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PREFACE

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Entry into first marriage or cohabitation by Norwegian men and women born 1945 and 1960[1]

by

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1. Introduction

After the recession during the time of economic hardships in the inter-war years, the Norwegian marriage rates for singles made a leap upwards in the latter half of the 1940s, and at the same time people started to marry younger. This trend, which was part of a broader Western pattern and by no means a special feature of Norway, culminated around 1970, when the average age at marriage for single males and females were 25,2 and 22,7 years respectively. The marriage rates then started to decline and the average age at marriage to increase. This has been the situation up to the present time, if we ignore a minuscule growth in marriage rates for singles over thirty in the late 1980s.

Part of the picture is also the gradual appearance (or reappearance) of informal cohabitational unions between heterosexual partners. Although it may be possible to trace historical roots for this phenomenon (Trost 1978, Brunborg 1979), its prevalence in early postwar Norway must have been quite insignificant. The first reliable data on the matter appear in surveys conducted in the 1970s. The most thorough of these was the national Fertility Survey of 1977, which found the percentage of currently cohabiting women aged 18-44 to be about 5. While the percentage who ever lived in a nonmarital cohabitational union was considerably higher, with a peak at 40 per cent for women aged 23-24, only 17 per cent of the women over 34 years of age reported any cohabitational experience (Central Bureau of Statistics 1981, Table 5). Less than one third of such unions were reported to have been initiated before 1960.

As we now are well aware of, the number of people living in informal cohabitational unions had a rapid growth in the 1980s. The second national fertility survey in Norway, conducted in 1988, found the share of women aged 19-42 cohabiting without marriage to be 18 per cent (Central Bureau of Statistics 1991, Table 1.1.1). More than 60 per cent of women at the end of their 20s and beginning of their 30s reported having had nonmarital cohabitational experience.

Our aim in this paper is to give a broad picture of different factors influencing the two mutually exclusive transitions from the single state to first marriage or to first unmarried cohabitation using the method of hazard regression. Results will be based on the data of the Survey of 1988 and will be presented for each sex separately for the two cohorts born in 1945 and 1960, which are the ones for which we have data for both sexes.

Thus, the paper partly approaches a long-standing tradition in American family research on the social, economic and demographic antecedents of marriage (for an overview, see e.g. Otto 1979, Goldscheider and Waite 1986, and Cooney and Hogan 1991). Only recently has the interest been extended to nonmarital cohabitational unions also. Much of the literature on cohabitation has, however, aimed at describing the social characteristics of the cohabitors, compared to the singles and the married (Glick and Spanier 1980, Spanier 1983, Rindfuss and VandenHeuvel 1990), rather than at identifying the determinants of the entry into (first) cohabitation. Our data, which contain complete retrospective histories of marriage and cohabitation, births, education and periods of work, are especially well suited to the study of the dynamics of the family-building process.

Among recent studies on formal and informal union formation that apply hazard regression, we mention the work by Bernhardt and B. Hoem (1985), J. Hoem (1986) (Swedish data) and Liefbroer (1991) (Dutch data). Their contributions depart from ours in certain respects. Bernhardt and B. Hoem (1985) include no time-varying covariates in their regression models, while J. Hoem (1986) includes two such factors (educational enrollment and educational level).

These two covariates are also included in our study. The Swedish data on educational level are, however, less complete than ours, which may have influenced the results for that factor. In addition, we enter time-varying covariates to represent employment, first coital experience, and entry into parenthood, as well as a fixed covariate for the respondent's number of siblings. Besides, our data allow us to study both sexes, while the Swedish authors have been restricted to women. Liefbroer (1991) includes several covariates, and his data cover both sexes, but his study is based on one cohort only.

Marital status is generally of considerable importance in human life. It has been repeatedly shown that being married is associated with higher levels of mental health and subjective well-being than being unmarried or formerly married (Campbell, Converse and Rodgers 1976, Mastekaasa 1984, Gove, Style and Hughes 1990). That is the case for both sexes, although the association tends to be somewhat stronger for men. There is reason to believe that some of the beneficial effects of marriage also accrue to unmarried cohabitors (Blom and Listhaug 1988), while single life on the average may be less advantageous.

It is also generally acknowledged that cohabitational unions are more shortlived than marriages. Although a substantial part of such unions are transformed into marriages after some time, the resulting marriages are more likely to break up than marriages entered directly from the single state (Hoem and Hoem 1992, Halli and Zimmer 1991, Teachman, Thomas and Paasch 1991). That may seem puzzling as one would be inclined to believe that only the more successful cohabitational unions would proceed to marriage. Selectivity in the option of cohabitation may be part of the explanation for the higher dissolution risk of marriages preceded by cohabitation, although one can hardly rule out the possibility that social habits and interaction patterns acquired during the unmarried phase also work to produce the result (Booth and Johnson 1988).

Union formation also matters because of the well-known inherent association between conjugal unions and fertility. Singles always have lower fertility than the married, while cohabitors generally have a level of reproduction intermediate to that of the married and that of the singles (e.g. Bachrach 1987). It is likely that the choice of union type and childbearing expectations are mutually dependent.

2. Theory and previous findings

Main assumptions underlying much of the work referenced in this paper actually belong to the "rational choice" (Heath 1976) or "new home economics" (Becker 1981) approach to social theory. The social actor is seen as to performing those kinds of actions that maximize benefits and minimize costs, and the attractiveness of an object or a social action is thought to depend on the availability of acceptable alternatives. To a large extent, this theoretical perspective is also implicit in the present study. However, we additionally stress the importance of cultural guidelines and reference groups influencing the decision-making of actors in the field of family formation. Theoretical approaches describing social action as influenced by social norms and ideational forces are therefore highly relevant (Lesthaeghe 1983).

In what follows, we shall present the hypotheses that are to be tested in our empirical analysis. Some have been relatively extensively substantiated in previous research, though not always for Norway, while others seem to have been less explored before. Some of the hypothesized findings may have been reported previously only for one of the types of union formation or for one of the sexes. With our data, we are able to fill in missing gaps in the picture.

The factors to be investigated here can be grouped into three kinds: early background factors, factors related to sex and procreation, and factors related to education and employment. We shall approach them one by one.

2.1. Early background factors

We expect a substantial reduction in the marriage intensity for both sexes from the cohort of 1945 to the cohort born in 1960. According to vital statistics, the marriage rate for unmarried Norwegian men at the age of 25-29 (the prime marrying years for men) fell from 161 (per 1000 unmarried men) for the birth cohorts of 1946-1950 to 73 for the birth cohorts of 1961-1965, a reduction of 55 per cent. The reduction was even higher (62 per cent) for the adjacent age interval of 20-24 years. Similarly, the marriage rate for women aged 20-24 (their prime marrying years) fell from 226 for the birth cohort of 1946-1950 to 95 for the birth cohort of 1961-1965, a reduction of 58 per cent. Conversely, we expect an increase in the intensity of cohabitational union formation of about the same size for both sexes from the cohort of 1945 to that of 1960. In the U.S., early cohabitation has largely compensated for the decline in first marriage (Bumpass, Sweet and Cherlin 1991).

It is also well known from previous research that the marriage rates and the occurrence of unmarried cohabitation have certain *regional* variations (Østby and Strøm Bull 1986). We expect the propensity to enter marriage to be higher in Western Norway and lower in Northern and Middle Norway than in the rest of the country. Conversely, we expect the propensity to enter unmarried cohabitation to be higher in Northern/Middle Norway and lower in Western Norway than in Eastern Norway. Different cultural values prevailing in the different regions is the most likely explanation for the variations observed (Brunborg 1979).

The *urban/rural* dimension of the place where one grew up can further be expected to influence union formation behaviour. The most common impression is that marriage is entered earlier among people with a rural background (Otto 1979), probably because of a different value orientation. As the geographical mobility in a society increases, such differences are supposed to diminish, however.

The *religious* involvement of the individual has been shown to correlate with the choice between an unmarried or a married first union (Hoem and Hoem 1992, B. Hoem 1988). Religiously active persons strongly tend to choose marriage while the opposite is true for the religiously passive. This tendency is of course a consequence of the negative stand towards extra-marital sexual relations implicit in the religious codex. The religious dimension may possibly be a stronger determinant of union type for women than for men, for religious values have been shown to be more central for women than men on average (Harding, Phillips and Fogarty 1986).

It has been hypothesized that the number of *siblings* in the parental home during adolescence influences the timing of marriage: the more siblings, the lower the age at marriage (Otto 1979). Various explanations for the hypothesized relationship have been proposed. One is that the relative advantage of staying in the parental home declines as the number of siblings increases, due to fewer resources available per person (Michael and Tuma 1985). Another version is that more siblings lead to less parental monitoring of each child, higher risk of unwanted pregnancy and thereby higher risk of early marriage (Waite and Spitze 1981). It seems, however, that the empirical support for the assumed relationship tends to be meager (Hogan 1978, Blossfeld and Huinink 1991, Landale and Forste 1991).

Finally, a low *socioeconomic status* in the family of origin has been found to encourage early marriage. The effect seems to be mediated through differential educational attainment and is generally week or non-existent once educational advances are controlled (Hogan 1978, Carlson 1979, Cooney and Hogan 1991, Blossfeld and Huinink 1991). There is some disagreement in the literature whether high or low socioeconomic background is charateristic of cohabitors, but we prefer to handle that question in section 2.3.

2.2. Sex and procreation

It is rather trivial that having had *sexual intercourse* increases the likelihood of cohabitation or marriage (Landale and Forste 1991). However, it is not obvious how the timing of sexual initiation affects the timing of marriage. The most immediate hypothesis is probably that early sexual initiation leads to early marriage. Miller and Heaton (1991) report early sexual initiation to be followed by low initial marriage rates among white American females, while late sexual initiation is followed by rapidly increasing marriage rates. A study of Puerto Rican women in New York city with adjacent counties shows that having engaged in sexual activity before union formation lowers the odds of entering marriage relative to the odds of entering unmarried cohabitation (Landale and Forste 1991).

Being *pregnant* strongly increases the propensity to enter a union, whether formal or informal (Goldscheider and Waite 1986, Blossfeld and Huinink 1991, Landale and Forste 1991). Swedish data show that the choice of union type when pregnant depends on the birth cohort. Women born before 1946 chose marriage most often, while women born later chose to enter unmarried cohabitation when pregnant (B. Hoem 1987, B. Hoem 1988).

Previous research has also addressed the impact of having a premarital *child.* It has been argued that two counteracting effects may be at work. Having a baby out of wedlock increases the probability to marry the baby's father. That effect is probably strongest shortly after delivery. Later on, if the mother does not marry or enter cohabitation with the father, having a baby may act as a barrier against entering a union with other men. Empirical evidence has generally supported these assumptions, often showing effects depending on age (Cherlin 1980, Waite and Goldscheider and Waite 1986, Kobrin and Waite 1984, Landale and Forste 1991). The effect of a premarital child on the likelihood of marriage has also been tested for men, yielding a positive correlation (Teachman, Polonko and Leigh 1987).

2.3. Education and employment

A finding replicated in many studies is that being *enrolled in school* generally reduces the propensity to enter a formal or informal union, especially at younger ages (Cherlin 1980, Waite and Spitze 1991, Kobrin and Waite 1984, Blossfeld and Huinink 1991, Cooney and Hogan 1991, Landale and Forste 1991). The effect has been shown to be stronger for women than men (Marini 1978, Goldscheider and Waite 1986, Teachman, Polonko and Leigh 1987). Some studies indicate, however, that union type may be of some importance. School enrollment has been found to be somewhat less incompatible with cohabitation than with marriage (J. Hoem 1986, Liefbroer 1991, Rindfuss and VandenHeuvel 1990).

Some studies distinguish between the fact of being enrolled in school per se and the *educational level* attained. So do we in this study. The educational level has been interpreted as a proxy for (attained) social status or "human capital investment". It is reasonable to assume that higher-educated men have a stronger bargaining position in the marriage market, and that they -

although marrying at somewhat higher ages - in the end tend to marry in higher proportions than their less educated male competitors. That may especially be the case when men at marriageable ages outnumber the prospective wives. The position of highly educated women has evoked more controvercy. According to some theorists (Becker 1981), taking higher education increases the feasibility of a work career, which in turn reduces the woman's willingness to marry. Nevertheless, others have found women's level of educational achievement either to be by and large unrelated (J. Hoem 1986, Blossfeld and Huinink 1991, Liefbroer 1991, Blossfeld and Jaenichen 1992) or positively related to the propensity to enter marriage (Goldscheider and Waite 1986, Landale and Forste 1991, Waite and Spitze 1981).

As for the association between educational level and unmarried cohabitation, the findings have been greatly diverging, especially concerning the early cohabitors. Dutch (De Feijter 1991, Liefbroer 1991) and French (Carlson 1985) data indicate a positive association between education and the incidence of cohabitation, while Swedish data indicate the opposite (J. Hoem 1986). U.S. data are mixed, with some authors claiming the association to be positive (Glick and Spanier 1980, Spanier 1983) and others strongly advocating that it is negative (Tanfer 1987, Bumpass and Sweet 1989, Bumpass, Sweet and Cherlin 1991). A downward trend in the educational levels reported for the cohabitors, can probably be discerned in the American data. The idea that unmarried cohabitation developed from two different origins has, however, also been advanced, both for the U.S. (Spanier 1985) and for Sweden (Lewin 1982). An u-shaped educational profile has been reported for unmarried cohabiting women in Britain (Haskey and Kiernan 1989). For Norway (Østby and Strøm Bull 1986) and the U.S. (Spanier 1983), the relation between education and cohabitation has been found to interact with sex, with well-educated men generally less prone to cohabit (and more prone to marry) than women of a comparable educational level.

The literature unanimously agrees that *employment* increases the odds of marriage for unmarried men (Cooney and Hogan 1991, Kobrin and Waite 1984, Goldscheider and Waite 1986, MacDonald and Rindfuss 1981, Oppenheimer 1988). The reason for this is most probably that men in industrial societies, until recently, have been considered the main breadwinner of the family. Being employed enables a person to meet the economic expenses of setting up an independent household.

The opinions about the effect of female employment on marriage rates have been more diverging. The argument for a positive effect is that employed women can contribute to the household economy and are thereby more attractive marriage partners. The workplace may, in addition, have the latent function of being a local marriage market, increasing the likelihood of finding a good match. The argument for a negative effect is that employed women can afford to postpone or forego marriage if they want to. At any moment, a promising career may be a more attractive alternative (e.g. Dixon 1971, Dixon 1978). A third possibility is that the net effect is negligible because the two opposite effects cancel each other.

It may be no big surprise that the empirical evidence also has been diverging. On one hand, it has been shown that increased female work opportunities (Preston and Richards 1975), occupational achievement (Mueller and Campbell 1977), future work plans (Cherlin 1980) or higher wages relative to men's (Ermisch 1981) tend to reduce marriage rates. On the other hand, more recent data have shown positive effects for women of being employed on the propensity to marry (Waite and Spitze 1981, Goldscheider and Waite 1986, Landale and Forste 1991, Teachman, Polonko and Leigh 1987). A zero effect has also been shown (Kobrin and Waite 1984). Apart from differences in methods and operationalizations, some of the divergences

above may be due to period effects. The forerunners of female work-enrollment may have met more obstacles in the marriage market or may have been more positively selected for non-marriage (or delayed marriage) than the majority of women who followed in their wake.

As for the impact of employment on the propensity to enter unmarried cohabitation, empirical findings seem scarce. However, Glick and Spanier (1980) and Spanier (1983) note that unmarried cohabiting men are less likely to be employed than married men, while unmarried cohabiting women are more likely to be employed than married women. According to Spanier (1983), that may reflect "the more tenous nature of unmarried cohabitation .. requiring unmarried cohabiting women to be more independent and financially self-reliant than their married counterparts".

3. Data and methods

3.1. Data

Our data come from the Survey of Families and Occupations, based on lengthy face-to-face interviews with 4019 women and 1053 men from a national probability sample of selected cohorts of men and women living in Norway at the beginning of 1988. The interviews were conducted by the Central Bureau of Statistics between October 1988 and August 1989, and the non-response was 19 per cent for women and 22 per cent for men. The women belong to the cohorts born in 1945, 1950, 1955, 1960, 1965 and 1968, and the men belong to the cohorts of 1945 and 1960. Complete retrospective life histories on childbearing, cohabitation and marriage, education and employment were recorded by month and year, and registered individual information on income and tax payments has later been linked to the data.

3.2. Method

We apply the method of hazard regression to estimate the impact of a number of fixed and time-dependent covariates on the intensities of first union formation. We estimate separate models for the formation of marriage and of unmarried cohabitation and also treat each sex separately. For simplicity and for ease of comparison between the sexes, we limit the study to the cohorts of 1945 and 1960.

The individuals included in the analyses contribute to the population at risk from the beginning of the calendar year in which they became 16 years old until they marry or start to cohabit, or until the end of the observation period (which is the time of interview or the end of the calendar year in which they reached age 29). The great majority of first unions is entered by that age, so the number of persons left for exposure at higher ages rapidly becomes too small for analysis.

Estimation is done by the computer programme LOGLIN (Olivier and Neff 1976), which applies a maximum-likelihood algorithm. The baseline intensity is assumed to be constant within certain time intervals (here 24-month intervals). Only categorical covariates are permitted. Interaction terms between covariates, or between one covariate and the time variable, are easily included in the model.

Hierarchical models are compared by likelihood-ratio tests. The significance of the difference between two relative risks can be evaluated by estimating a new model where the two categories

are collapsed and by comparing the difference in likelihood using the chi-square distribution with one degree of freedom.

3.3. Covariates

A brief description of the covariates that enter our analysis, is given here. The first six covariates are fixed, i.e. they do not vary with time. The last five are time-varying covariates.

Region is where the respondent mainly lived before age 16. Codes for municipality are aggregated into three broad regions (Eastern, Southern/Western and Middle/Northern Norway). *Urban/rural* indicates the character of the place where the respondent grew up. Of the five categories of the original scale, we have kept the two at the extremes and have collapsed the three in the middle into a single middle group called "other". *Church attendance* indicates how often the respondent claims to have attended church or religious meetings, apart from christenings, weddings and funerals, during the last 12 months. Though the covariate captures the level of religious activity at the time of the interview, we consider it a proxy for religious influence during adolescence. The rationale for this is the rather stable nature of basic values (e.g. Rokeach 1973). *Siblings* is the number of siblings the respondent reports to have had. *Socioeconomic status* is based on the occupation of the main breadwinner of the family during the respondent's adolescence. The original codes for occupation have been recoded according to a standard for the classification of socioeconomic status (Central Bureau of Statistics 1984) and have been collapsed into four categories (unskilled worker, skilled worker/low-level white collar, middle/high-level white collar, farmers/fishermen).

Sexual debut, the first time-varying covariate, has been constructed from the answers to a question about the year of first sexual intercourse. As the month was not asked for, we have imputed June for all the reported events. The covariate assumes values according to time elapsed since sexual initiation. Respondents who gave no answer ("do not remember"/"do not want to answer"/unknown), are treated as if they have no coital experience, which no doubt introduces a minor error. The main effect is that the risk of union formation for the category of the sexually un-experienced is somewhat overestimated[1]. *First child* distinguishes time before and after entry into parenthood, and also indicates whether the respondent (or his partner as the case may be) is pregnant in a given month. The category "pregnancy" refers to the seven months just before the first child is born.

The time-varying covariate *educational enrollment* is based on the educational history, and it indicates whether the respondent is reported to be enrolled in school in any given month, irrespective of whether the education was finally completed. Intervals up to three months between two subsequent spells of education are ignored, and the respondent is considered as enrolled throughout the interval. *Level of education* indicates the highest level of completed education recorded. The original eight levels have been collapsed into three levels that correspond to the three main categories of the educational system (primary school, senior secondary, university/college). *Employment status* indicates whether the respondent is recorded as employed, based on the employment history. For convenience, episodes of employment shorter than three months or encompassing fewer than 10 hours a week were never recorded.

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[1] The non-response on the question of age at first sexual intercourse was 22% for men born in 1945, 12% for men born in 1960, 14% for women born in 1945, and 7% for women born in 1960.

4. Results

In this section, we first present results concerning first marriage formation and subsequently corresponding findings for the start of a first consensual union. Most of our comments refer to the estimates for the two cohorts combined. Only occasionally do we discuss the differences between the cohorts.

4.1. Marriage

The age-specific marriage rates for men and women born in 1945 and in 1960 are presented in Figure 1. The data are simple occurrence/exposure rates for two-year intervals. The curves display the baseline intensities by *age*.

The figure clearly demonstrates once more that women marry earlier than men. For both cohorts, the marriage rate for women is higher at every age than the corresponding rate for men. The minor deviation for the youngest cohort is due to random variation. The difference between the *cohorts* is also very conspicuous. Within each sex, the marriage rate of the oldest cohort is always higher than the marriage rate of the youngest, as expected. A peculiarity is that teenaged women of the (low-marrying) 1960 cohort are more inclined to marry than teenaged men of the (high-marrying) 1945 cohort.

Table 1 reports the relative "risks" of marriage formation for single men and women, estimated separately in models with only main effects. The statistical significance of each covariate is given in parantheses. The table shows that the "risk" of marriage is 69 and 62 per cent lower for the birth cohort of 1960 than for the birth cohort of 1945 for men and women, respectively.

As expected, the marriage intensity also varies significantly with *region*, both for men and for women. Men from Middle/Northern Norway married much less readily than men from other parts of the country. For women, we find a higher intensity in Southern/Western Norway and lower intensity in Middle/Northern Norway than in Eastern Norway, i.e. a pattern close to the one we expected. We have no explanation for the slight divergence between the sexes.

The *urban/rural* dimension showed no significant or interesting impact on the marriage intensity, neither for men nor women, when the cohorts were analysed jointly (data not shown). To simplify our computer work, we removed this covariate. Our data do not support the notion that rural people marry earlier than people from urban districts.

