04; 1.22]	1.45 [0.29; 7.26]
Complex	1.25 [0.41; 3.78]	0.84 [0.26; 2.69]
Unpartnered	1.22 [0.35; 4.27]	1.06 [0.28; 4.06]
Early Standard	0.27 [0.02; 2.97]	1.53 [0.29; 7.99]
Postponed	1.34 [0.38; 4.63]	2.34 [0.48; 11.26]
Birth cohort 1960-62 $*$		
Trial Union	0.17 [0.03; 1.00]*	0.96 [0.16; 5.96]
Complex	0.71 [0.23; 2.25]	1.02 [0.27; 3.78]
Unpartnered	0.38 [0.10; 1.43]	0.90 [0.20; 4.13]
Early Standard	0.24 [0.02; 2.69]	1.28 [0.19; 8.42]
Postponed	0.22 [0.05; 1.00]*	3.14 [0.46; 21.20]
N	3862	3956
AIC	2534.16	2431.63
LR(Df)	84.60(30)	63.78(30)
P(LR)	0.00	0.00

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