As expected, frequently *attending church* increases the marriage intnsity both for males and females. We cannot detect any stronger effect for women than for men, however.

No main effect of the number of *siblings* was found for any of the sexes (data not shown). However, a significant interaction between siblings and age for men was found, showing the hypothesized earlier age at marriage the higher the number of siblings (Appendix, Table A). No such effect was discerned for women.

Socioeconomic status of the main breadwinner during adolescence proved to have a significant effect on the marriage intensity for women ($p<.05$). The marriage intensity for sons and daughters of unskilled and skilled workers/lower employees were 30-40 per cent higher than the intensity for sons and daughters of medium/higher employees (Appendix, Table B). When controls were entered for educational enrollment, educational level and first child, the effect was

no longer significant. No significant interaction of socioeconomic status and age could be found either (data not shown).

The timing of *sexual initiation* turned out to have strong effects on the marriage intensity both for men and women. Being a "virgin" impedes the entry into marriage for both sexes, which was no surprise. The larger share of non-respondents in the group of non-experienced men, may have caused their seemingly higher marriage "risk" compared to virgin women. More interesting is probably the tendency of falling marriage intensity with time elapsed since sexual initiation. The effect is apparent for both sexes, but is significant only for women ($p<.0001$)[2] The marriage intensity is highest through the first couple of years after sexual initiation and decreases thereafter, especially for women. For both sexes, there is a significant interaction with age showing a weak association between early sexual debut and early age at marriage (Appendix, Table C-D). Several of the groups in the interaction matrix are, however, rather small.

Being *pregnant* or having a pregnant partner increases the intensity of marriage formation remarkably for both sexes. Compared to the situation of zero parity, the overrisk is 38 times higher for men and 22 times higher for women. This is no big surprise, but the magnitude of the overrisk is impressing. The seemingly stronger effect for men is probably an artifact due to selective reporting. Men who report the birth of their non-maritally conceived child may have been the men most prone to marry the child's mother (cf. Teachman, Polonko and Leigh 1987).

The same covariate also shows the effect of having a *child* before entering a conjugal union. For both sexes, having a child while not in a union increases the marriage intensity relative to being childless. The effect is, however, far more modest after the child is born than during the time of pregnancy. The seemingly higher "risk" for men, is probably due to selective reporting. To check if the effect varies with age, as found in other studies, a model with interaction between timing of first child and age was estimated. The interaction was significant for both sexes and showed increased marriage intensities associated with a pre-union child especially at lower ages. After age 25, a child born before first union reduces the "risk" of marriage formation relative to being childless for women (Appendix, Table E-F).

Being *enrolled in school* reduces the intensity of marriage formation more strongly for women than for men. Women may experience a more serious role-conflict between being in school and starting a family than men do, as has been found in previous studies as well. It is worth noting that being enrolled reduces the marriage intensity for women to one third relative to women not enrolled in education. Taking higher education implies that women are continually exposed to lower marriage intensity during a substantive period of time.

The *level of education* increases the propensity to marry for both sexes (net of other factors). We expected that higher education would enhance the marriage intensity for men, and this is what we find. It is not equally obvious that the effect of educational level is similar for women, given the diverging empirical evidence reported (e.g. zero-effects). We find no support for the microeconomic thesis that highly educated women refrain from marriage.

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[2] Compared to a model with sexual debut dicotomized (experienced/non-experienced), the fit of the original model, with several time categories after sexual debut, is significantly better.

As expected, being *employed* increases the marriage intensity for men[3]. The "risk" of marriage is 35 per cent higher for employed men relative to the not employed, and the effect is significant. For women, the marriage intensity is higher for the not employed, though not significantly. That seems to confirm the traditional notion that employment is a more central asset for men than women, when forming a family.

If we take a glance at the different male cohorts, we find that the effect of employment is substantially stronger for the 1960 cohort than the 1945 cohort. That may be surprising, considering the more traditional role expectations about being the breadwinner that probably faced men born in 1945, compared to men born fifteen years later. However, the attitudinal change in this field has probably more been a shift from expecting one to expecting two wages. The increased importance of employment status for the 1960 cohort, may therefore more be a shift of weight from potential to actual work attachment. Taking a closer look, we see that as the significance of actual employment increases from the 1945 to the 1960 cohort, the significance of educational level decreases correspondingly. Could a higher education during the economically flourishing 1960s have had roughly the same function as an actual work-contract during the more crisis-ridden time period fifteen years later?

The effect of employment status for women has different directions depending on cohort. That may only be a reflection of the general change in female employment taking place during these years. It could also be that we in the 1945 cohort see a slight verification of the proposition put forward by Becker (1981) that increased female work opportunities lead to reduced propensity to marry. That the effect is limitted to the oldest cohort, is in line with assumptions about special circumstances hitting (and selecting) the pioneers in the movement for paid employment more strongly than the successors.

4.2. Cohabitation

In Figure 2 the *age*-specific rates of unmarried cohabitation for both sexes and each cohort are presented. Comparing the cohabitation rates for men and women of the same cohorts, women's rates are higher than men's during the teens and beginning of the twenties. The difference between the sexes is pronounced for the 1960 cohort and only very slight for the 1945 cohort. The higher initial rates for women are due to their earlier start. About halfway in the twenties the rates for men catch up with the rates for women and surpass them. The reason for this is probably men's tendency to choose younger partners than themselves, and the fact that umarried cohabitation has gradually increased over the cohorts. Men are influenced by their younger partners to enter cohabitation more often than marriage, compared to women of their own cohort (who tend to ally with older partners). Somewhere along the age-axis the latter effect outbalances the effect of women's earlier start, hence the crossing of the curves for the two sexes. No such crossing of the curves appears for marriage, because men marry later than women and marriage progressively loses out on cohabitation over the cohorts.

What is more obvious in the figure, is that for both sexes the cohabitation rates for the 1960 *cohort* at all ages are higher than the cohabitation rates for the 1945 cohort.

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[3] One should be careful to note that the opposite category, not employed, is not equal to unemployed, as a large part of the not employed will be enrolled in school. The covariate *employment* shows the effect of employment status net of the effect of *school enrollment*, and vice versa.

Table 2 shows the effects of our various different covariates on the relative intensities of entering unmarried cohabitation. Only main-effect models are presented, and the covariates are the same as in Table 1.

We see from the table that the cohabitation "risk" for the 1960 cohort is more than four times as high as for the 1945 cohort, for men and women alike. The increase in the propensity to enter first unmarried cohabitation has, consequently, more than compensated for the decrease in the propensity of singles to marry.

The cohabitation intensity is so evenly distributed across the country that *region of origin* fails to have any significant effect. Nevertheless, contours of the expected pattern can be recognized for both sexes.

No sigificant main effect of the *urban/rural* dimension can be seen for any of the sexes either, nor does it have any significant interaction with age (data not shown). A significant interaction between region and the urban/rural dimension, as indicated by Brunborg (1979), was not found in our data (not shown).

Church attendance, however, proves to have an effect in the expected direction: the higher the religious activity, the lower the propensity to enter unmarried cohabitation. The effect can be discerned for both sexes, but is not very strong. It is significant only for women. Here we may have a reflection of women's stronger attachment to religion.

The number of *siblings* has no significant effect on the risk of cohabitation for any of the sexes, nor any interesting interaction with other factors.

Several models with the factor *socioeconomic status* were estimated for the pooled two cohorts. Socioeconomic status gave no significant main effect for any of the sexes (data not shown). A significant interaction with age was, however, detected for men, showing the effect hypothesized (but not found) regarding entry into marriage: there is a lower age at union formation with lower socioeconomic status (Appendix, Table G). Sons and daughters of self-employed farmers and fishermen were especially slow to enter unmarried cohabitation. The interaction with age for women was not significant (data not shown).

Sexual initiation substantially increases the "risk" of entering unmarried cohabitation. Contrary to the marriage intensity, however, the cohabitation intensity does not diminish with time elapsed since first sexual intercourse; instead it tends to increase, especially for women. The intensity actually doubles for women. This is highly significant ($p<.00001$), while there is no significant increase for men. The longer the interval between first sexual intercourse and first union formation for women, the higher the chance that first union will be unmarried cohabitation instead of marriage.

Men with *pregnant* partners or women who are pregnant have higher "risks" of entering cohabitation than childless people who do not expect to be parents the next seven months. The impact of pregnancy on the intensity of entering cohabitation is, however, far lower than on the intensity of marriage formation. This holds for both cohorts. Marriage strongly seems to be the preferred union type to those who enter a first union while expecting a baby.

Having had a *child* before the first union increases the "risk" of cohabitation somewhat, though not as much as a pregnancy does. The effect is smaller than in the case of marriage formation.

Only for the oldest cohort of women, having a pre-union child actually lowers the intensity of marriage formation relative to childless non-pregnant women (though not significantly).

Enrollment in school impedes the propensity to enter unmarried cohabitation for women, but not for men. Nevertheless, cohabitation seems to be somewhat more compatible with school enrollment than marriage, which was also hypothesized. For men born in 1945, being enrolled actually increases the cohabitation intensity with 50 per cent, though the effect is not significant. The male cohabitors of the 1945 cohort seem to have been highly involved with school.

That is substantiated when looking at *educational level*. The cohabitation intensity for men born in 1945 increases monotonously and significantly with the level of education. There is in fact a doubling of the "risk" from the intermediate to the highest level. The effect is slightly opposite for the youngest male cohort. When the two cohorts are collapsed, the effect of the covariate actually becomes insignificant. Significant first order interactions with cohort have been found both for enrollment in school and educational level for men (data not shown).

For women, the effect of educational level is significant and u-shaped. The effect is strongest (and significant) for the 1945 cohort, but the pattern is u-shaped also for the youngest. The effect for the 1960 cohort is so much weaker that educational level interacts significantly with cohort (data not shown).

What seems clear, is that our earliest male cohabitors show no sign of belonging to an unpriviliged group, in fact they do quite the opposite. Better-educated men born in 1945 were more prone to enter both marriage and unmarried cohabitation than the lower-educated. The "risks" of marriage and cohabitation for men born in 1960 were less influenced by the extent of educational involvement.

All in all, male and female cohabitors exhibit somewhat different social profiles. Not only the well educated women, but also the poorly educated, tend to have higher cohabitation intensities. That coincides with findings in some other countries. The findings on men are consistent with an assumption of the spread of unmarried cohabitation as a "diffusion" process from higher to lower social strata, while the findings on women are more compatible with imagining the spread as a movement from two disparete and opposite origins.

We finally find that being *employed* significantly increases the propensity to enter unmarried cohabitation for both sexes. The notion that being out of the workforce contributes to the formation of unmarried cohabitational unions for men is not supported. Having a job seems to boost men's union formation activity, be it marriage or unmarried cohabitation, and the effect is strongest in the youngest cohort. That employment tends to increase the cohabitation intensity also for women, is in line with previous findings. The effect does not reverse over the cohorts, as was the case for entering marriage.

4.3. Differences between the cohorts

So far we have paid relatively little attention to the difference between the cohorts. We now turn to such features, particularly concerning early background factors, sex and procreation.

Regarding entry into marriage (Table 1), we find that the estimated effect parameters of both region, church attendance, sexual debut and first child differenciate members of the 1960 cohort more strongly than in the 1945 cohort. That is the case for both sexes. For men, cohort interacts

significantly with all four covariates, while for women interaction with cohort is significant only for church attendance and sexual debut (data not shown). The message, nevertheless, is quite the same for both sexes:

Coming from Middle/Northern Norway is less characteristic of those who marry without preceding cohabitation in the 1960 cohort than in 1945 cohort, while coming from Southern/ Western Norway is more characteristic of those who marry in the 1960 cohort. Similarly, being religiously active is more strongly correlated with marriage in the youngest than in the oldest cohort. Having a long time interval between sexual debut and first union entry is rarer in the 1960 cohort than in the 1945 cohort. A long interval may be interpreted as indicating looser ties between sexual activity and the purpose of family formation. The propensity to enter marriage when having a pregnant partner (or being pregant) or having a child outside a union, is stronger in the 1960 than in the 1945 cohort. To marry under such circumstances probably signals an interest in "legalizing" the offspring or to conform to traditional value standards. All in all, the effects of the four covariates uniformly indicate that traditional family values were more preponderant among those who married without preceding cohabitation in the 1960 cohort than in the 1945 cohort.

For women, two other background factors interact significantly with cohort in the marriage model. That is the urban/rural dimension and siblings (Appendix, Table H-I). The "risk" of entering marriage without preceding cohabitation, when coming from the most urban areas, is only half the "risk" experienced by women coming from areas intermediate on the urban/rural scale if born in 1960. Women from urban areas, born in 1945, actually have higer marriage intensities than women from other areas. It is trivial that traditional values are least predominant in urban areas. The significant interaction between number of siblings and cohort shows that only children born in 1960 marry twice as often without preceding cohabitation as women with siblings. No such effect is present in the 1945 cohort. Perhaps only children (especially girls) are more rigidly socialized than children with siblings?

The reason for this presumably stronger correlation between traditional values and entry into marriage in the 1960 cohort than in the 1945 cohort, both for men and women, is probably the substantially stronger selection of those who marry without preceding cohabitation in the 1960 cohort. For the 1945 cohort, to marry directly was mainstream behaviour, while for the 1960 cohort it was minority behaviour (c.f. Figure 1)[4].

Regarding entry into cohabitation (Table 2), there are fewer significant interactions between cohort and the relevant covariates. For men, only the timing of first child interacts significantly with cohort, while none of the interactions are significant for women (data not shown). The reason why pregnancy and a pre-union child appears as stronger determinants of cohabitation in the 1960 cohort than in the 1945 cohort, is not that early male cohabitors cared less about creating a family context for their offspring than cohabitors born 15 years later. The fact is that few of the early cohabitors actually had or expected a child, so on entering cohabitation, that factor was really not very preponderant. Men born in 1945 who had a child or a pregnant partner, usually married if entering a union.

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[4] 65% of men born in 1945 had married without preceding cohabitation before age 29. The corresponding figure for men born in 1960 is 17%. Similarly, 77% of women born in 1945 had married directly before age 29, while the corresponding figure for women born in 1960 is 23%.

Though none of the covariates in table 2 interacted significantly with cohort for women (apart from educational level, which is not discussed here), we found a significant effect of the interaction between the urban/rural dimension and cohort on the propensity to cohabit (Appendix, Table J). Women born in 1945 and coming from rural areas had only half the cohabitation intensity of other women of the same age coming from other areas. No such effect could be discerned for the 1960 cohort.

In the case just cited, it seems to be the cohabitors born in 1945 who are the most strongly selected for untraditional values, but that is not uniformly supported by the effect of the other relevant covariates. It is actually hard to decide in which of the two cohorts cohabitation is most strongly correlated with untraditional family values.

Why is that? Initially, one should believe that cohabitors in the oldest cohort were the most strongly selected for untraditional family values, because to cohabit in the 1960s (minority behaviour) should require more social courage than to cohabit in the 1980s. To start union formation by cohabiting in the 1980s is actually mainstream behaviour. What we must not forget, however, is that the attitudes and values of the whole society also has "moved" during the same time period (Inglehart 1990). So it is probable that the "radicals" or "liberals" of the 1945 cohort, entering cohabitation instead of marriage in their younger days, actually emerge as less radical or liberal when compared to younger cohorts following mainstream standards of today. Hence, the difficulty finding significant culturally relevant differences between the cohabitors in the two cohorts.

5. Conclusions

Norway, as well as many other Western countries, witnessed a gradual decline in marriage rates and an an almost parallel increase in the propensity to enter nonmarital cohabitational unions since the beginning of the 1970s (United Nations 1990). While living together in informal unions in the beginning only was an option chosen by the few, it is now mainstream behaviour, either as a precursor to marriage or a lifestyle in its own.

In this paper we have tried to give a broad picture of factors precipitating either marriage or unmarried cohabitation as first step in union formation for single men and women. By applying the method of hazard regression, allowing inclusion of time varying covariates, we have modelled the effect of dynamic events like educational activity, employment, sexual initiation, pregnancy, and birth of first child.

Cohort is a basic determinant of union type. Men and women born in 1960 have a marriage intensity only one third of the marriage intensity of the 1945 cohort and a cohabitation intensity four times as high as the corresponding intensity of the 1945 cohort.

The expected regional variations were largely found, but they were significant only for entry into marriage. Marriage intensity is lower in Middle/Northern Norway and higher in Southern/Western Norway than in the rest of the country, while the opposite is true for unmarried cohabitation.

The urban/rural dimension proved to have little impact, though women from urban areas born in 1960 were comparatively less inclined to marry without preceding cohabitation than other

women born in 1960. Conversely, women from rural areas born in 1945 were relatively less inclined to enter unmarried cohabitation than other women born in 1945.

Not surprisingly, religious activity was found to influence the choice between marriage and unmarried cohabitation. The religiously active had a clear preference for marriage.

No main effects of the number of siblings in the family of origin were detected. Nevertheless, we discovered that men tended to marry younger when having several siblings, substantiating a hypothesis about declining marginal utility of staying home the more siblings, or a hypothesis about attenuated parental supervision in crowded families. We also found that women born in 1960 with no siblings had higher propensity to enter marriage without preceding cohabitation than other women of the same cohort. More traditional socialization in only-children families is proposed as a possible explanation.

A significant main effect of socioeconomic status was found only for women and only for entrance into marriage. Women with blue collar/lower white collar family background had slightly higher marriage intensity than women with middle and high-level white collar background, especially in the youngest birth cohort. A greater propensity to enter unmarried cohabitation at younger ages was found for men with lower socioeconomic background.

Time elapsed since sexual initiation was found to influence the choice between marriage and unmarried cohabitation. The longer the time interval between sexual initiation and first union formation, the higher the chance that first union will be unmarried cohabitation. The effect is significant for women. A slight association between early sexual initiation and early marriage could also be seen.

Pregnancy is the single factor increasing the union formation "risk" the most, especially the marriage intensity. Norms to the effect that children ought to be born in marriage, is probably (still) an important driving force behind this. Having a baby before entering a union, also increases the intensity of union formation, relative to having no child, but the effect is far weaker than the effect of pregnancy. The marriage intensity when having a baby before a union is entered, declines with age.

Educational enrollment impedes the "risk" of union formation for women, but not for men. The reason for this sex-dependent outcome is probably that women anticipate a higher risk than men of having to abandon the education. The reduction in the union formation intensity is, however, somewhat larger for marriage than unmarried cohabitation. It is possible that the more ad-hoc character of unmarried cohabitation, compared to marriage, makes cohabitation more compatible with school enrollment.

Educational level, net of the effect of educational enrollment, increases the marriage intensity for both sexes. We see no sign of well-educated women wanting to "buy out of marriage" and instead investing their human capital in occupational career.

The present data also shed some light on the discussion about the social origin of modern cohabitation. The picture is somewhat different according to gender. Our oldest male cohabitors are significantly more often educated at the highest than at the medium or lower level. Their cohabitation intensity is also actually higher when enrolled in school than when not, which is rather extraordinary (though not significant). The educational profile of the 1945 cohort of female cohabitors is on the other hand u-shaped. Both the low and high educated women exhibit

higher cohabitation intensity than the medium educated. These findings seem to support, at least partly, the notion that modern cohabitation originated as a practical living arrangement among the unconventional intelligentsia and subsequently spread to other segments of the population, but the findings are also partly consistent with a theory claiming the roots of cohabitation to be in the working class.

Employment increases the intensity of marriage formation significantly for men, but not for women. That is in line with previous findings for men. For women, the effect of employment on marriage rates has created more theoretical controversy and more ambiguous empirical results. The effect for men is consistent over the cohorts, but significant only for the youngest cohort. We speculate about possible period effects behind that. The effect of employment for women is actually reversed over the cohorts. Being not employed increases the marriage intensity for the oldest cohort, while being employed increases the marriage intensity for the youngest. None of the effects are, however, significant. We speculate if the slight negative effect of employment in the 1945 cohort can be a reflection of the special circumstances often facing and selecting pioneers conquering new land.

Finally, we argue that men and women born in 1960 who married without preceding cohabitation, probably are stronger selected for traditional family values than those in the 1945 cohort who married directly. Assuming that information about different value standards can be elicited from the effects on union formation of regional origin, religious activity, sexual conduct and pregnancy/birth of first child, we find empirical support for this hypothesis. A comparable difference between the unmarried cohabitors of the two cohorts is not found.

Later research on union formation, based on the present set of data, should include income as a time-varying covariate to assess the theoretically important impact of economic resources on the marriage and cohabitation intensities. Research should also preferably be extended to the other female cohorts.

Figure 1. First marriages without preceding cohabitation per 1000 singles per year. Men and women born 1945 and 1960.

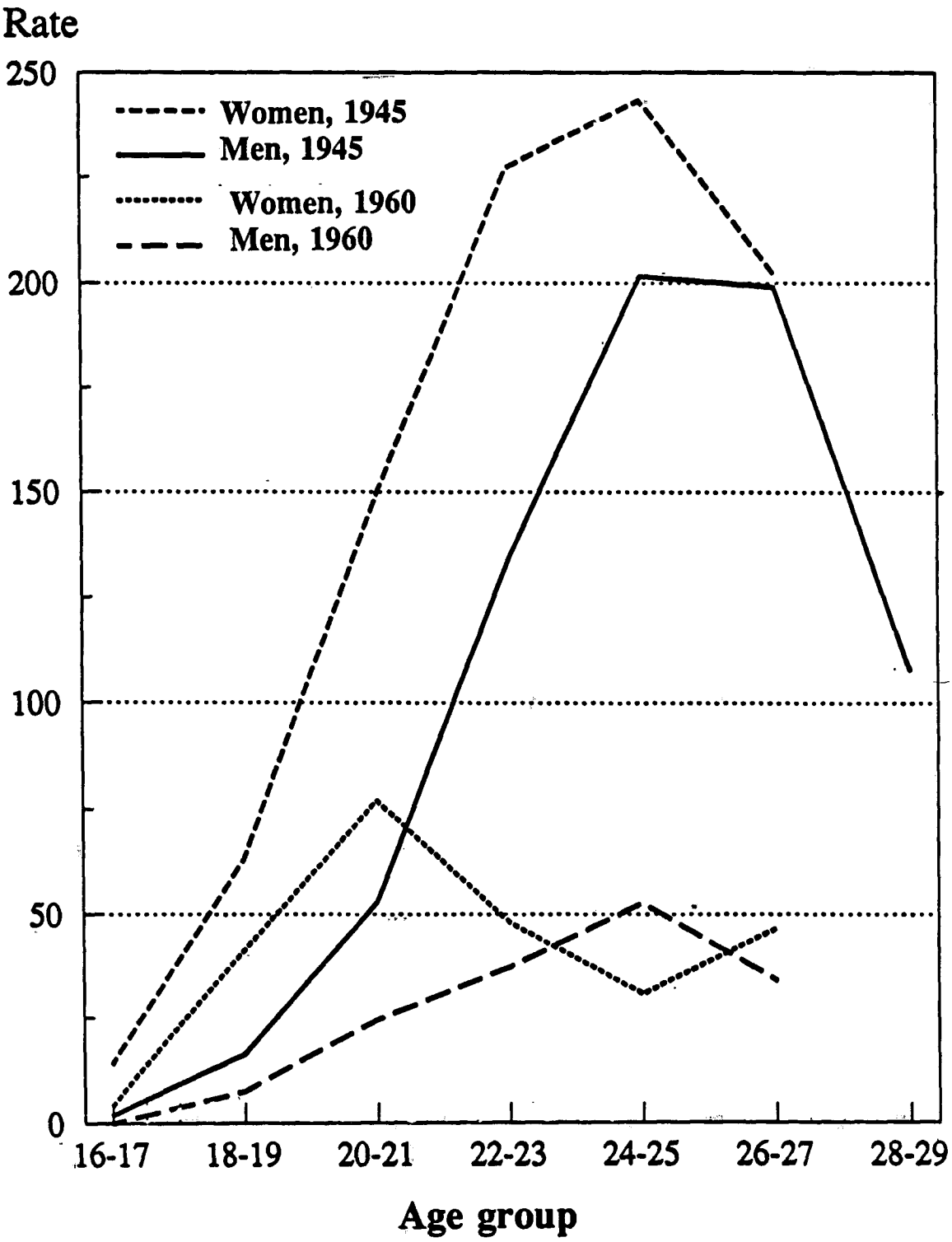

Figure 2. First unmarried cohabitations per 1000 singles pe year. Men and women born 1945 and 1960.

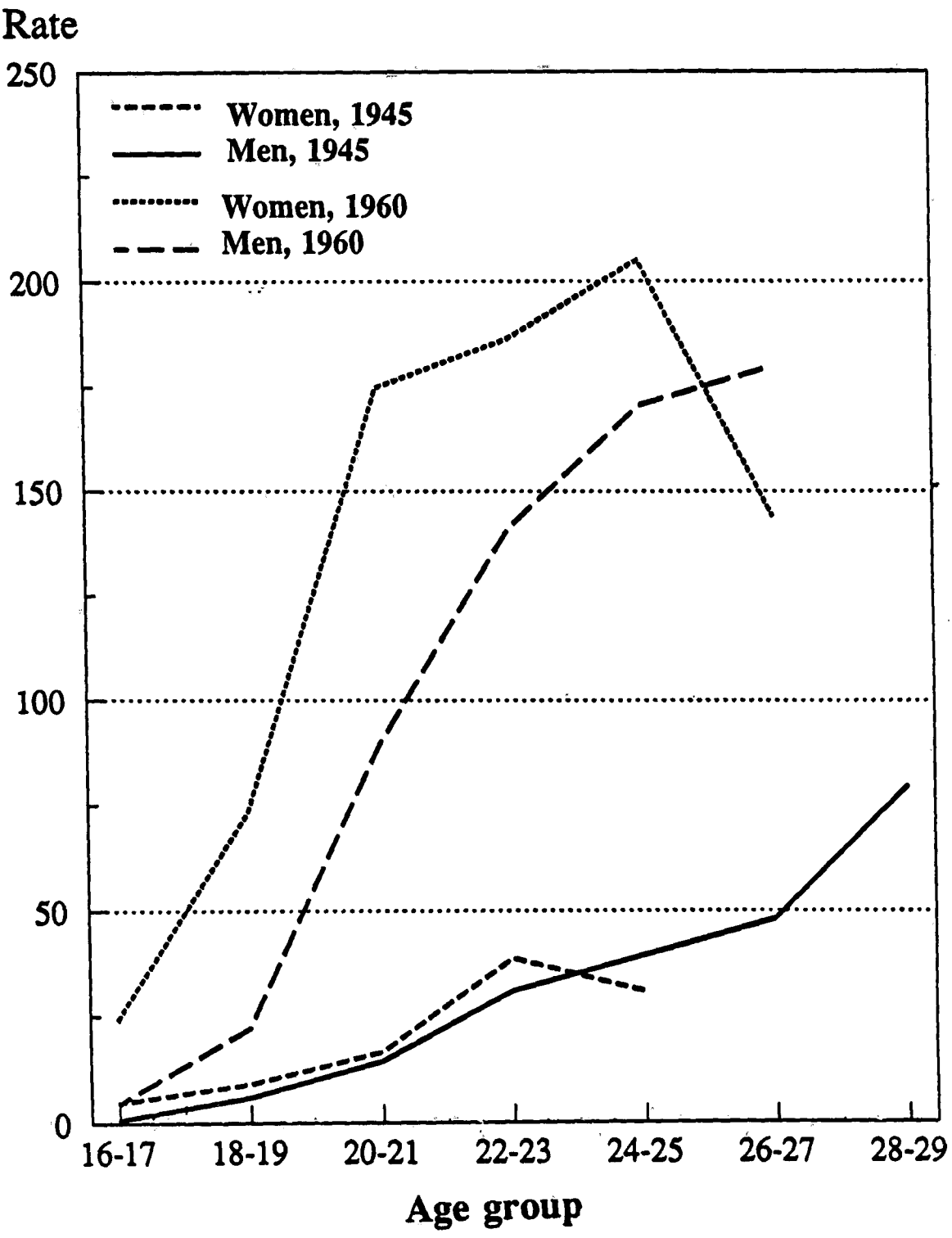

Table 1.

Relative intensities of first entry into marriage without preceding cohabitation. Men and women, born 1945 and 1960.

SEX	MEN			WOMEN		
COHORT		1945	1960		1945	1960
1945 B[1]	1.00			1.00		
1960	.31			.38		
	(p=.37*10*-31)			(p=.36*10*-23)		
REGION						
Eastern Norway B	1.00	1.00	1.00	1.00	1.00	1.00
Southern/Western Norway	.97	.90	1.02	1.25	1.14	1.32
Middle/Northern Norway	.53	.55	.25	.80	.83	.68
	(p=.11*10*-7)	(p=.12*10*-5)	(p=.00020)	(p=.00084)	(p=.070)	(p=.019)
CHURCH ATTENDANCE						
0 times	.90	.90	.92	.98	1.02	.93
1-2 times B	1.00	1.00	1.00	1.00	1.00	1.00
3+ times	1.42	1.17	4.14	1.46	1.14	3.35
	(p=.00023)	(p=.096)	(p=.31*10*-5)	(p=.00067)	(p=.61)	(p=.83*10*-8)
SEXUAL DEBUT						
No debut	.52	.63	.25	.25	.26	.24
<=2 years after debut B	1.00	1.00	1.00	1.00	1.00	1.00
2-4 years after debut	.79	.79	.93	.67	.78	.43
>4 years after debut	.73	.86	.49	.59	.70	.43
	(p=.38*10*-4)	(p=.011)	(p=.71*10*-4)	(p=.22*10*-26)	(p=.39*10*-20)	(p=.18*10*-6)
FIRST CHILD						
Before 1. child[2] B	1.00	1.00	1.00	1.00	1.00	1.00
Pregnancy	37.71	33.45	51.42	22.42	19.49	31.19
After 1. child	6.17	4.90	13.87	2.12	1.92	2.97
	(p=.63*10*-197)	(p=.85*10*-155)	(p=.12*10*-38)	(p=.96*10*-135)	(p=.31*10*-91)	(p=.26*10*-41)
EDUC. ENROLLMENT						
Not enrolled B	1.00	1.00	1.00	1.00	1.00	1.00
Enrolled	.85	.87	.79	.31	.31	.37
	(p=.31)	(p=.43)	(p=.48)	(p=.61*10*-13)	(p=.86*10*-9)	(p=.00023)
EDUC. LEVEL						
Youth school	.73	.73	.82	.84	.83	.93
Senior secondary B	1.00	1.00	1.00	1.00	1.00	1.00
University/college	1.13	1.26	.99	1.45	1.54	1.73
	(p=.0038)	(p=.0037)	(p=.78)	(p=.025)	(p=.023)	(p=.40)
EMPLOYMENT						
Not employed B	1.00	1.00	1.00	1.00	1.00	1.00
Employed	1.35	1.20	2.41	.85	.80	1.27
	(p=.029)	(p=.26)	(p=.0034)	(p=.18)	(p=.094)	(p=.27)
-2LN LIKELIHOOD	4865.38	3756.56	1045.88	4391.86	2939.32	1380.61
D.F.	21	20	19	21	20	20
N	1457	733	724	1218	526	692

[1] B=Baseline category

[2] and before pregnancy eventually is detected

Table 2.

Relative intensities of first entry into unmarried cohabitation. Men and women, born 1945 and 1960.

SEX	MEN			WOMEN		
COHORT		1945	1960		1945	1960
1945 B[1]	1.00			1.00		
1960	4.48			4.14		
	(p=.18*10*-53)			(p=.11*10*-32)		
REGION						
Eastern Norway B	1.00	1.00	1.00	1.00	1.00	1.00
Southern/Western Norway	.90	.81	.93	.99	.82	1.02
Middle/Northern Norway	1.11	1.09	1.14	1.17	1.23	1.17
	(p=.19)	(p=.44)	(p=.30)	(p=.30)	(p=.48)	(p=.37)
CHURCH ATTENDANCE						
0 times	1.15	1.43	1.01	1.08	.90	1.13
1-2 times B	1.00	1.00	1.00	1.00	1.00	1.00
3+ times	.82	.92	.71	.64	.61	.62
	(p=.12)	(p=.13)	(p=.34)	(p=.012)	(p=.37)	(p=.016)
SEXUAL DEBUT						
No debut	.44	.34	.49	.28	.22	.29
<=2 years after debut B	1.00	1.00	1.00	1.00	1.00	1.00
2-4 years after debut	1.15	.80	1.27	2.12	1.43	2.23
>4 years after debut	1.11	.72	1.23	2.08	1.46	2.23
	(p=.35*10*-13)	(p=.0023)	(p=.59*10*-10)	(p=.93*10*-36)	(p=.21*10*-6)	(p=.64*10*-28)
FIRST CHILD						
Before 1. child[2] B	1.00	1.00	1.00	1.00	1.00	1.00
Pregnancy	6.11	2.89	7.77	3.16	3.03	3.19
After 1. child	4.44	3.60	5.05	1.42	.91	1.54
	(p=.15*10*-19)	(p=.00066)	(p=.17*10*-17)	(p=.74*10*-6)	(p=.079)	(p=.67*10*-5)
EDUC. ENROLLMENT						
Not enrolled B	1.00	1.00	1.00	1.00	1.00	1.00
Enrolled	.98	1.52	.89	.57	.37	.59
	(p=.84)	(p=.17)	(p=.42)	(p=.00012)	(p=.055)	(p=.00076)
EDUC. LEVEL						
Youth school	.98	.84	1.11	1.26	1.82	1.21
Senior secondary B	1.00	1.00	1.00	1.00	1.00	1.00
University/college	1.15	2.12	1.02	1.40	3.03	1.40
	(p=.62)	(p=.031)	(p=.74)	(p=.041)	(p=.0059)	(p=.12)
EMPLOYMENT						
Not employed B	1.00	1.00	1.00	1.00	1.00	1.00
Employed	1.68	1.22	1.86	1.32	1.38	1.32
	(p=.22*10*-4)	(p=.48)	(p=.80*10*-5)	(p=.034)	(p=.40)	(p=.045)
-2LN LIKELIHOOD	5703.70	1440.95	4221.63	4715.37	815.37	3861.99
D.F.	21	20	20	21	20	20
N	1457	733	724	1218	526	692

[1] B=Baseline category

[2] and before pregnancy eventually is detected

APPENDIX

Table A.
Relative intensities of first entry into marriage without preceding cohabitation. Men, born 1945 and 1960. Interaction between number of siblings and age.[1]

	AGE GROUPS						
SIBLINGS	16-17	18-19	20-21	22-23	24-25	26-27	28-29
0			.35	.59	.95	1.14	1.57
1		.14	.34	.64	1.00*	.90	.79
2	.02	.08	.39	.87	.87	.51	.44
3 +	.03	.20	.40	.72	.81	1.09	.30

p=.0045
* Baseline category
[1] Controls for cohort, region, church attendance, first child, educational enrollment, and educational level. Main effects model with one interaction.

Table B.
Relative intensities of first entry into marriage without preceding cohabitation. Women, born 1945 and 1960.[1]

	BOTH COHORTS	1945	1960
SOCIOECONOMIC STATUS			
Unskilled worker	1.38	1.16	1.93
Skilled worker+low-level white collar	1.30	1.16	1.77
Middle and high-level white collar B	1.00	1.00	1.00
Farmers/fishermen (self-employed)	1.15	1.14	1.09
	(p=.027)	(p=.68)	(p=.0041)

B=Baseline category
[1] Controls for urban/rural, region, church attendance, and age. Three main effects models: one for both cohorts together, and one for each cohort separately.

Table C.
Relative intensities of first entry into marriage without preceding cohabitation. Men born 1945 and 1960. Interaction between timing of sexual debut and age.[1]

	AGE GROUPS						
SEXUAL DEBUT	16-17	18-19	20-21	22-23	24-25	26-27	28-29
No debut	.01	.05	.17	.40	.78	.61	.33
<=2 years after debut		.15	.34	.96	1.00*	1.54	5.47
2-4 years after debut	.08	.18	.35	.84	.52	.62	.41
>4 years after debut		.24	.52	.61	.72	.71	.37

p=.00034
* Baseline category
[1] Controls for cohort, region, church attendance, first child, educational enrollment, educational level, and employment. Main effects model with one interaction.

Table D.
Relative intensities of first entry into marriage without preceding cohabitation. Women born 1945 and 1960. Interaction between timing of sexual debut and age.[1]

	AGE GROUPS						
SEXUAL DEBUT	16-17	18-19	20-21	22-23	24-25	26-27	28-29
No debut	.01	.07	.19	.36	.31	.24	.17
<=2 years after debut	.17	.44	.78	1.00*	.80	1.48	.93
2-4 years after debut	.30	.36	.59	.50	.65	.56	.20
>4 years after debut		.69	.58	.50	.58	.45	.19

p=.016
* Baseline category
[1] Controls for cohort, region, church attendance, first child, educational enrollment, educational level, and employment. Main effects model with one interaction.

Table E.
Relative intensities of first entry into marriage without preceding cohabitation. Men born 1945 and 1960. Interaction between timing of first child and age.[1]

	AGE GROUPS						
FIRST CHILD	16-17	18-19	20-21	22-23	24-25	26-27	28-29
Before 1. child[2]	.01	.06	.26	.69	1.00*	1.03	.62
Pregnant partner	8.00	18.73	21.98	24.05	24.78	20.09	15.49
After 1. child		2.94	6.62	6.49	2.94	3.67	.65

$p=.32*10^{-11}$
* Baseline category
[1] Controls for cohort, region, church attendance, sexual debut, educational enrollment, educational level, and employment. Main effects model with one interaction.
[2] and before pregnancy eventually is detected

Table F.
Relative intensities of first entry into marriage without preceding cohabitation. Women born 1945 and 1960. Interaction between timing of first child and age.[1]

	AGE GROUPS						
FIRST CHILD	16-17	18-19	20-21	22-23	24-25	26-27	28-29
Before 1. child[2]	.04	.30	.70	1.00*	.90	.86	.52
Pregnant partner	4.95	12.81	17.46	10.80	16.44	16.28	
After 1. child	10.80	1.11	1.49	1.55	1.52	.66	.48

$p=.12*10^{-9}$
* Baseline category
[1] Controls for cohort, region, church attendance, sexual debut, educational enrollment, educational level, and employment. Main effects model with one interaction.
[2] and before pregnancy eventually is detected

Table G.
Relative intensities of first entry into unmarried cohabitation. Men born 1945 and 1960. Interaction between socioeconomic status and age.[1]

	AGE GROUPS						
SOCIOECONOMIC STATUS	16-17	18-19	20-21	22-23	24-25	26-27	28-29
Unskilled worker	.03	.17	.57	.91	1.06	.68	1.20
Skilled worker+low-level white collar	.02	.18	.53	1.22	1.22	.65	.94
Middle and high-level white collar	.01	.09	.45	.70	1.00*	1.52	.97
Farmers/fishermen (self-employed)		.07	.37	.57	.73	1.12	1.60

p=.023
* Baseline category
[1] Controls for cohort, urban/rural, region, and church attendance. Main effects model with one interaction.

Table H.
Relative intensities of first entry into marriage without preceding cohabitation. Women born 1945 and 1960. Interaction between urban/rural dimension and cohort.[1]

	COHORT	
URBAN/RURAL	1945	1960
Rural	.87	.34
Other	1.00*	.46
Urban	1.26	.23

p=.021
* Baseline category
[1] Controls for region, church attendance, socioeconomic status, first child, educational enrollment, educational level, and age. Main effects model with one interaction.

Table I.
Relative intensities of first entry into marriage without preceding cohabitation. Women born 1945 and 1960. Interaction between number of siblings and cohort.[1]

	COHORT	
SIBLINGS	1945	1960
0	.89	.70
1	1.00*	.31
2	.96	.30
3+	.73	.37

p=.023
* Baseline category
[1] Controls for region, church attendance, first child, educational enrollment, educational level, and age. Main effects model with one interaction.

Table J.
Relative intensities of first entry into unmarried cohabitation. Women born 1945 and 1960. Interaction between urban/rural dimension and cohort.[1]

	COHORT	
URBAN/RURAL	1945	1960
Rural	.47	4.66
Other	1.00*	4.14
Urban	.96	4.57

p=.0091
* Baseline category
[1] Controls for region, church attendance, socioeconomic status, first child, educational enrollment, educational level, and age. Main effects model with one interaction.

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Demographic consequences of AIDS, with special reference to Zambia[1]

Helge Brunborg

[1] Preliminary version

Summary

AIDS is becoming a more and more serious problem in large parts of Africa. Zambia is one of the countries that is worst affected, with 20-30 per cent of the adult urban population being HIV positive. HIV/AIDS is not any more an urban problem only, as the prevalence is very high in some rural areas as well. There are probably several hundred thousand persons who are HIV positive in the population of 8 million. Most of these will die before the year 2000.

The most common source for data to estimate the time trend and level of HIV prevalence is the so-called sentinel surveillance system. The groups that are usually tested in this system - pregnant women, blood donors and patients at STD clinics - are all too special to yield good estimates for the general population. A national representative sample survey would be required for this. New survey instruments need to be developed and demographers could contribute to this. New simple and inexpensive test methods (testing urine or saliva) may make representative sample surveys more feasible.

Lack of data makes it difficult to study the demographic and other consequences of AIDS. HIV and AIDS cases are seriously under reported. The level of completeness in the vital registration system is far too low to yield reliable data on the number of deaths by age and sex, not to mention the cause of death. The 1990 Census in Zambia collects no data on deaths by age, only total deaths in the household by sex, and cannot be used to estimate age-specific death rates.

The demographic consequences of AIDS may not be as serious as often claimed, however. It is, for example, unlikely that any national population in Africa will die out due to AIDS. Small and special subgroups may decline in size but most national populations will continue to grow but at a slower rate than before. The growth rate may be reduced by one third and infant and child mortality rates may cease to decline, according to some studies. The age structure will be only slightly affected and primarily at ages 20-50.

The most important reason for the lack of massive demographic consequences is the high fertility level. The annual addition to the population from births is very high compared to the number of people dying from AIDS and other causes. But if the onset of the fertility transition that has recently been observed in some African countries spreads fast, the role of AIDS mortality for the population growth will become increasingly important.

Vertical HIV transmission from mothers to babies is an important problem but it is unlikely that more than 10-12 per cent of all newborn babies in a population will be infected. Most of these will die before age 5. But this implies that almost 100 percent of the children who grow up will be HIV negative and that they can only be infected by older cohorts. Thus, if each cohort only had sex among themselves, nobody would be infected and HIV/AIDS would die out after one or two generations.

A tragic consequence of AIDS is the loss of family members and the disruption of families, especially the loss of parents, which results in a large number of orphans.

1 Introduction

The HIV/AIDS epidemic is reaching alarming proportions in many parts of the world, and particularly in Africa. The impact on many societies in sub-saharan Africa is very serious. There is,

however, a tendency to describe the situation in even more gloomy terms than it really is. We often read in newspapers or hear people say that the population of Africa, or of certain countries, will die out and that, consequently, there is no use in doing anything at all about the social and economic and health situation. Some people also argue that AIDS will solve the problems of rapid population growth.

This paper will look at some of the demographic consequences of HIV/AIDS in Sub-Saharan Africa, with a special emphasis on Zambia. Considerable attention is given to data problems. I begin with a brief discussion of why HIV/AIDS is important for demography and vice versa.[1]

2 Why should demographers be interested in AIDS?

There are a number of reasons why AIDS is important for demography and why demographers have a lot to contribute to the study of the epidemic:

A. Because HIV/AIDS may affect a number of demographic variables, including:

- morbidity
- mortality
- population growth
- population size and age-sex composition
- fertility (possibly)
- internal migration
- external migration
- regional population distribution
- household composition, formation and dissolution, esp. single-parent households and orphans

B. Because demography can provide insight and methodology that can contribute to the understanding of the epidemic, in the following and other areas:

- data collection
- data evaluation and analysis
- demographic processes and population dynamics
- behaviour, esp. on reproductive behaviour, contraception and union formation
- projections
- demographic, economic and social consequences

3 Data needs

There is a great lack of good data on the AIDS pandemic. Data on the following variables are particularly important - and difficult to obtain:

[1] I distinguish between HIV, which is the virus that causes the deterioration of the immuno system, and AIDS, which is used for diseases caused by the virus. People with HIV are usually not sick but may have a number of so-called opportunistic diseases, while not being classified as having AIDS. It is difficult to draw a sharp distinction here, however, and the definition of AIDS is continuously being debated. The most widely used current definition (from CDC, Center for Disease Control in Atlanta) is attacked for several reasons, inter alia because it does not take full account of diseases that are common to women, and that the definition is of little use in poor countries where there is limited testing. To avoid problems caused by definitions, some people use the term *HIV disease* in stead of AIDS.

- AIDS cases
- Incidence of HIV/AIDS disease
- AIDS deaths
- HIV prevalence
- HIV incidence

There are probably no reliable estimates of these variables for any African country (nor for any other country), not even nationally. It is also important to know these figures by age and sex, region (at least by urban/rural residence) and socio-economic status. The last dimension is essential when we want to assess the social and economic impact of AIDS.

We also need data on partnerships and sexual behaviour, including:

- frequency of intercourse
- age difference between partners, both for marriages and relationships of short duration,
- number of partners and their characteristics, esp. if they belong to high-risk groups
- use of contraception

Other and more basic biological data that are important, for example for making projections, are:

- incubation period, i.e. progression from infection to disease
- transmission rates from mothers to children
- rate of infectivity at intercourse

It is, however, not necessary to have country-specific data for these variables for all countries, as some of them probably vary less from country to country than the behavioral variables mentioned above.

3.1 Mortality

It is a general problem to estimate mortality rates in poor countries. Registration systems are non-existent or poor, sample surveys are too small, and censuses are not the best instrument for measuring events, although a number of indirect methods have been developed. Measuring AIDS mortality poses an additional problem as AIDS cases are severely under reported in the medical system and there is also considerable stigma and ignorance surrounding the disease. Many deaths are classified as being caused by other causes than AIDS, for example.

The level of completeness in the vital registration system in Zambia is too low to yield good data on the number of deaths by age and sex, not to mention cause of death.

The 1990 Census of Zambia collects fertility and mortality information by asking about the number of births and deaths in each household in the previous 12 months. The only information on deaths are the number of male and female deaths but without any age data. Consequently, the Census cannot be used to estimate age-specific death rates, at least not directly. The total number of deaths in an area may give some indication about the prevalence of AIDS, but will not be very reliable.

Thus, the limited mortality and fertility measures that can be estimated from the Census data will be almost three years old (or more) when the Census data are available some time in 1993. In the mean time AIDS will surely have a strong impact on these parameters.

The Zambia DHS (Demographic and Health Survey) 1992 will provide new estimates of fertility

and child mortality for the whole country and for the urban/rural population, but nothing on adult mortality.

To obtain reliable general and AIDS-specific mortality estimates it is probably necessary to follow the total population in an area in a longitudinal study. An example of this is Mulder at al. (1992) who have calculated HIV incidence and mortality rates in a rural Ugandan cohort, finding an annual incidence rate of 10.8 for adults and an excess mortality rate due to AIDS of 660 per 100,000 in the adult population.

Valleroy, Harris and Way (1990) have estimated the HIV-1 attributable mortality under 5 years in several developing countries, including Zambia, with rates of 10-40 per 1000. They conclude that HIV infection may "undermine any gains that have been made in the area of child survival". WHO (1991c) concludes the same.

3.2 Sentinel Surveillance System

One of the most common data sources for seroprevalence is the so-called Sentinel Surveillance System (SSS). This has been established in a number of countries on the recommendations of WHO.

The principles of the system are that blood tests are performed regularly at a number of fixed sites. The sites are usually chosen in both urban, semi-urban and rural districts and the sites/groups are most commonly clinics for pregnant women (ante-natal clinics), blood-donors, and patients with sexually transmitted diseases (STD clinics). The tests are usually anonymous but the persons being tested may in some countries learn about their test result if they ask for it.

SSS is undoubtedly a great improvement over studies of special and rather arbitrary groups that have been tested in many countries (typically prostitutes, truck drivers, hospital patients, soldiers, prisoners, students and employees of certain firms).

The purpose of the SSS is to measure *trends* in HIV prevalence. This is achieved if the composition of the groups that are tested do not change much over time. However, results from the Sentinel Surveillance System are also used as cross-section estimates of the prevalence level in a population (as, for example, by Anderson et al. (1991) and U.S. Bureau of the Census 1991), due to the lack of studies of the prevalence of the general population. Since this is done it is important to know how representative the test groups are.

There are strong indications that the SSS estimates can <u>not</u> be taken as representative of the general population, as all of the groups that are tested to a smaller or greater extent represent special subpopulations:

> A. The prevalence rate for **pregnant women,** who are referred to as a low-risk group, is often used as an indicator of the prevalence for the whole population (e.g. by Anderson et al. 1991 and U.S. Bureau of the Census 1991). It is questionable whether pregnant women are a low-risk group, however, for the very reason that they have become pregnant. Women with little or no sexual activity and women who use condoms to avoid pregnancy and/or AIDS, have a much lower probability both of becoming pregnant and of becoming HIV-positive. Teenagers who become pregnant, for example, have a higher sexual activity than normal and probably belong to the high-risk group.

The *age structure* of pregnant women should also be taken into account, as most pregnant women are between 20 and 35 years and thus can only represent women in these age groups at the most. The age structure of pregnant women is quite different from the age structure of the general 15-49 group.

The proportion of all pregnant women who *attend* the ante-natal clinics is usually not known. It may very well be that this group of women is biased in some way, e.g., by being more educated and mobile than women who do not attend the clinics.

Since only women attend ante-natal clinics the SSS does not provide any prevalence figures for *men*. Nevertheless, the estimates for pregnant women are often used as estimates of the seroprevalence for the whole adult population (sometimes referred to as the sexually active population, which is somewhat more appropriate). There are indications, however, that women are more easily infected than men, which implies that infections levels may be lower for men than for women.

B. **Blood donors** are also a select group of people. The most common blood donors in Sub-Saharan Africa seem to be students, soldiers, prisoners and relatives of the persons needing blood. There are indications that all of these have a higher HIV than the general population. On the other hand, people who know or fear that they are HIV positive will probably abstain from giving blood, which would reduce the seropositivity of the blood donors. The characteristics of the blood donors may change over time, which makes the results even more questionable. There is a great need for studying the socio-economic characteristics of blood donors and their motives for giving blood.

C. People with **sexually transmitted diseases** have a high prevalence rate precisely because they have many sexual partners, many of them being commercial sex workers, but also because they are more easily infected by HIV due to genital ulcers, etc. Moreover, we do not know how representative the STD clinic patients are of all people with STDs. In Botswana, for example, people with STDs often visit traditional doctors in stead of or in addition to modern doctors.

Our conclusion from this discussion of the Sentinel Surveillance System is that the results should be interpreted with caution as they are not representative of the general population. The results for the blood donors and the STD clinic attenders should not be used at all as an indicator of the general prevalence, although the time trend for these groups may be of some interest and they may also indicate regional differences. The estimate for pregnant women seems to be the best approximation to the prevalence of the general adult female population, although it is probably biased upwards.

The shortcomings of the Sentinel Surveillance System imply that there is a great need for sample surveys of general populations. A few such exist, but to my knowledge only for small populations in limited geographical areas.[2] There are, of course, both logistic, economic and ethical problems in carrying out national representative sample surveys that measure HIV prevalence (in addition to demographic, socio-economic and other variables). But this needs to be looked into. Perhaps a DHS (Demographic and Health Survey) could be combined with an HIV survey? The recently developed

[2] Examples include subdistricts of Masaka and Rakai in Uganda, and Arusha and Kagera in Tanzania, see Mulder et al. (1992), Konde-Lule et al. (1992), Ole-Kingóri et al. (1992), and Killewo et al. (1992), respectively.

tests using urine or saliva in stead of blood should make such studies more feasible. But people's reluctance to being tested and fear of break of confidentiality about the test result may be problematic.

4 The current AIDS situation in Zambia

4.1 AIDS cases

Zambia is one of the worst affected countries in the world when it comes to AIDS. The first AIDS cases were diagnosed in 1985 and the number has grown rapidly since then, see table 1. The reported cumulated number of AIDS cases since 1986, as per 31 October 1991, is 5,419 persons. In addition 17,624 ARC (AIDS Related Complex) cases have been reported, making a total of 23,043 cases of AIDS-related disease in Zambia.[3] The number of reported AIDS cases grew by more 1/3 in the first 10 months of 1991 (which corresponds to an annual growth of 42 per cent).

Table 1. Cumulated reported ARC and AIDS cases

	ARC cases	AIDS cases	Total	Source
31 Dec.1990	14,782	4,036	18,818	MOH 1991a,b
31 May 1991	15,991	4,690	20,681	MOH 1991c
31 Oct.1991	17,624	5,419	23,043	Unpubl. data from MOH

The true figures are probably substantially higher, however, since "*There is reason to believe that the reported cases reflect a significant under-reporting, as the guidelines on AIDS notification are not always available at the district level, and the notification forms are not always utilized and forwarded ...*" (MOH 1991b). Many doctors are overworked and do not think that it is worth their time to fill in forms, or they reach the wrong conclusion as to the cause of death.

As in the rest of sub-saharan Africa, the major mode of HIV transmission in Zambia is heterosexual intercourse. An indication of is that the number of male and female AIDS cases are almost equal (1.04:1) (MOH 1991a,b). Some people are infected through blood transfusion but most blood is screened.[4] Homosexual practice and intravenous drug use seem to be relatively uncommon and their contribution to the spread of the infection is minimal.

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[3] The Ministry of Health adds the AIDS and ARC cases together. It is not clear that this is done without some double counting, as most people with ARC develop AIDS sooner or later. This over counting is probably small compared to the under reporting mentioned below.

[4] A problem in high prevalence countries is the so-called window effect, which is the 4-8 week period after infection when antibodies cannot be found in the blood. False negative test results may also be a problem but most tests have a very high degree of both specificity and sensitivity. Since the risk of becoming infected is close to 100 percent when a person receives a transfusion with infected blood, it is important that all blood is tested. Susan Foster (personal communication, 1992) has found that blood testing only costs about 30 USD per averted HIV case.

4.2 HIV prevalence

As for other countries, no national survey of the HIV prevalence has ever been taken in Zambia. Prevalence figures exist only for small and non-representative samples. The Sentinel Surveillance System was established in 1990 and the results from the first round of this are shown in table 2. The number of sites was initially 9 and will increase to 18 in 1991. The tests are anonymous and the results are not reported to the persons being tested.

Table 2. HIV prevalence. Sentinel Surveillance System 1990
Source: Ministry of Health (1991a,b)

	Urban (Lusaka)	Peri-urban (Solwezi)	Rural (Mukinge)
Ante-natal clinic attenders (pregnant women)	24.5 %	30 %	13 %
Blood donors	21 %	23 %	18 %
STD clinic attenders	54 %	53 %	36 %

These figures are alarmingly high, and on par with the highest figures recorded anywhere, including Uganda. Unofficial and preliminary results for the 1991 round indicate a further increase.

Anderson et al. (1991) give a weighted mean percentage of the HIV prevalence of the 'general' sexually active population in Zambia to be 13.2 per cent, ranging from 1.96 to 37.7 per cent, based on 43 surveys up to 1989 with blood tests of 20,000 people. This is the fifth highest among the 46 African countries they present data for.[5]

Based on Anderson et al.'s (1991) estimate of 13 per cent seroprevalence in the adult population, I have used the DemProj model to estimate the total number of infected persons, see section ..... The model estimates that 479,000 or almost 1/2 million people are HIV positive, of a total population of 8 million. This figure is consistent with an unofficial and unpublished estimate of 3-400,000 HIV-positive persons in Zambia.

This is a staggering figure. It shows that the problem is going to become much more serious in the coming years, when these persons become sick and develop AIDS. Most of them will die before the year 2000. In the meantime they will suffer from opportunistic diseases, as well as infect other people.

The number of AIDS cases as a proportion of the number of HIV positive persons is now quite low in Zambia, only about 20,000 : 500,000, or 1 : 25. This indicates two things:

- HIV is currently spreading very fast in Zambia and the epidemic may have started later in Zambia than in countries farther to the north, like Rwanda and Uganda.
- Zambia is probably near the steepest part of the curve for HIV prevalence in the population and some years will pass before this levels off, as it is bound to do, sooner or later.

[5] The prevalence levels in the six most infected countries are, according to Anderson et al. (1991): Rwanda 21.4%, Malawi 17.0%, Burundi 15.2%, Uganda 15.2%, Zambia 13.2% and Tanzania 8.5%.

We conclude that the HIV prevalence in Zambia is high and growing but that the exact level is quite uncertain. We might, however, say that it does not really matter so much for most purposes whether every fifth or fourth urban adult is HIV positive. The important point is that the prevalence is exceedingly high. We know more than enough to conclude that the number of people suffering and dying from AIDS in the next 5-10 years will be extremely high.

We should, however, not forget that 70-80 per cent of the adult urban population is HIV negative. Thus, there is no need to despair and give up the work against the spread of HIV/AIDS. Nor should activities to reduce the incidence and treat other diseases be given up.

5 Some aspects of the epidemic

5.1 Infants and the spread of HIV

The mechanisms for vertical HIV transmission, i.e. from seropositive mothers to their children, are not fully known. Infection takes place both before, during and after birth (through breast-feeding). Estimates of the transmission rate range from 14.4 per cent in Europe (Newell 1992) to 39 per cent in Kinshasa (Kabeya 1990) and Lusaka (Hira et al. 1989).

If 25 per cent of pregnant women are seropositive (as in Lusaka, see table 2)[6] and the vertical transmission rate is about 40 per cent, 10 per cent of all newborn babies will be HIV-positive (since 0.40 * 0.25 = 0.10). Studies indicate that most seropositive infants die before age 5 (which will almost double the infant mortality rate).

This means, however, that fully 90 per cent of those who grow up will not be infected. They will start to become infected when they reach reproductive ages, the girls first and the boys later (except for a few who become infected though blood transfusions). Thus, a young cohort is almost 100 per cent HIV-negative when it reaches puberty and they can only will be infected by people from older cohorts. This implies that if each cohort only had sex amongst themselves, i.e. with persons of the same age, new cohorts would not be infected and HIV/AIDS would die out after one or two generations. This is, of course, totally unrealistic as a policy recommendation. Nevertheless, this scenario demonstrates the strong effect of the age difference between partners. The large age difference between marital and other types of partners, which is substantially greater than in Europe, contributes to the rapid spread of AIDS in Africa. A reduction in the age difference would reduce the spread.[7] It is also important to incorporate this age difference into projection models.

5.2 Why is not everybody infected?

Most observers of the AIDS pandemic find that HIV and AIDS will reach a plateau or saturation level, which implies that the general HIV prevalence in the population will reach a level of considerably less than 100 per cent (see e.g. Anderson et al. 1991). We might ask then, why will

[6] To my knowledge, the highest prevalence figures for pregnant women that have been observed are 30 per cent for Kampala in Uganda.

[7] No to sex with "sugar daddies" (and "sugar mummies") is part of the campaign against AIDS in Zambia.

not everybody in a population become infected? There are several reasons why this is unlikely to happen. Those who are most likely to become infected, for behavioral, genetic, other reasons, are affected first, and other people later:

- Most people are not infected before marriage
- Many couples are monogamous or change partners infrequently
- Some individuals have low or no sexual activity
- The transmission rate is small, normally less than 1 per cent in an unprotected intercourse.
- "Only" 30-40 per cent of babies of seropositive mothers are infected
- Some individuals use condoms and this may increase[8]
- HIV prevalence is low in many subpopulations, esp. in rural areas
- Persons with full-blown AIDS are sick and unlikely to infect other people
- Older people are less sexually active
- Some subgroups have a very high sexual activity and many partners while other subgroups have a low activity (heterogeneity)
- Sexual interaction between different subgroups varies
- There seems to be individual variation in the risk of becoming infected. One known risk factor is STD but there are probably many other factors that increase or reduce the risk of becoming infected.
- There seems to be considerable variation in the infectivity over the life cycle of HIV infection. The infectivity seems to be the greatest during the first weeks after infection and when a person gets full-blown AIDS.

All these factors, many of which are not independent, contribute separately or combined to reduce the proportion of a population that is infected to significantly below 100 per cent. Well-known researchers find the same:

Bongaarts (1988, 1989) made a hypothetical projection of an African country and found the HIV prevalence after 25 years to be 21 % for adults, 55 % for male partners of prostitutes, and 75 % for prostitutes. Anderson et al. (1991)'s epidemiological model found HIV prevalence levels ranging from 30 to 75 %, depending on the assumptions, for example, the proportion of men who have sex with prostitutes, and the amount of behavioral change as a response to the epidemic.

5.3 Orphans

A tragic consequence of AIDS is the disruption of families. Spouses lose each other and children lose their parents. This has become a very serious problem in parts of Uganda. It has been estimated that in 1991 79,300 orphans were orphaned in Zambia because of AIDS and that there will be

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[8] Current use of condoms is still low in Sub-Saharan Africa, according to *Demographic and Health Surveys* (DHS):
Botswana 1988: 1.3 % of women never or currently in union, 0.9 % of other women 15-49
Kenya 1988: 0.4 % of all women 15-49;
Uganda 1988/89: 0.0 % of all women 15-49;
Zimbabwe 1988: 1.2 % of all women 15-49 but more recent sales figures indicate a substantial increase.
In all countries: Current use of condoms is generally higher the younger the women and for educated women are and the more education they have, with some exceptions, particularly for Uganda where the use of condoms is almost nil.

600,000 AIDS orphans by the year 2000 (*AIDS Analysis Africa* 2(2:8), March/April 1992). These estimates are highly questionable, however, as there do not seem to be any large studies of household composition and AIDS orphanage.

A small study of orphans in East Matero, a part of Lusaka, found that approximately 10 per cent of children below 21 were orphans (215 of 2104) (from all causes, not only AIDS) (CINDI 1992). Among children below age 16 only 1-2 per cent them had lost both parents. AIDS children do not yet seem to be a large problem, at least not in this part of Lusaka.

However, as the figures quoted above indicate, orphans are most likely going to become a serious problem in the future in Zambia, judging from the large and increasing number of HIV positive persons, most of whom will develop AIDS and die within the next 8-10 years. We mentioned in section 5.1 above that about 10 per cent of all babies will be infected and die at a young age. On the other hand, about 15 per cent (= 0.60 * 0.25) of all children will not be infected but they will lose their seropositive mothers (and many fathers as well) before they reach maturity.

6 Population projections

6.1 Projection methods

The two major problems of projecting the demographic consequences of AIDS are:

i) How to model the mechanisms that are important for the spread of AIDS.

ii) How to obtain reliable data for the parameters in the model. For example, what is the average duration from infection to outbreak of AIDS? Does it vary by age, sex or other factors? It is even more difficult to obtain data on sexual behaviour, for example the number of sexual partners and the average number of sexual acts. It is hard to obtain such data for a country like Norway, but the data problem is, of course, much more severe for poor countries. New data are coming, but the large variation across countries and regions makes generalization difficult.

The most common method for projecting the development of AIDS has been to extrapolate past trends. An 11-month doubling time of the number of AIDS cases has often been used. This method may be useful for making projections for very short time periods, but is inadequate for making long-term projections as the complex dynamic nature of AIDS need to be taken into account.

To project the number of AIDS cases we need to make a projection of the whole population, taking into account factors like the infection rate, modes of transmission, duration from infection to full-blown AIDS and death, etc. Behavioral aspects should also be included, like differences in sexual behaviour between various subgroups in a country.

The standard method in demography for making population projections is the cohort-component method. All persons born in a year (i.e. a birth cohort) are followed over the life course. At each age a certain proportion of them experience a demographic event (marriage, birth, migration, death, AIDS-infection, etc.). At a future time point the experience of all the different cohorts are combined.

There have been several attempts in recent years to apply this method to AIDS, including Palloni et al (1987), Bongaarts (1988, 1989) and Chin et al (1989), see UN and WHO (1991). The problem with the standard demographic models in projecting AIDS is the epidemiology, that is, how the infection is spread in the population.

6.2 Projection of the population of Zambia, with and without AIDS

To study the possible demographic consequences of AIDS I have made a projection of the Zambian population using the DemProj model. This model is very simple and has a number of limitations but is nevertheless useful for illustrating the possible consequences of AIDS, particularly for the short run, say up to the year 2000.

Model

DemProj is a population projection model which includes a section on AIDS to study the demographic consequences of HIV/AIDS. The manual states that "The AIDS calculations area based ... about the incidence[9] of new adult infections ... DemProj does not contain an epidemiological model that projects the spread of the HIV infection. Rather, it uses your assumptions about the spread of the infection as the starting point for calculating the number of infected, the number of new AIDS cases and the number of deaths due to AIDS. Therefore DemProj can be useful for examining the demographic impacts of different rates of HIV spread, but is not intended to provide guidance about the likely future course of the epidemic or which interventions are likely to be more effective." (Stover 1990: 46).

The AIDS module of DemProj seems to have more shortcomings than the demographic part of it. In addition to the shortcomings mentioned above we can mention that there is no saturation effect, no urban-rural distinction and no subgroups with high-risk behaviour. (I have tried to incorporate the saturation effect by assuming that the prevalence level in two of the scenarios will increase to a high level (25 and 50 %, respectively) and remain constant thereafter.)

Demographic assumptions

Projection period: 1990-2040
Population: Age distribution 1980 (UN 1991), population size by sex 1990 (CSO 1991) (assuming that HIV/AIDS did not significantly affect the age distribution in 1990)
Sex ratio at birth: 1.02 boys per 100 girls (common for African populations)
Fertility: Total fertility rate constant at 7.2 (UN 1990), model age schedule provided by DemProj (assuming no effect on fertility of HIV/AIDS)
Life expectancy at birth: constant at 51 years for males and 55 years for females (without AIDS), taking an average life expectancy of 53 years from UN(1990) and assuming that the sex difference is the same as in 1980 (UN 1991: 476)
Age pattern of mortality: Coale and Demeny Life Table Model South. Note that I have not assumed a gradual decrease in mortality, which is commonly done (by UN and the World Bank), to get a more clear picture of the demographic impact of HIV/AIDS
Migration: no external migration
Urban/rural: no distinction (the model allows for inclusion of urban and rural populations, but not for separate assumptions about urban and rural HIV prevalence)

HIV/AIDS assumptions

HIV prevalence in 1990: 13 per cent for adults, except for Scenario 1 which assumes no HIV/AIDS.
Future HIV prevalence: four scenarios, see below

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[9] This does not seem to be quite correct, however, as the user is asked by the programme to provide HIV *prevalence* figures and not incidence figures. The incidence figures are calculated by the model.

Annual increase in incidence during last 10 years: 50 per cent per year (needed to distribute the infected population in the base year by time since infection)
Perinatal transmission: 40 per cent (Studies from Zambia and Zaire give estimates of 39 per cent transmission from seropositive mothers to children, according to Anderson et al. 1991)
Adult conversion from HIV to AIDS: Distribution provided by DemProj, implying that 51 % have developed AIDS after 10 years and 85 % after 18 years
Infant conversion from HIV to AIDS: Distribution provided by DemProj, implying that 84 % have developed AIDS after 5 years and 97 % after 9 years
Time from AIDS to death: One year
Per cent of infants with AIDS that die in first year: 67 %
Distribution of new adult infection by age and sex: Distribution provided by DemProj, implying a peak for men 25-29 years and women 15-19 years, and that 51.6 % of the new infected persons are females and 48.4 % are males

Scenarios
Four scenarios have been chosen:

Scenario 1: No HIV/AIDS
Scenario 2: Adult prevalence stays constant at 13 per cent
Scenario 3: Adult prevalence increases to 25 per cent in 2000
Scenario 4: Adult prevalence increases to 50 per cent in 2000

The first scenario assumes that there is no HIV/AIDS. This is completely unrealistic, of course, but is made to have a bench mark scenario with which we can compare and estimate the consequences of the epidemic. The second scenario assumes that the HIV prevalence stays constant at the estimated 1990 level of 13 per cent for the national adult population (from Anderson et al. 1991). (This implicitly assumes a low annual incidence of new infections to replace those HIV-positive persons who die from AIDS or other causes.) Although this level is very high compared to almost all other countries, it may already be somewhat too low, since the prevalence levels of certain groups may have increased since 1990 (more recent official estimates were not available to me at the time of writing). We have, therefore, introduced a third scenario where the prevalence increases to 25 per cent in 2000 and stays constant thereafter. This corresponds to the 1990 estimate for pregnant women in Lusaka, which is the highest level observed for any Zambian subgroup that is approximately representative of the general population (see the discussion in section 3.2 above). The fourth scenario assumes that the level increases to 50 per cent in 2000 and then stays constant. This is also an unrealistic alternative, as such a high level for a general population to my knowledge never has been observed anywhere, not even for the most infected parts of Uganda or Rwanda.

Results
Some of the results are presented in tables 3-5 and figures 1-2 on the next pages. To summarize the most important findings:

- The number of infected persons will increase to 1-2 million in the year 2000 (and 2,5 to 4 mill, in 2040).

- The number of AIDS cases and deaths will increase very fast in the coming years, and in all three HIV-scenarios, see figure 1. Almost 1/2 million persons will die from AIDS between 1990 and 2000, even if the prevalence level stays constant at 13 per cent. And an increase to 25 per cent would imply almost 700,000 deaths before 2000.

- The population size in the year 2000 will be only weakly affected by AIDS, reaching 11.3 mill. with no AIDS and 10.9 mill. with the continuation of the current HIV prevalence, see figure 2. The population size in 2040 will be strongly affected, however, with the size in scenario 3 being only half of the scenario without AIDS, but still 3-4 times the size in 1990.

- The growth rate of the population will *not* become negative, not even in the extreme scenario 4, where the growth rate will be only half of the growth rate without AIDS. A reduction of 1-2 percentage points seems likely.

- The crude death rate will be significantly higher with AIDS than without AIDS, both in 2000 and 2040.

- The age structure will not be much affected by AIDS, the proportion in the productive ages 15-64 stays at about 49 per cent in all four scenarios. The dependency ratio is slightly worse the higher the HIV prevalence is.

Discussion

Our results are similar to the results of other projections, including WHO's (1991c) projections of the demographic impact of the HIV/AIDS pandemic in a hypothetical Sub-saharan African country. The WHO projection concludes that the demographic impact of AIDS for the period 1985-2010 are going to be substantial but the population is not going to decline rapidly in size. However, WHO warns that the results have to treated with caution because it is extremely difficult to simulate such a complex human problem.

The most dramatic demographic effects are the increase in the number of deaths and the crude death rate, and the dissolution of families. AIDS reduces population growth but not by as much as often believed. The age structure is hardly affected at all.

The main reason for the lack of strong demographic effects on the growth rate and the age structure is the high fertility level. With a total fertility rate of 7 children the incremental population each year is of such a large magnitude that not even an AIDS epidemic can eliminate the population growth. But if the fertility were to decrease, as in some other sub-saharan countries (in particular Botswana, Zimbabwe and Kenya) or as a response to the AIDS epidemic, the situation would change dramatically. If a low-fertility country like Norway, for example, had had a HIV/AIDS level as high as in Zambia, the population size would decline dramatically.

Another reason for some of the surprisingly weak demographic effects is the long incubation period of the infection, which smooths out most of the impact on the age structure.

AIDS already has serious economic, social and demographic consequences for Zambia, and these will become even greater and more difficult in the coming years. HIV/AIDS patients are over-burdening the health system, including an increasing number of patients with tuberculosis and other diseases that are affected by HIV. There will be a substantial loss of manpower in many sectors and at all levels, both highly qualified and unskilled. In addition comes absenteeism due to sickness and funerals. All this will affect both the quantity and quality of production. There is little specific knowledge about this to-day, but most, if not all, sectors are likely to be affected, including agriculture which may experience a shortage of manpower in the harvesting season, and the important mining industry. The public sector and private business will also lose valuable manpower.

Table 3. Population and HIV/AIDS data for Zambia 1990

HIV prevalence	13 %
HIV infected persons	479,000
Annual AIDS deaths	26,000
Cumulated AIDS deaths	19,000
Population size	7.8 mill
Population growth per year	3.7 %
Crude Death Rate	21.5
Per cent 15-64 years	47.6
Dependency ratio	1.043

Table 4. Population projections for Zambia for the year 2000 without and with AIDS

	No HIV/AIDS	HIV prevalence constant at 13%	HIV prevalence increases to 25%	HIV prevalence increases to 50%
HIV infected persons	0	765,000	1,418,000	2,685,000
Annual AIDS deaths	0	68,000	119,000	223,000
Cumulated AIDS deaths	0	469,000	687,000	1,136,000
Population size	11.3 mill	10.9 mill	10.6 mill	10.1 mill
Population growth per year	3.9 %	3.3 %	2.7 %	1.6 %
Crude Death Rate	15.0	22.0	24.2	32.1
Per cent 15-64 years	49.5	49.9	49.8	49.7
Dependency ratio	0.973	0.956	0.958	0.963

Table 5. Population projections for Zambia for the year 2040 without and with AIDS

	No HIV/AIDS	HIV prevalence constant at 13%	HIV prevalence increases to 25%	HIV prevalence increases to 50%
HIV infected persons	0	2,563,000	3,723,000	4,266,000
Annual AIDS deaths	0	247,000	357,000	394,000
Cumulated AIDS deaths	0	6,155,000	9,974,000	13,964,000
Population size	50.6 mill	37.5 mill	28.7 mill	17.2 mill
Population growth per year	3.8 %	3.2 %	2.7 %	1.9 %
Crude Death Rate	15.0	20.9	26.4	35.9
Per cent 15-64 years	49.2	49.0	48.9	49.3
Dependency ratio	0.993	1.001	1.013	1.015

Figure 1. Annual number of deaths in Zambia due to AIDS, 1990-2040

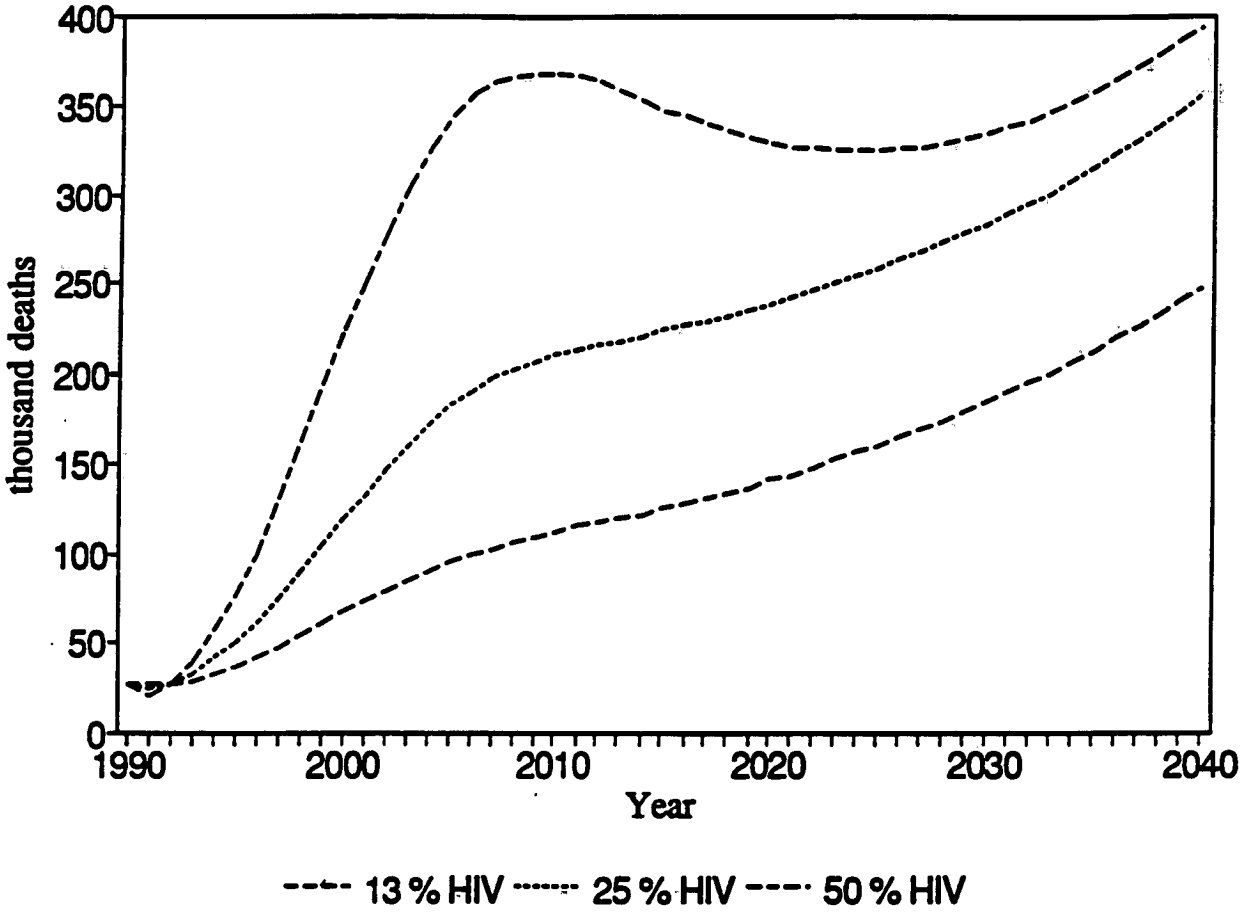
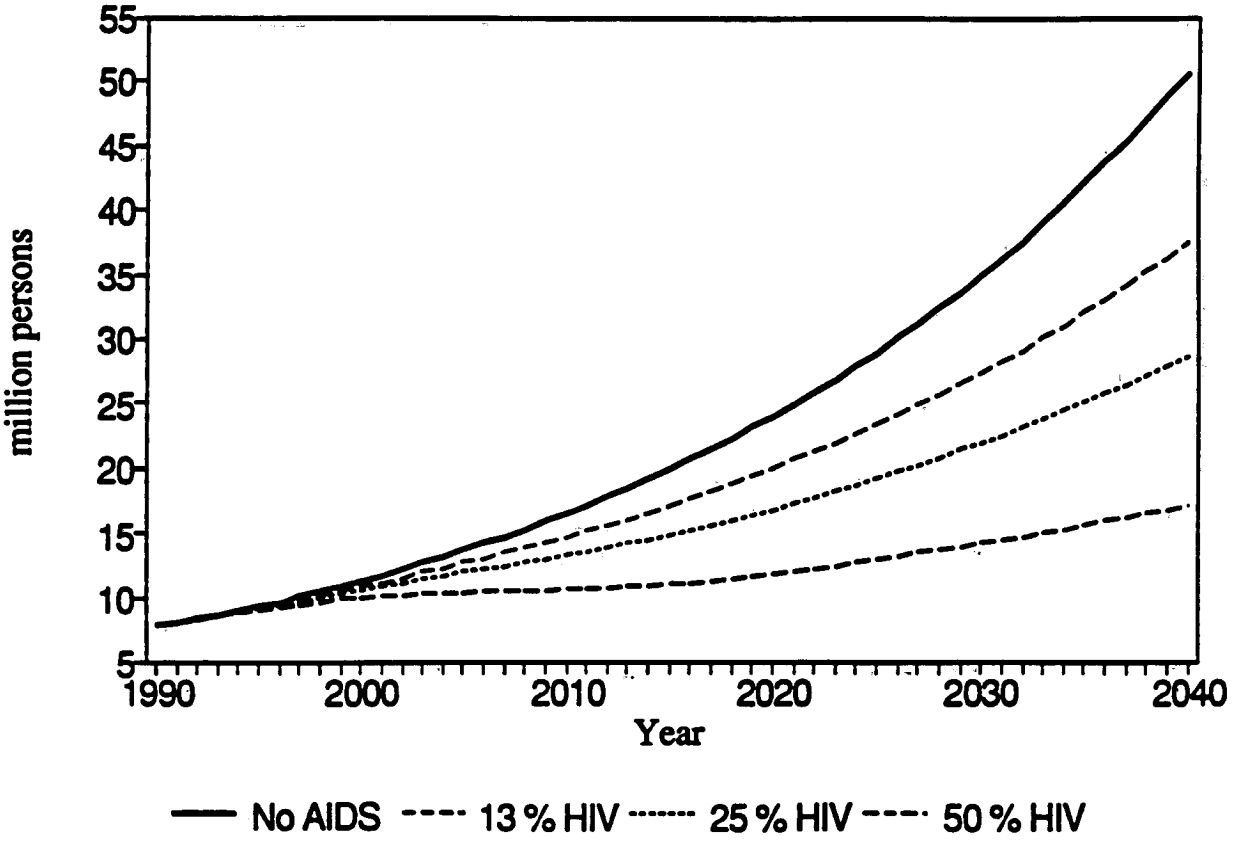


Figure 2. Total population in Zambia without and with AIDS, 1990-2040



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MOSART-H: A combined micro-macro model for simulation of households[1]

by

Helge Brunborg and Nico Keilman

[1] Revised version

ABSTRACT

This paper describes work in progress concerning the construction of MOSART-H, a model which is intended to simulate the dynamics in future household structures in Norway. The model consists of two parts: one for macrosimulation, and one for microsimulation.

First, a macromodel of the multidimensional cohort-component type projects the population broken down by sex, age group and 15 individual household positions: 14 for private households and one for persons living in an institution. Adults may be classified into one of 13 private household positions: one for a one-person household, four for living in consensual union (with 0, 1, 2, or 3+ children), four for living with a spouse (with 0, 1, 2, or 3+ children), three for heads of one-parent families (with 1, 2, or 3+ children), and finally a rest category. Children constitute an own category. By jumping from one household position to another each individual experiences a household event. We identified 133 such events, where birth, death, immigration and emigration are also taken into account. Many of the events are linked. For instance, the number of males who start a consensual union is equal to that for females. Similar constraints (some of them being much more complex) may be formulated for marriage, for marriage dissolution, for the dissolution of consensual unions, and for young adults leaving or re-entering the parental household. On the basis of the 15 individual household positions and the 133 household events we identified 21 different constraints for various events. Some simplifying assumptions turned out to be necessary to keep the model within reasonable bounds.

The model contains an option to simulate numbers of births, deaths and migrations (irrespective of household position) that correspond to numbers projected earlier by the Norwegian Central Bureau of Statistics in its official population projection. The model is a multidimensional cohort-component projection model with constraints on internal events (household events) and, optionally, also on external events (births, deaths and migrations).

Input parameters for the model are occurrence-exposure rates describing the various events. Together with an initial population structure this results, for each projection interval, not only in a set of aggregate household projections, but also in transition probabilities connected to the model's state space.

The microsimulation model describes individuals and the events they experience as they move through the state space, which is the same as that for the macrosimulation model. Its input parameters are the transition probabilities produced by the macroprojection step. The microsimulation model groups individuals into separate households, and it simulates their decisions regarding the household these individuals will move to when they leave their original household. Since household dynamics are simulated at the level of individuals, and not at that of households, household formation and household dissolution involves the joint decisions of two or more persons. These processes are simulated by means of the concept of "wishes". A "wish" is an intended event. For all the persons in a household a "wish" is drawn. Sometimes these "wishes" are in conflict with each other, for instance when a man wants to separate, but his wife "wishes" to remain married. A random process is used to reconcile conflicting "wishes" for all types of household formation and dissolution processes. For new consensual unions and new marriages, we also take account of age preferences among the partners.

Finally we describe in the paper some of the difficulties we currently experience in estimating the input parameters and in the compilation of the initial population.

1. Introduction

There are commonly two approaches to the simulation of household dynamics: macrosimulation and microsimulation. Dynamic household models describe individuals broken down by household position, age, sex and possibly additional characteristics. This multidimensional breakdown defines a state space, and a vector in the state space is called a state vector. In the macrosimulation approach the state vector represents the whole population, and each element of the state vector contains the number of individuals in a certain state, i.e. with one particular combination of the characteristics, for example the number of females aged 40-45 that are head of a one-parent family. In microsimulation, each individual has his or her own state vector, which contains a 1 in the appropriate element, the other elements being 0.

The dynamics in both approaches are introduced by means of transition probabilities, which link the state vector at two successive points in time. They describe the probability that an individual is in state j of the state vector at time t_1, given that he or she was in state i at time t_0. An example of such a transition probability is that for a transition from being a married spouse, aged 35-40, with children, at time t=0, to being head of a one-parent family, aged 40-45 at time t=5. In the macrosimulation approach, the state vector is multiplied by the complete matrix of transition probabilities to yield the population broken down by the relevant characteristics at some further point in time. In microsimulation, one individual is simulated at a time, on the basis of only those transition probabilities in the full matrix that apply to the state the individual occupies at the beginning of the interval. The dynamics of the whole population are simulated by successive treatment of all individuals.

Because the arithmetical operations are relatively easy in microsimulation, compared to macrosimulation, the models used in microsimulation may include more relationships and variables than those used in macrosimulation. In particular, information about household relationships between individuals may be traced relatively easy in microsimulation. Indeed, it would be impossible to answer, for example, the question "Who lives with whom in the same household?" by means of macrosimulation - in microsimulation this is much less problematic.

The possibility of including information on household structures, decision rules such as those determining which household to join when household formation takes place,

and with other socioeconomic variables, is the most important advantage that a microsimulation approach to household dynamics has over macrosimulation. Examples of microsimulation models for household and family dynamics are the Frankfurt model (Galler, 1988), the NEDYMAS model developed in the Netherlands (Nelissen, 1991; Nelissen and Vossen, 1989), the regional model constructed by Clarke (1986) for Yorkshire and Humberside, the Darmstadt model (Heike et al., 1987) and a model constructed by Egidi and Tomassetti (1988) for Italy. But in spite of its advantage, there is a price to be paid when choosing microsimulation: the development of a computer program for the microsimulation of household dynamics takes relatively much time. Therefore, a number of macrosimulation models which project household dynamics have been constructed in the past (for a review, see Keilman, 1988) and a flexible PC-program called LIPRO (Van Imhoff and Keilman, 1991).

This paper describes work in progress concerning the construction of a combined micro-macro model to be used for the simulation of household dynamics. The model is called MOSART-H, and it is part of a larger model called MOSART.[1] MOSART projects and analyses individual life courses with respect to education, marriage, births, and labour market participation in Norway. It is run by a micro simulation programme which simulates the life course of a 4 per cent representative sample of the population of Norway starting at December 31st, 1987. An overview of MOSART is given by Andreassen (1990, 1992), Andreassen and Fredriksen (1991), and Andreassen et al. (1992). The model consists of a number of modules, one of which is the *demographic module*. This module not only takes account of the death and "birth" (new individuals are not born inside the model, but added exogenously at age 16) of men and women, but also of their marital status, and of the number of children ever-born to women. The purpose of MOSART-H is to extend the demographic module of MOSART, which is marital status based, to a more comprehensive *household module*, involving household positions for both males and females (in addition to birth, death and external migration).

MOSART-H consists of two parts. First, a macrosimulation model projects the population

[1] MOSART is a Norwegian acronym for Model for Microsimulation of Schooling, Labour Supply and Pensions (*MO*dell for mikrosimulering av *S*kolegang, *AR*beidstilbud og *T*rygd). MOSART-H is the household module of MOSART. MOSART-T, also currently under development, is a social security module (Fredriksen, 1992).

broken down by sex, age group and 15 individual household positions. The macrosimulation model contains an option to simulate externally given numbers of births, deaths and external migrations, irrespective of household position of the individuals concerned. This option gives the user the possibility to make a projection which agrees with the official population projection of the Norwegian Central Bureau of Statistics (NCBS). Input parameters for the macromodel are occurrence-exposure rates describing the various events. Together with an initial population structure this results, for each projection interval, not only in a set of aggregate household projections, but also in transition probabilities connected to the model's state space. The microsimulation model describes individuals and the events they experience as they move through the same state space as that used in the macrosimulation model. Its input parameters are the transition probabilities produced by the macroprojection step. A random number procedure determines whether or not each individual experiences the transitions he or she is exposed to, given the person's current position in the state space. The microsimulation model groups individuals into separate households, and it simulates their decisions regarding the household to which these individuals will move when they leave their original household. The expected values of the aggregate results of the microsimulation step are the same as the results obtained in the macrosimulation step.

This paper describes the current state of the project: the macromodel (sections 2 and 3) and the micromodel (sections 2 and 4) have been programmed and tested, and currently we are engaged in compiling the initial population and estimating the occurrence-exposure rates that describe household dynamics.[2] That the latter task is by no means an easy one will become clear from section 5.

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[2] The MOSART-project is carried out by a project group at the Norwegian Central Bureau of Statistics. In various compositions, the group has included Leif Andreassen, Truls Andreassen, Helge Brunborg, Dennis Fredriksen, Andre Hansen, Tone Heimdal, Nico Keilman, Gina Spurkland and Yngve Vogt. In addition, we are grateful to Inger Texmon for assistance in estimation. The Census Office at Kongsvinger also provided valuable assistance and advice, in particular Anders Falnes.

2. State space and events

The model describes individuals who move from one household position to another as they grow older. Based upon various considerations related to the purpose of the project, data availability and model complexity we decided to choose the following set of household positions for individuals for each combination of age and sex:

1.	CHLD	dependent child
2.	SING	adult in one-person household
3.	COH0	cohabiting, no children
4.	COH1	cohabiting, 1 child
5.	COH2	cohabiting, 2 children
6.	COH3	cohabiting, 3+ children
7.	MAR0	married, no children
8.	MAR1	married, 1 child
9.	MAR2	married, 2 children
10.	MAR3	married, 3+ children
11.	H1P1	head of one-parent family, 1 child
12.	H1P2	head of one parent family, 2 children
13.	H1P3	head of one parent family, 3+ children
14.	OTHR	other position in private household (for instance other adult in household with members in positions 3-13, or member of a multiple family household, or adult sharing the same household with one or more adult persons without having a partner relation to any of them)
15.	INST	in institutional household

This breakdown covers the most important aspects of the *de facto* household structures of the population of Norway. It will be clear, that we need not only "traditional" households (married couple with or without children, one-person household, one-parent family caused by widowhood), but also those which emerged only a few decades ago (consensual unions, one-parent families caused by divorce).

The 15 household positions which individuals may occupy at any point in time result in the following 14 types of households:

A. one-person household
B. a cohabiting couple without dependent children (but possibly with other adults)
C. a cohabiting couple with one dependent child (and possibly with other adults)
D. a cohabiting couple with two dependent children (and possibly with other adults)
E. a cohabiting couple with three or more dependent children (and possibly with other adults)
F. a married couple without dependent children (but possibly with other adults)
G. a married couple with one dependent child (and possibly with other adults)
H. a married couple with two dependent children (and possibly with other adults)

I. a married couple with three or more dependent children (and possibly with other adults)
J. a one-parent family with one dependent child (and possibly with other adults, none of whom has a partner relation to the head of the one-parent family)
K. a one-parent family with two dependent children (and possibly with other adults, none of whom has a partner relation to the head of the one-parent family)
L. a one-parent family with three or more dependent children (and possibly with other adults, none of whom has a partner relation to the head of the one-parent family)
M. other household (such as multiple family household, or co-resident adults without partner relation)
N. institutional household

The model contains a parameter which denotes the maximum age of a "child". Most probably this parameter will be set to 25 or 20 years of age. When a child exceeds that maximum age, or when that child gets an own child (childbearing is restricted to women in the model), she or he will be denoted as "other".

The number of private households of various types may be inferred easily from the number of persons in the 14 private household positions. Thus, a household projection in terms of individuals may be translated into one in terms of households. The rules are listed below. They apply to the beginning and the end of each unit projection interval. Persons in institutional households will be thought of as living in one enormous household.

1. The numbers of households of types A, J, K, and L equal the numbers of (non-child) persons in the corresponding household positions.
2. The number of household of types B-I equal half the numbers of (non-child) persons in the corresponding household positions.
3. The number of households of type M equals the number of persons in household position M divided by the average number of persons in M-households.

Given the classification of household positions, a matrix of *household events* can be identified. Events are direct jumps between two distinct household positions, taking place in infinitesimal short periods. Some individuals enter the population (birth, immigration), others leave it (death, emigration). Such jumps are also called events. They are labelled as *external events*, to distinguish them from jumps between two household positions, which are called *internal events*.

Not every pair of distinct household positions defines an event. Some events are impossible by definition, or by assumption. An example of an inherently impossible household event is the *direct* jump from CHLD to H1P1: a dependent child living with its parent(s) (CHLD) has several *indirect* possibilities to reach the state "head of a one-parent family with one child" (H1P1). He or she may pass through the intermediate state "with marriage partner, one child" (MAR1), or through the sequence of intermediate states "single" (SING), "cohabiting, no child" (COH0) and "cohabiting, one child" (COH1), before he or she can occupy the position H1P1. Other paths are feasible as well, but a direct jump is impossible.

We identified altogether 133 events, both internal and external. The events matrix, which is given in table 1, is based on the following assumptions.

1. Partners who divorce or separate do no longer co-reside.
2. A return to the position of dependent child is only possible from the position SING. As a consequence, in the position prior to SING, a dependent child cannot have (had) own children and he/she cannot have had a partner with whom a household was shared.
3. Adults can only leave the household they are in through the (possibly intermediate) positions of SING (however short the duration in this state may be), head of one-person household, or upon entering an institution, emigration or death.

*** table 1 here ***

Although it is not immediately clear from table 1, the sub-table with intra-household events contains a rich structure. To show this, we rearranged the household positions in a somewhat different order and this resulted in event table 2. Household positions involving the same number of children (0, 1, 2, 3 or more) each constitute a block of household events. Position "SING" is grouped together with "MAR0" and COH0", because it is conceptually equivalent to the latter two positions: "MAR0" and COH0" can be reached when the last child leaves a household of type "MAR1" and "COH1", respectively. Similarly, a lone parent with one child ("H1P1") becomes "SING" as soon as the child leaves the parental household. Events in blocks I, VI, XI, and XVI represent processes of union formation and dissolution for household positions with 0, 1, 2, and 3 or more children, respectively. Events in block II describe the arrival of the first child in the

household without children. Block V represents the departure of the last child - it is the transpose of block II. Blocks II, VII and XII have a similar structure: each of these three stands for the arrival of an additional child. Similarly, blocks V, X and XV represent the departure of a child.

*** table 2 here ***

The macrosimulation model and the microsimulation model may be characterized as models representing a first-order Markov process with constant intensities for intra-household events, death and emigration, and for the remaining events (birth and immigration) a uniform distribution of events over the unit projection interval. The mathematics of such a model were derived by Van Imhoff (1990). The macrosimulation model is a time-continuous model, with occurrence-exposure rates (o-e rates) for all relevant events as input parameters (except for immigration, which is described by means of absolute numbers of immigrants into each household position). The underlying jump intensities are assumed constant on the unit projection interval, and each observed o-e rate is thus a Maximum Likelihood estimator for the corresponding jump intensity (Hoem and Funck Jensen, 1982: 203). The focus in the macrosimulation model on continuous-time intensities and o-e rates as the basic parameters of the process facilitates dealing effectively with competing risks and multiple events within one unit projection interval (Andreassen, 1992: 8). If we would have started from discrete-time transition probabilities this would have been much more difficult. However, for the *microsimulation* model continuous time is computationally inconvenient because of the interaction between individuals in the marriage market and the "cohabitation market" - or "partner market". Although in reality the partner market is cleared continuously, this cannot be done in microsimulation models - clearing the market is done at discrete points in time (usually one year apart). Thus the time-advance methodology in microsimulation models for the partner market may be characterized as *fixed-increment time advance* (or time-driven approach), see Law and Kelton (1982: 5). In case individuals would not interact during their life course, one could use a continuous-time microsimulation model based upon a *next-event time advance* (event-driven approach), and simulate each individual from birth to death before the next person would have to be simulated.

Because of the problems connected to continuous-time microsimulation models

with interactions between individuals, we chose for pragmatic reasons a discrete-time approach for the microsimulation, in which it is assumed that one transition is equivalent to one event. Since we work with unit projection intervals of one year in the microsimulation model, the probability that a transition involves multiple events is small for most transitions. The transition probabilities resulting from the (continuous-time) macrosimulation model are entered into the microsimulation model. Competing risks are dealt with effectively in the microsimulation model: an individual who is in position i is first exposed to the risk of experiencing a transition (assumed equal to an event) to position j, or k, or l ... etc. Next, a random choice mechanism determines which of the competing events will be realized (see section 4).

Although the risks of occurrence of competing events operate at the same time, standard practice in microsimulation has been to fix a certain sequential ordering in the types of events. In micro simulation approaches described by Clarke (1986), Volkov and Soroko (1986), Nelissen (1991), and Galler (1988) one arbitrarily chooses a certain priority for the events. Individuals in all these four approaches are subject first to the risks of mortality, and the survivors next to those of nuptiality. But mortality first, followed by marriage, will produce results which differ from those obtained when marriage comes first, and mortality next. This is so because mortality shows considerable variation over marital statuses. Also the current version of the larger MOSART-model is based upon a fixed order of events. Clarke (1986, 251) lists the problem of sequential ordering of events as one of the drawbacks of microsimulation. On the other hand, the approach described in this paper takes due account of competing risks theory and stochastic processes (except for an assumed equivalence of transitions and events). It should be noted that a different solution to the sequential ordering problem in microsimulation was recently proposed by Egidi and Tomassetti (1988), who suggested not to fix the order of the events which compete, but to determine their order randomly for each individual in each unit time interval. Heike et al. (1987) probably uses a similar approach. This method is not appropriate in the present study, since individuals belonging to the same household interact strongly.

The fact that a macrosimulation model may effectively handle multiple events within one transition is not the only reason why the microsimulation of household structures is preceded by a macrosimulation step. Another, even more important, reason is

the fact that projection results from MOSART-H regarding numbers of births, deaths and international migrations have to correspond with those resulting from population projections of the NCBS produced with the BEFREG model (NCBS, 1990). The macrosimulation model is adapted from the LIPRO-model, and the latter model contains an option which takes full account of such externally imposed constraints. To implement this in a microsimulation model would be very cumbersome (unless its parameters are absolute numbers of births, deaths and migrations, instead of transition probabilities or o-e rates). The option referred to above is part of the so-called consistency algorithm, which will be described below.

3. Consistency in the macrosimulation model

Within the context of household models, the consistency problem can be considered a generalization of the well-known two-sex problem in marital-status models. Unless the model builder includes a two-sex algorithm in the marital-status model, male marriages will *not* be equal to female marriages (nor will male divorces correspond to female divorces, or deaths of married persons to transitions to widowhood of the other sex). In household projection models, numbers of male entries into cohabitation have to correspond to numbers of female entries into cohabitation in a certain period, and the number of last children who leave a one-parent household must be equal to the number of heads of such a household who become single. These requirements are but a few of the many consistency relations that may appear in the framework of a household projection model. The LIPRO computer program contains a very flexible consistency module that automatically produces consistent numbers of events once the user has specified which sets of events are linked in linear combinations. The algorithm, developed by Van Imhoff (1992), is based on weighted linear least-squares optimization. We have chosen the harmonic-mean solution to the consistency problem which involves a proportional adjustment of age-specific numbers of inconsistent events to find age-specific numbers of consistent events.

Most of the consistency constraints (e.g. the two-sex requirements) stem from the nature

of the household classification chosen; this type of consistency is referred to as *internal* consistency. Other constraints may occur because of interrelationships between different models. For instance, numbers of events computed from models of a low aggregation level may be required to add up to the corresponding numbers in the national population forecasts, which is of a higher aggregation level. The latter type of constraints is referred to as *external* consistency (Keilman, 1985). LIPRO's consistency algorithm ensures that the projected numbers of events satisfy certain linear constraints, thus allowing for both internal and external consistency requirements. The external consistency conditions in MOSART-H follow from the NCBS population projections.

On the basis of the 15 individual household positions and the 133 household events we identified 21 different constraints for various events. Four assumptions, in addition to the three assumptions listed in section 2, turned out to be necessary for the formulation of the consistency requirements.

4. Divorced partners do not continue to live together.
5. The formation and dissolution of homosexual consensual unions can be disregarded as far as the two-sex requirement for cohabitation (numbers of male and female new cohabitees are equal in each interval) is concerned.
6. Only complete households can immigrate.
7. Adoption can be disregarded for the entry of children into a household.

The 21 consistency relations hold for each unit projection interval. Two examples will be given here:

- the total (i.e. summed over all ages) number of married males with one child in the household who experience a jump either to the position "single", or to "lone parent with one child", or to "in institution", or to "dead", or to "living abroad", must be equal to the total number of females who experience these events; a similar constraint applies to males and females in initial position "married, two children present";
- the total number of cohabiting males with two children (position COH2) who experience a jump to position COH3 should be equal to the number of COH2-females who either have given birth to a child, or who jump to the position COH3 because a child returns to her household[3]. A similar constraint applies to males and females in initial positions COH0 and COH1.

[3] Childbearing is connected to females only - males "follow passively".

4. Main principles of the microsimulation model

In this section we shall sketch the main features of the microsimulation part of MOSART-H. The object oriented language SIMULA was chosen, because it is well suited for simulating processes for interrelated objects, such as the household dynamics for persons belonging to the same household (Kirkerud, 1989). For a fuller account one may consult Andreassen et al. (1992, 11-16).

Each individual is member of one household, possibly together with other individuals. Each person bears a set of attributes indicating his or her personal identification number (PIN), age, sex, household position, marital status, parity, and household number. Children have a pointer to their father and one to their mother, as long as they live in the parental home. Spouses or cohabitees point to each other. Each household contains pointers to all of its members. Examples of two households are given in figure 1. The first household is of type H: a married couple with two dependent children and with one other adult. The parents have household position MAR2, the two children are CHLD. In addition, there is one OTHR-person. The second household is a one-parent family with one child (type J in section 2).

*** figure 1 here ***

Since household dynamics are simulated at the level of individuals, and not at that of households, processes of household formation and household dissolution involve the joint decisions of two or more persons. These processes are simulated by means of the concept of "wishes". A "wish" is an intended event. For each person in a particular household a "wish" is drawn, on the basis of the transition probabilities that govern possible jumps out of the current household position. (Since the transition probabilities are based upon observed events, and not intended events, the concept of a "wish" does not have a very strict behavioural interpretation here.) Sometimes these "wishes" are in conflict with each other, for instance when a man in position MAR0 wants to separate and make a jump to position SING, but his wife "wishes" to remain in position MAR0. A random process is

used to reconcile conflicting "wishes" for many types of household formation and dissolution processes. However, some "wishes" are dominant over others. Those referring to the events of birth and death are realized without regard to the partner's "wish". And regarding children's "wishes" we have assumed that these can always be realised, without taking the parents's "wishes" into account. This implies that parents may change household position more than once during a particular projection interval, according to the events that their children experience (for example, from MAR2 to MAR1 to MAR0, in case two children leave the parental household).

For some events, such as marriage or the start of a consensual union, other persons are involved who are not identifiable at the time the household of the individual is simulated. Individuals "wishing" to experience such an event are stored in different pools (candidate lists). Matching is carried out at the end of each projection interval when all households have been simulated. We will describe here the procedure for marriage - that for new consensual unions is similar.

Although the transition probabilities resulting from the macrosimulation model should result in equal numbers of males and females marrying, the number of male marriages equals that for female candidates by chance only. This is due to two reasons. First, in the microsimulation model each transition is assumed to be equal to exactly one event - in the macrosimulation model this assumption was not necessary. Second, even if one transition would be equivalent with one event, the random drawing mechanism for "marriage wishes" described above yield numbers of male and female candidates which are equal in terms of *expectations* only - the actual realizations of the random drawings may result in different numbers. Therefore, the "final" numbers of male and female candidates are made equal, using the harmonic mean of the initial numbers.[4] For the sex for which there is a shortage, new candidates are taken from an extra pool. A random procedure determines which individuals of the sex for which there were too many candidates will be removed from the candidate list. Matching takes place in agreement with an externally given two-way preference table of marriage partners by age-

[4] Cohabitees who (both) want to get married are married right away, and next these are removed from the list of candidates.

combination, using Iterative Proportional Fitting (IPF).[5] This yields a distribution of the partners by age combination which corresponds as closely as possible to that of the preference table, thereby preserving the marginal distributions determined in the previous step. Finally the weddings are carried out for each cell in the updated table. The procedure described here is essentially the same as that used by Clarke (1986) and very similar to that of Nelissen (1991). McFarland (1975) employed IPF for the macrosimulation of marriage.

5. Data sources, initial population and occurrence-exposure rates

The household model requires two types of data:
- data on the initial population to be simulated forward in time, and
- occurrence-exposure rates for internal and external events in the model.

The system of Personal Identification Numbers (PIN) in Norway makes it possible to match data on individuals from many different sources, including population registers, population censuses, and sample surveys. This proved to be of great value in constructing the initial population and estimating the o-e rates.

5.1 Initial population

The initial population is based on a random sample (N=28,384) from the population of Norway, collected in the Population and Housing Census of 1990. This census was, for the first time, not a wholecount. In municipalities with less than 6000 inhabitants, all persons born in 1973 or later received a census form. In larger municipalities a random sample of between 8 and 24 per cent received the census form, and the respondent was asked to

[5] When MOSART-H is to be integrated into the larger MOSART model, each individual's educational status (studying/not studying) is known, among other things. This information will also be used in the preference table, since partner choice depends strongly on educational status. Thus we will work with a 12 by 12 preference table, which includes 6 age classes (below 20, 20-24, 25-29, 30-39, 40-49, 50 or over) and 2 educational statuses.

provide information for the whole household. However, the information thus obtained turned out to be less than that collected for households in wholecount municipalities, and this complicated the reconstruction of household structures.

The Central Population Register (CPR) was used as the "correct" answer in the 1990 census. Thus, information from the census was not used to make changes in the CPR. On the contrary, if a respondent entered an address on the census form different from the one registered in the CPR, this person's address was changed in the census file and not in the CPR. The same applies to marital status. Because some household positions are not very well reflected in the register (see below) we did not want to rely completely on the information from the CPR. Consequently, we have based our initial population on the census returns *before* these were corrected so as to agree with the CPR.

There are several reasons for inconsistencies between the actual and registered CPR address of individuals. Besides errors and omission of reporting household changes, the most important reasons are caused by the peculiarities of the population register. The CPR has an extensive set of rules for registration, of which we mention two particular cases (see, for example, NCBS, 1985, 4)[6]. (1) A never-married person who resides outside the home of the parents because of education or military service is registered as living at the parents' home. (2) A married person who resides outside the partner's dwelling because of labour, education, military service etc. is registered at the partner's house. These rules imply that the following persons will be underestimated:

- students who actually live in student or other housing;
- couples who live in consensual unions;
- married couples who live apart, without being registered separated.

Finally, note that people living in institutions, particularly in homes for old people, are often registered at their home address. Moves are only supposed to be registered if they are assumed to be effective for at least 6 months.

The CPR can be used to combine persons into family units, but only according to a rather narrow definition. A family consists of a married couple with or without unmarried children, a single mother or father with children, or a single person. Thus, other relatives

[6] To a large extent, these rules are the same in other Nordic countries.

or non-relatives living at the same address will be classified as separate family units, as, for example, cohabiting couples, or grandparents living with their son or daughter and their grandchildren.

In addition to the CPR information concerning the family, Question 1 in the 1990 census asks about the composition of the respondent's household: "With whom do you share this dwelling?" Respondents could tick one or more of the following responses:

- nobody
- marriage partner
- partner in consensual union (cohabitee)
- daughter, son
- mother, father
- sibling
- parents-in-law, sister-in-law, brother-in-law, children-in-law, aunt, uncle, niece, nephew
- grandparents, grandchildren
- other persons.

The PIN of each person in the household was registered, which implies that we knew the sex and date of birth of all persons in the sample. The selected respondents in large municipalities received, in addition to an individual form, a household form which contained a list of names of all persons who were registered in the CPR as living in the dwelling, including their PIN. The respondent was asked to write down the name and year of birth of adults (above 16) who were not included in the name list. They were instructed to only include persons who were registered as living in the house on the given address *according to the Population Register*. We think, however, that many respondents included other persons as well, that is, persons actually living in the house but not registered by the CPR as living there.

The full PINs of all these additional persons were later included by staff at the Central Bureau of Statistics. Next, a sample of 10,000 households including slightly over 28,000 individuals was drawn from the Census file. This sample will be referred to henceforth as the "28,000 file".

Before we could use the 28,000 file in the simulation we needed to determine the household positions of all individuals in the sample and the household types of all the households. This proved to be a complicated and labour intensive process, as we discovered a number of errors and inconsistencies, including for example, a number of respondents who ticked off both "marriage partner" **and** "cohabitee". There were also

many inconsistencies between the response to Question 1 and the number of persons in the household and their age and sex. Many persons were "missing" from the household, in particular partners in consensual unions. These inconsistencies were solved by making reasonable assumptions about the correct household composition. For example, in the case of missing consensual partners, an arbitrary "superfluous" partner of the appropriate age and sex in another household was assigned to the household. Most of the inconsistencies were solved through automatic algorithms, but the hardest cases had to be corrected manually. Yet the overall data quality of the 28,000 file is good: the number of problematic cases was approximately one per cent of all cases.

*** table 3 here ***

Table 3 shows the distribution of the individuals contained in the 28,000 file over the most important household positions and broad age groups. It should be noted that these figures are unweighted numbers - in a later stage these will be corrected to take into account the fact that persons who live in relatively small households (in particular one-person households) had a lower probability to be sampled than persons in large households. A little over one-fourth of the population lives as a child with parent(s), at least when we set the maximum age for a child equal to 20. Married couples without children are observed particularly among persons over 50, which reflects the "empty nest phase". All cohabitees taken together make up some 5 per cent of the population, and more than half of them are without children. Roughly two per cent of all adults are head of a one-parent family, most often with only one child. Persons who live alone are frequently between 20 and 30 years of age, or over 60.

5.2 Occurrence-exposure rates

The data needs to estimate occurrence-exposure rates by age and sex for 133 events (see section 2 and table 1) are formidable. This section describes our progress so far and some of the problems we have encountered.

Births

The birth rates are estimated from the so-called Women file, which gives life-history data on live births and marital status for all women who have lived in Norway since 1964 (see Brunborg and Kravdal, 1986). The birth histories are almost 100 per cent complete for women born after 1935. However, this file does not have any data on household position, which are needed to estimate the appropriate occurrence-exposure rates.

To obtain the household positions we linked births in 1990 in the Women file to women born 1940-1977 in the 28,000 file. This made it possible for us to estimate most of the age-specific fertility rates by household position of the mother (see the lower panel of table 1). It should be noted that we distinguished between women according to the number of children present in the household ("household parity") rather than the number of children ever born ("biological parity"). Because of the small numbers of women in some age-household position groups, grouping and smoothing was often necessary.

Deaths

Ideally we would like to have death rates by age, sex and household position. There are, however, too few persons in the 28,000 sample who die in one year to estimate reliable death rates. Therefore we decided to use deaths from the CPR, and estimated death rates by age, sex and *formal* marital status (never married, married, widowed, and separated/divorced) for the period 1986-90. There are indications that recent mortality behaviour of Swedish cohabitees is closer to that of married persons (who live together with their spouse) than to that of persons living alone (Prinz, 1991), and it is not unreasonable to assume that marital status may serve as a proxy for actual household position at the prime ages of mortality (60 years and over). An alternative is to assume that the distribution over household positions for each combination of age, sex and marital status in the initial population is the same as that for the deaths. This would allow us to calculate death rates by household position as a weighted average of death rates by marital status.

Leaving the parental home

Rates for leaving the parental home have been estimated by Inger Texmon (1992) with data from the Family and Occupation Survey 1988 (F&O, see NCBS 1991). This survey provides information on the date (month and year) that young adults left the parental

home, among others, for six female birth cohorts (1945, 1950, 1955, 1960, 1965, 1968) and two male cohorts (1945 and 1960). Unfortunately, it does not contain the type of household to which the respondent moved. The distribution by type of household of destination may be borrowed from Dutch data used in the LIPRO-projections (Van Imhoff and Keilman, 1991, 73).

Figure 2 shows the rates for some selected cohorts (rates were estimated for all six female cohorts). These turn out to be higher for females than for males, and higher for the 1960 cohort than the 1945 cohort. However, the upward trend is reversed for later cohorts (not shown here). We also notice the random fluctuations in the rates, in spite of the large sample size of approximately 700-1000 in each cohort. The problem is that there are relatively few persons who live with their parent(s) beyond age 22-23. Some smoothing will be required.

We have no information on the *return* to the parental home. Data from other countries may be used here.

*** figure 2 here ***

It has been very time consuming to establish the data files and estimate the rates, and rates for several types of events remain to be estimated:

Marriages

Marriages are well recorded in the Norwegian statistical system. However, information regarding the type of household to which the marriage partner belongs is lacking. Thus, the marriage rates that can be estimated from the CPR combine marriages for both single and cohabiting persons. To estimate marriage rates by age, sex and household position we will use data on marriage- and cohabitation histories from the Family and Occupation Survey 1988.

Separation and divorce

Estimating divorce rates from the CPR would face the same problems as those for marriage rates, and again we have to resort to using the Family and Occupation Survey 1988. However, the household histories are more complete with regard to marriage

dissolution than to marriage itself. We will try to estimate rates for separation (and not those for divorce), to come as close as possible to the actual time of the breakup of the partnership.

Start and dissolution of consensual unions

Since the Family and Occupation Survey 1988 records the complete marital and consensual histories of the respondents, we can use that survey to estimate the rates for both entry into and dissolution of consensual unions.

Institutionalization

Data on institutionalization are very scarce. Fortunately, institutionalization is a rare event for all ages except the old ones. Thus, we assume that all o-e rates for entry into an institution are zero for ages below 65. For older ages we may be able to use panel data from the Level of Living Surveys. If this is not possible due to small number of observations or other problems, we will make rough estimates based on aggregate data for admittances to old-age homes and hospitals. The consistency algorithm of the macrosimulation model will be used to control for the growth in the stock of the institutionalized population: the latter algorithm facilitates to set the net-inflow to institutions exogenously, in accordance with (expected future) changes in capacity.

Emigration and immigration

Emigration and immigration data by household position may be found from vital statistics using the breakdown by marital status of the migrants, very much in the same way as for deaths.

6. Conclusions

Modellers of household dynamics are confronted with the choice between microsimulation and macrosimulation. Each of the two approaches has its advantages and disadvantages. Microsimulation models are often very complex, labour-intensive, and little user-friendly. On the other hand, they may provide the user with a highly detailed description of individuals and of household structures. It appears that most scholars make the choice

between microsimulation and macrosimulation based on arguments of tradition, convenience, and taste, but it is unjustified to claim that any method is intrinsically the best. Indeed, as Wachter (1987) states, it is far better to use microsimulation and macrosimulation in tandem on a single problem, than to view these approaches as alternatives.

This paper presents work in progress on a combined micro-macro model for the projection of household dynamics. A macrosimulation model of the multidimensional cohort-component type describes household events (leaving the parental home, start of a consensual union, etc.) that individuals experience, as they jump from one of the 15 household positions that are distinguished in the model, to an other. The macromodel effectively deals with problems of competing risks, multiple events within one unit projection interval, and externally formulated constraints in the sense that future numbers of births, deaths and migrations must correspond to those following from official population projections. The input for the macrosimulation model consists of an initial population classified by age, sex and household position, as well as the occurrence-exposure rates for all relevant demographic and household events. Its output is twofold: an aggregate household projection, and a set of transition probabilities for the events simulated by the macromodel. The latter probabilities are fed into the microsimulation model, in which individual decisions are simulated regarding whom lives with whom in the same dwelling.

The model's initial population is based on a random sample of some 28,000 individuals drawn from the 1990 Census file of the Norwegian Central Bureau of Statistics. Current work includes the estimation of occurrence-exposure rates by age and sex of the 133 household events that were identified. This is a labourous process, and a combination of data sources is used here, of which the two most important are the Central Population Register and the 1988 Family and Occupation Survey. Our preliminary investigations indicate that the data availability is sufficient to estimate the model with 15 household positions for individuals. Nevertheless, we are confronted with some problems: an underregistration of consensual unions, and lack of data concerning events for children, single persons, and entries into institutions. Pragmatic solutions, and information borrowed from other countries is (and will be) used in these instances. This increases the need for

sensitivity analysis in the projection stage, to investigate to what extent general simulation results (for instance, we may expect an increase in the number of one-person households, in particular among the elderly) depend upon uncertain assumptions regarding the input parameters.

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Table 1. Events matrix of the MOSART-household model

from \ to	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	dead	abroad
	intra-household events															mortality and emigration	
1. CHLD	-	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+
2. SING	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3. COH0	-	+	-	+	-	-	+	-	-	-	-	-	-	+	+	+	+
4. COH1	-	+	+	-	+	-	-	+	-	-	+	-	-	+	+	+	+
5. COH2	-	+	-	+	-	+	-	-	+	-	+	+	-	+	+	+	+
6. COH3	-	+	-	-	+	+	-	-	-	+	+	+	+	+	+	+	+
7. MAR0	-	+	-	-	-	-	-	+	-	-	-	-	-	+	+	+	+
8. MAR1	-	+	-	-	-	-	+	-	+	-	+	-	-	+	+	+	+
9. MAR2	-	+	-	-	-	-	-	+	-	+	+	+	-	+	+	+	+
10. MAR3	-	+	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+
11. H1P1	-	+	-	+	+	+	-	+	+	+	-	+	-	+	+	+	+
12. H1P2	-	+	-	-	+	+	-	-	+	+	+	-	+	+	+	+	+
13. H1P3	-	+	-	-	-	+	-	-	-	+	-	+	+	+	+	+	+
14. OTHR	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+
15. INST	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	birth[1]														
1. CHLD	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
2. SING	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. COH0	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. COH1	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. COH2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. COH3	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7. MAR0	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8. MAR1	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9. MAR2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. MAR3	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11. H1P1	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12. H1P2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13. H1P3	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14. OTHR	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
15. INST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	immigration														
abroad	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

- = impossible event
+ = possible event
1) position of the mother before birth columnwise, position of the child after birth rowwise.

Table 2. Selected events for the MOSART-household model in rearranged order

to / from	3	7	2	4	8	11	5	9	12	6	10	13
	intra-household events											
	I			II			III			IV		
3. COH0	-	+	+	+	-	-	-	-	-	-	-	-
7. MAR0	-	-	+	-	+	-	-	-	-	-	-	-
2. SING	+	+	-	+	+	+	+	+	+	+	+	+
	V			VI			VII			VIII		
4. COH1	+	-	+	-	+	+	+	-	-	-	-	-
8. MAR1	-	+	+	-	-	+	-	+	-	-	-	-
11. H1P1	-	-	+	+	+	-	+	+	+	+	+	-
	IX			X			XI			XII		
5. COH2	-	-	+	+	-	+	-	+	+	+	-	-
9. MAR2	-	-	+	-	+	+	-	-	+	-	+	-
12. H1P2	-	-	+	-	-	+	+	+	-	+	+	+
	XIII			XIV			XV			XVI		
6. COH3	-	-	+	-	-	+	+	-	+	+	+	+
10. MAR3	-	-	+	-	-	+	-	+	+	-	+	+
13. H1P3	-	-	+	-	-	-	-	-	+	+	+	+
	3	7	2	4	8	11	5	9	12	6	10	13

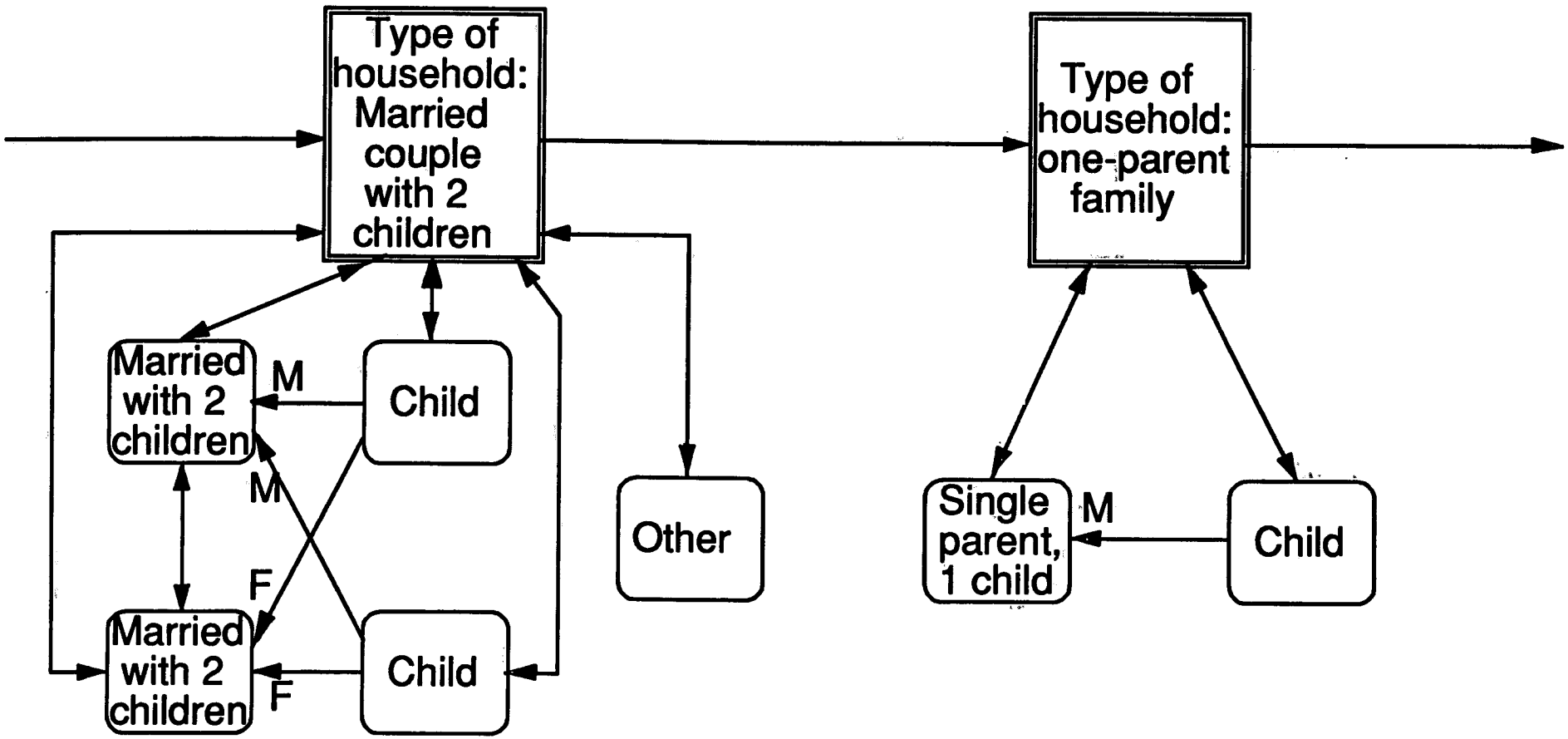
Table 3. Individuals by age-group and household position, Norway, 1990 (unweighted results)

	CHLD	SING	COH0	COH+	MAR0	MAR+	H1P+	INST	OTHR	All
						per cent				
0-14	16.5	-	-	-	-	-	-	-	-	16.5
15-29	10.3	1.6	1.8	0.5	0.7	2.1	0.3	0.0	10.1	27.0
30-44	-	1.3	0.9	0.9	1.0	14.9	1.0	0.0	1.5	21.5
45-59	-	0.8	0.4	0.2	4.1	11.2	0.8	0.0	0.6	18.0
60-74	-	1.8	0.0	0.0	7.9	1.3	0.0	0.1	0.5	11.9
75+	-	1.7	0.0	0.0	2.5	0.1	0.0	0.4	0.5	5.1
All ages	26.7	7.0	3.2	1.6	16.1	29.6	2.1	0.4	13.3	100.0 (N=28,384)

Codes for household positions are as follows:
CHLD Lives as a child with parent(s); at age 20 these persons are no longer considered as "child, but they will be denoted as "other" (as long as they do not leave the parental home)
SING Lives alone, i.e. in a one-person household
COH0 Lives in non-married cohabitation, no children present
COH+ Lives in non-married cohabitation and with one or more children
MAR0 Lives with marriage partner, no children present
MAR+ Lives with marriage partner and one or more children
H1P+ Is head of a one-parent family with one or more children
INST Lives in an institution
OTHR All other household positions

Source: Own processing of 28,000 file

Figure 1. Two households



M: Pointer to mother
F: Pointer to father

Figure 2. Rates for leaving the parental home
(moves per 1000 per year)

Source: Family and Occupation Survey 1988

Eldrebølgen og pensjonssystemene i Norden. Synspunkter fra Norge

by

Olav Ljones

Innledning.

I dette innlegget skal jeg presentere noen sider ved det norske pensjonssystemet og endringer i tallet på eldre. I innlegget kommer jeg ikke til å legge fram nye analyser men heller gi et overblikk og stille sammen noen resultater fra ulike beregninger. Analyser av trygder og demografi stiller krav til modeller og analyseverktøy og jeg vil gi en kort omtale av pågående arbeid med å videreutvikle modell- og analyseverktøyet i SSB.

Om pensjonssystemer

Mange vil med et pensjonssystem tenke på folketrygden og gjerne også snevre inn til folketrygdens alderspensjon, men det kan være grunn til å minne om at et lands pensjonssystem er noe videre enn dette. Et lands pensjonssystem vil være det samlede tilbudet som innbyggerne har av ordninger for inntektssikring ved inntektsbortfall. En kan også se dekning av utgifter til medisinsk behandling ved sykdom, ulykker etc som knyttet til pensjonssystemet, uten at jeg skal gå nærmere inn på disse delene.

Inntektsbortfall som en skal sikre seg mot kan skyldes:
-sykdom
-uførhet
-arbeidsløshet
-tap av forsørger
-oppnådd pensjonsalder (aldersgrense i arbeidslivet)

Den inntekt som individet får når det oppstår et inntektsbortfall kaller vi *pensjon*. Begivenhetene som utløser inntektsbortfallet kan inntreffe med mer eller mindre usikkerhet. Oppnådd pensjonsalder kan sies å være en ventet begivenhet. Usikkerheten ligger i hvor lenge vedkommende vil leve.

Sykdom, uførhet, arbeidsløshet og tap av forsørger er alle inntektsbortfall med større usikkerhet. Noen vil ikke oppleve disse begivenheter og det er stor usikkerhet knyttet til dem. Sannsynligheten for at en tilfredsstiller kravene for disse pensjoner kan være nært korrelert med alder, slik at også "eldrebølger" påvirker utbetalingene gjennom disse delene av pensjonssystemet.

Pensjonssystemer kan i prinsippet ordnes på flere måter. Fra de gamle bondesamfunn kjenner vi *kår-ordningen*. De eldre får da en andel av verdiskapningen på bondegården. I dagens samfunn kan den enkelte sikre sin inntekt gjennom ulike former for sparing. Den oppsparte kapital skal gjennom avkastingen sikre mot et eventuelt framtidig inntektsbortfall. Avkastningen av den oppsparte kapital er avhengig av at det i samfunnet foregår verdiskapning som gir avkastning selv om enkeltindividets inntekt har falt bort. Selv om det kan virke søkt, er det grunn til å minne om at hvis vi holder utenriksøkonomien utenfor, vil det hvis inntektssvikten gjelder alle, ikke være noen verdiskapning som kan sikre kapitalinntektene. Et annet viktig spørsmål er å bestemme hvor

stor den oppsparte kapital må være for å sikre inntekten etter inntektsbortfallet, når det er usikkert om inntektsbortfallet vil oppstå og hvor lenge det vil vare. Usikkerheten gjør det hensiktsmessig og naturlig med forsikringsordninger.

En måte å ordne privat alderspensjon på er derfor gjennom livsforsikring. Disse kan være individuelle eller kollektive, knyttet opp mot et arbeidsforhold. Staten og kommuner har også som arbeidsgivere egne pensjonsordninger for sine ansatte. Livsforsikringsselskapene tilbyr ulike former for livsforsikring som sikrer mot inntektsbortfall. Disse forsikringer kan også inneholde bestemmelser om forsikring mot uførhet, sykdom tap av forsørger etc.

Frivillige forsikringsordninger vil kunne innebære at det skjer en seleksjon blant dem som tegner forsikring. Dette vil innebære at det blant dem som tegner forsikring vil være en betydelig overrepresentasjon av personer som vet eller med stor sannsynlighet tror at de vil komme til å få inntektsbortfall. En måte å unngå dette på er å si at alle er tvunget til å delta i ordningen, det vil si i praksis å gjøre den kollektiv eller offentlig.

Det offentlige kan vedta trygde- og pensjonsordninger som innebærer tvunget medlemsskap. I Norge er dette gjennomført ved folketrygden. Folketrygden i Norge ble innført fra 1967. På mange områder var dette en samordning av eksisterende bestemmelser, men særlig reglene for alderspensjon representerte et betydelig sosialt løft med en klar forpliktelse til inntektssikring. Nye innslag var at pensjonene ved siden av et felles minstebeløp, ble gjort avhengig av tidligere inntekt, eller som en også kan si avhengig av innbetalinger gjennom premier til folketrygden. Slik sett kan den likne på en privat forsikringsordning. Folketrygden har imidlertid en betydelig omfordelingsprofil som en neppe vil finne i private ordninger. Fordelingsprofilen i skattesystemet og folketrygden bør også betraktes som en helhet.

Etter at folketrygden ble innført har bekymringen for utgiftsveksten stadig tiltatt. Bekymringen knytter seg til en rekke forhold:

1. Forverringen i forsørgelsesbyrden; frykt for eldrebølgen.
2. Økte utgifter.
3. Effektivitetstap i økonomien av overføringer(trygder) og premier (trygdeavgifter)
4. Økt andel av utgiftene dekkes via overføringer fra staten (folketrygdens underskudd).
5. Lite eller intet fondsopplegg.

Siden det er vel kjent at fruktbarhetsfallet betyr at vi en gang i framtida står foran en økende andel eldre noe som isolert sett fører til økte utgifter til alderspensjon, kan mye av folks bekymring for folketrygdens framtid ha sin årsak i en overflatisk kunnskap om eldrebølgene. Folks oppfatning av sammenhengen mellom demografi og pensjon kan imidlertid til dels bygge på misforståelser, selv om det er langt mer komplisert for et land

å opprettholde sosiale kontrakter om alderspensjoner når alderssammensetningen endres som følge av fruktbarhetsfall.

En vil kanskje vente at utbyggingen av folketrygden over tid ville medføre minsket interesse for private pensjonsordninger. Fortsatt er det imidlertid stor og økende interesse for private forsikrings/spareordninger som sikrer mot inntektsbortfall. Vi ser (tabell 1) at vi på få år har fått en betydelig økning i innbetalingene til de private pensjonsordninger. Interessen blant publikum for slike private pensjonsordninger er imidlertid ikke bare motivert av hensynet til langsiktig sikring mot inntektsbortfall, men er også påvirket av skattehensyn. Dette henger bl.a. sammen med at premieinnbetalingen har kunnet trekkes fra inntekten ved beregning av skatt.

De private forsikringsselskaper tilbyr i dag forsikringsordninger som dekker både alder, uførhet og enke/enkemannspensjoner. Problemene i folketrygden ligger ikke bare i økningen i tallet på alderspensjonister, men skyldes også den sterke økningen i antall uførepensjonister. Dette kan skyldes egenskaper ved den offentlige ordning. Regelverket i de private selskapene for tilståelse av uførepensjon er imidlertid nært knyttet til folketrygdens regler slik at hvis en får uførepensjon i folketrygden får en også uførepensjon i de private ordninger. Det betyr at de private selskapene får overført konsekvensene av økt tilgang til uførepensjon i folketrygden.

Tabell 1: Innbetalinger til individuelle pensjonsforsikringer i norske livsforsikringsselskaper 1990 kr. mill kr

Ordninger med:	1987	1988	1989	1990
Årlige premier	1961	2257	2125	2094
Engangspremier	328	298	687	1146
Sum	2289	2555	2812	3240

Kilde: Norges Forsikringsforbund (hentet fra St.meld nr 2 1990-91, Revidert nasjonalbudsjett 1991)

Noen stiller spørsmål om de nasjonaløkonomiske problemer med en offentlig folkepensjon kan løses ved å satse på private ordninger. Mange forhold vil da være annerledes med hensyn til sparing og incentivstruktur, men det er også grunn til å minne om at et av hovedproblemene med den sterke veksten i antall pensjonister og deres inntekter er om de legger beslag på en problematisk stor andel av den løpende produksjonen. Dette blir mye det samme problemet om forbruket sikres via private eller offentlige ordninger.

Hvis andelen som tegner privat forsikring vil bli liten, vil en overgang fra offentlige til private ordninger kunne ha betydelige fordelingsvirkninger. Hvis andelen som tegner privat forsikring er stor - kanskje nær 100 prosent -kan vi se på overgangen som et skifte fra utligningsprinsippet (pay as you go) til et

pensjonssystem basert på kapitaldekningssystemet. I Andreassen et al 1988 er både kapitaldekningssystemet og utligningssystemet beskrevet. Det er foretatt beregninger som viser hvordan fondets størrelse, premieinnbetalinger etc avhenger av demografiske forhold som levealder og befolkningsvekst (fruktbarhet). Beregningene er vist for stasjonære befolkninger, men det er også foretatt beregninger som viser hvordan varierende kohortstørrelse påvirker pensjonssystemene.

I kapitaldekningssystemet skal fondet for den enkelt kohort ved pensjonsalder være så stort at det dekker forventede utbetalinger. Hvis vi ser bort fra rente vil fondet da være forventet gjenstående leveår multiplisert med årlig pensjonsbeløp. Rente gjør nødvendig fondsstørrelse mindre. For hele samfunnet vil samlet fond framkomme som sum over alle kohorter og dermed avhenge av kohortstørrelsene dvs aldersfordelingen. Ved skifte av demografisk regime f.eks. fall i befolkningsvekst (fruktbarhetsfall), vil nødvendig fondsstørrelse avta. Dette vil bety endringer i samlet sparing. Sett i forhold til pensjonssystemet skjer slike endringer automatisk men for resten av økonomien kan endringen i sparing være utilsiktet og uønsket.

Noen er bekymret for at folketrygden ikke har fond. For en nasjonal ordning vil det viktigste være om sparingen og kapitalveksten har vært optimal. Hvis en offentlig ordning påvirker privat sparing må bortfallet av privat sparing kompenseres med offentlig sparing. Videre er det viktig om incentivstrukturen utformes slik at økonomien funksjonerer slik at ressursene utnyttes optimalt. Slik sett kan spørsmålet om et formelt fond har mer karakter av en bokholderimessig diskusjon.

Selv om innføringen av folketrygden i 1967 bygde videre på eksisterende ordninger kom det noen viktige nye elementer inn. Særlig er det verdt å merke seg at utbetalingene ble koblet mot tidligere inntekt. Dette kan fortolkes som at utbetalinger er koblet til tidligere premieinnbetalinger gjennom trygdepremier/skatter. Utbetalingene består av faste minstebeløp og variable tilleggspensjoner som avhenger av tidligere inntekt.

Det ble også etablert et folketrygdfond som fikk årlige innbetalinger helt fram til 1976. Innbetalingene til fondet var noe forenklet basert på at premieinntektene var større enn årlige utbetalinger. Fondet eksisterer fortsatt, men uten at det skjer nye innbetalinger. Selv medregnet folketrygdfondet, er det riktig å si at den norske folketrygden hele tiden har vært basert på en finansiering gjennom at løpende utbetalinger i prinsippet skal dekkes gjennom løpende innbetalinger (utligningsprinsippet eller pay as you go).

Det har hele tiden vært etablert egne avgifter - skattesatser - som er knyttet til finansieringen av folketrygden. Avgiftene innbetales som en del av skatteinnbetalingen. Avgiftene betales både av arbeidsgiverne og av inntektstakerne. Arbeidsgiverne betaler gjennom arbeidsgiveravgift en skatt på bruk av

arbeidskraft. Avgiften beregnes av oppgavepliktig lønn etc. Den er regionalt differensiert og er i gjennomsnitt på 15,2 prosent (1991).

Tidligere (fram til og med 1988) var medlemspremiene delt på en pensjonsdel og en sykedel (denne avløste den tidligere syke- og arbeidsløshetstrygden). Pensjonsdelen ble beregnet av pensjonsgivende inntekt som for lønnstakere er tilnærmet lik lønnsinntekt før eventuelle fradrag for gjeldsrenter etc. Sykedelen ble beregnet av nettoinntekten det vil si etter fradrag for bl.a. gjeldsrenter. Fra og med 1989 ble pensjonsdelen og helsedelen samordnet og erstattet av en såkalt samordnet trygdeavgift som utskrives med tre satser (lav for pensjonsinntekten, mellom for lønnsinntekt, høy sats for næringsinntekt). Disse skattesatsene inngår som en integrert del av skattesystemet og det kan derfor ha liten mening å isolert studere fordelingsprofilen av disse skattesatser. At inntektene fra disse øremerkede skattene er mindre enn løpende utgifter i trygden betyr at dette må dekkes opp av andre skatter. Dette har på mange måter liten prinsipiell interesse, selv om denne overføringen fra andre skattearter (offentlige inntekter) til folketrygden kalles folketrygdens underskudd.

Folketrygdens regler

Reglene for langtidsytelsene står sentralt i folketrygden. Formålet med disse er å sikre en forsvarlig minsteinntekt samtidig som pensjonistene også skal ha en tilleggspensjon som skal avhenge av tidligere inntekt og dermed av hvor mye den enkelte har betalt inn til folketrygden i form av premier. Målet da folketrygden ble innført var at den fulle ytelse (grunnpensjon + tilleggspensjon) til en person med ordinær arbeidsinntekt skal svare til ca 2/3 av gjennomsnittlig arbeidsinntekt i de beste 15 år (ved endelig vedtak utvidet til beste 20 år).

Pensjonsalderen var opprinnelig 70 år og er i dag 67 år, selv om aldersgrensen i arbeidslivet fortsatt er 70 år. De siste årene er det på siden av folketrygden gjennomført en avtalefestet mulighet for pensjonsalder for deler av arbeidsmarkedet på 65 år.

En sentral størrelse i folketrygden er det såkalte grunnbeløpet - G. Dette har flere funksjoner i folketrygden. For det første ble grunnpensjonen for enslig i prinsippet satt lik grunnbeløpet. For gifte er grunnpensjonen samlet lik 1,5G.

Når tilleggspensjonen skal beregnes bygger en på de såkalte pensjonspoeng. Disse beregnes årlig i den yrkesaktive periode. Disse tar utgangspunkt i pensjonsgivende inntekt, som for lønnstakere vil være brutto lønnsinntekt før ulike fradrag i inntekten (gjeldsrenter etc).

Det årlige pensjonspoeng P framkommer i prinsippet som (W-G)/G. Her står W for den pensjonsgivende inntekt.

Minsteinntekten for å få pensjonspoeng er satt lik G. For høye inntekter er det både en avtrapping og en øvre grense. Den øvre

grense er satt lik 12G. Tidligere begynte avtrapningen ved inntekter på 8G, men er som et ledd i tiltakene for å dempe utgiftsveksten fra 1992 satt ned til 6G. Dette gjelder bare for pensjonspoeng som opptjenes etter dette år. I inntektsområdet fra avtrapningen begynner til 12G, får en bare 1/3 pensjonspoeng. Det at pensjonspoengene ikke er proporsjonale men degressive i forhold til inntekten, bidrar til folketrygdens fordelingsprofil.

For å få full tilleggspensjon er det nødvendig med 40 opptjeningsår (år hvor pensjonsgivende inntekt er større enn G). Hvis vedkommende har færre opptjeningsår reduseres tilleggspensjonen proporsjonalt med antall opptjeningsår. Sluttpoengtallet S som inngår i beregningsformelen framkommer som gjennomsnittet av de 20 beste opptjeningsårene. Opprinnelig var det foreslått at det skulle beregnes som gjennomsnittet av de 15 beste årene. Det har nå vært vurdert som ett av tiltakene for å dempe utgiftsveksten å regne S som gjennomsnittet av de 30 beste år. Dette er imidlertid ikke vedtatt.

En pensjonsordning som den norske folketrygden vil være avhengig av overgangsregler i en lang periode etter oppstartingen. Uansett overgangsregler vil pensjonssystemer bruke mange år før reglene får full gjennomslagskraft. I Norge viser beregninger (Andreassen et al 1988) at utgiftsveksten til alderspensjonen i årene framover ikke følger antallet pensjonister, men domineres av en vekst i gjennomsnittlig ytelse pr pensjonist. Slik sett er det ikke eldrebølgen som dominerer utgiftsendringene i årene framover men fortsatt opptrapping av den gjennomsnittlige pensjonsytelse.

Utbetalingene hittil har vært sterkt influert av de overgangsregler som ble innført i 1967 for å sikre dem med få opptjeningsår. Overgangsreglene sikret de som var 50 år i 1967 full pensjon med 20 opptjeningsår. For de som var mellom 30 og 50 år har det vært et krav for full pensjon, at en har pensjonsopptjening i alle år fra 1967. Overgangsreglene gjelder ikke for inntekter over 5G.

Reglene fra 1967 til 1992 var slik at tilleggspensjonen for en med full opptjening var:

$$0{,}45 \times G \times S$$

Fra 1992 ble faktoren som bestemmer tilleggspensjonens nivå i forhold til tidligere inntektsnivå redusert fra 0,45 til 0,42. Dette er også ett av tiltakene som skal dempe utgiftsveksten.

Særtillegget som ble innført i 1969 har hatt som formål å øke pensjonen for dem som har ingen eller liten tilleggspensjon. Særtillegget er bestemt som en prosentsats av grunnbeløpet G. Satsen har blitt hevet flere ganger fra 7,5 prosent i 1969, og er fra mai 1991 på 60,5 prosent for enslige (andre satser gjelder for ektepar). En har altså økt inntektene til minstepensjonistene klart sterkere enn opprinnelig forutsatt gjennom å innføre og øke særtillegget. Siden G har flere funksjoner ville en opptrapping av pensjonene og grunnpensjonen gjennom økt G fått flere effekter. En økning av minstepensjonene gjennom å øke G vil være

ufordelaktig sammenlignet med å øke minstepensjonene gjennom særtillegget.

I prinsippet er for folketrygden sagt at trygdene skal følge den alminnelige inntektsvekst gjennom årlig regulering av grunnbeløpet. Dette skjer imidlertid ikke gjennom en automatisk indeksregulering, men gjennom at Stortinget ved årlige vedtak fastlegger G. Erfaringene har vist at G-reguleringene har ligget noe etter den gjennomsnittlige vekst i pensjonsgivende inntekt. Det er verdt å være oppmerksom på at dette betyr lavere vekst i de årlige pensjonsutbetalingene, men sterkere vekst i opptjeningen av pensjonspoeng.

Uførepensjonen er bygd opp på samme måte som alderspensjonen. Det ytes således grunnpensjon, tilleggspensjon, særtillegg sammen med andre ekstraytelser som i alderspensjonen. Med visse modifikasjoner vil sluttpoengtallet for en som blir uføretrygdet ved alder x beregnes som det sluttpoengtall vedkommende ville fått ved alder 67 år hvis vedkommende hadde fortsatt med uendret inntekt fram til alderspensjonsalder. Sluttpoengtallet for uføre blir altså en blanding av faktisk opptjente pensjonspoeng (fram til uføretidspunktet) og imputerte pensjonspoeng basert på det siste årets pensjonspoeng. For de som er født uføre er det fra 1981 innført et garantert sluttpoengtall på 2. For å få uføretrygd må arbeidsevnen være varig nedsatt til 50 prosent, og pensjonen samsvarer med uføregraden.

Andelen av befolkningen som får uføretrygd har økt sterkt og gitt grunn til bekymring. Retningslinjene som definerer de mulige medisinske diagnoser har blitt noe utvidet og praksis synes også å ha blitt endret i liberal retning. Ulike framskrivinger viser en betydelig vekst i antallet uføretrygdede. Også uførhet er nært knyttet til alder og det finnes egne regler for eldre arbeidstakere. Dette betyr at andelen som er uføre avhenger markert av aldersfordelingen i befolkningen. Det kan ha interesse å sammenligne dette for flere land.

Tabell 2: Uføretrygdede i prosent av befolkningen 1987.

	Norge	Danmark	Sverige
16-19	0,3	0.1	0,7
20-29	0,9	0,9	0,9
30-39	2,5	2,5	2,1
40-49	5,6	5,0	4,2
50-59	15,8	14,1	12,6
60-64	29,9	26,9	31,1
ialt	6.5	6,0	6,3
65-66	37,5	33,9	

Kilde: NOU 1990:17 s 32-33.

Vi ser at uføreandelen øker sterkt med alder og selv om det er noen forskjeller er det klare felles trekk i mønsteret landene i mellom.

Det har som nevnt i Norge skjedd en betydelig økning i tallet på uføre som kan tilskrives:
1. Økt tilgang til uførhet i alle aldersgrupper, men særlig sterk i de yngre aldersgrupper
2. Redusert dødelighet blant uførepensjonistene

Både den økte tilgangen og den reduserte dødelighet blant uføre kan henge sammen med endringer i hvilke medisinske diagnoser som ligger til grunn for uførpensjonen. Liberal praksis og sterk økning i andelen med diagnosen "andre tilstander og symptomatiske og ubestemte lidelser" kan dermed forklare at overdødeligheten blant uføre avtar.

Framskriving av antall pensjonister.

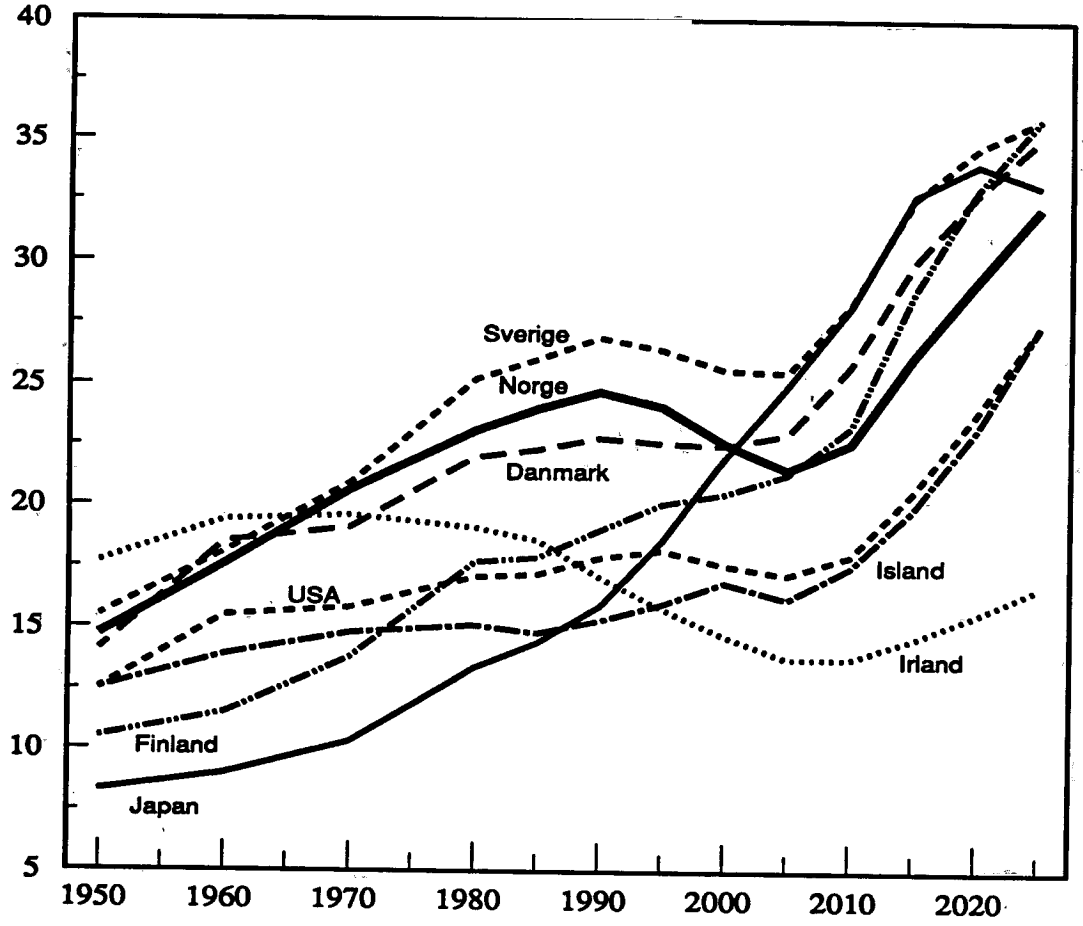
Bestandsmodeller for de fleste typer av pensjonister kan utvikles som ettermodeller til demografiske framskrivinger. Dette gjelder særlig alderspensjonister og andre pensjoner hvor kjennetegnet som betinger pensjon er demografisk betinget. Arbeidsløshetsprognoser vil vi imidlertid måtte ha en annen modellmessig forankring.

Norge - som mange andre land - vil i årene framover forvente en betydelig økning i antall eldre i forhold til personer i yrkesaktiv alder. Det er imidlertid viktig å minne om at befolkningsutviklingen i Norge i årene framover er sterkt dominert av bølger og liten tilgang til alderspensjonistgruppene i de nærmeste år. Når en skal se på problemer som oppstår med at det blir få yrkesaktive til å "forsørge" de som ikke er yrkesaktive er det selvfølgelig også et poeng å ta hensyn til at det kan bli færre barn å forsørge.

Som nevnt er den økte andelen eldre og bekymringen for de nasjonale alderspensjonssystemer et felles trekk ved industrilandene. Den viktigste forklaring til endringene ligger i variasjonene i fødselstallet og nedgangen i fruktbarhet. I etterkrigstiden hadde Norge et relativt høyt fruktbarhetsnivå lenge, men når fallet kom var det raskt og markert til et nivå under reproduksjonsnivået.

I de nærmeste årene vil tilgangen på alderspensjonister komme fra fødselskullene i 1930 årene, en periode da det norske fruktbarhetsnivået var meget lavt. Dette betyr at noe av det som særmerker Norge i forhold til andre land er at bølgebevegelsene i tallet på eldre i årene framover vil bli meget sterke.

Andelen av eldre i befolkningen i forhold til aldersgruppen 15-64 år. Utvikling 1950-2025. Prosent 1)



1) Relativt forhold mellom gruppa 65 år og eldre og gruppa fra 15 t.o.m. 64 år.

Tabell 3: Framskriving av antallet pensjonister. 1990 - 2025. Utarbeidet 1991

	1990	2000	2010	2025
Alderspensjonister	613	606	581	771
Uførepensjonister	234	310	396	410
Etterlattepensjonister	52	56	64	67
Sum	899	972	1041	1248
Arbeidsstyrke	2142	2319	2440	2449
Pensj i % av arb.styrk	42	42	43	51
Uføre i % av arb.styrke	11	13	16	17

Kilde: Revidert nasjonalbudsjett 1991. St. meld 12 1988-89 side 88.

I Norge har det i ulike sammenhenger blitt lagt fram framskrivinger av tallet på de som mottar langtidsytelser. Framskrivingene av antall alderspensjonister er for praktiske formål en ren demografisk framskriving. Problemene blir langt større ved uførepensjoner og etterlattepensjoner. Vi i SSB har tidligere utarbeidet framskrivinger over tallet på gamle og arbeidsstyrken, men først nå satt i gang arbeid med uføreframskrivinger.

Jeg har samlet og gjengitt noen ulike beregninger hentet fra offentlige dokumenter i Norge som kan belyse utviklingen og noen metodepoenger.

Som vi ser vil tallet på pensjonister innen disse tre gruppene øke fra omkring 900 000 til over 1,2 millioner. Også relativt sett innebærer dette en betydelig økt andel pensjonister. Gruppen uføretrygdede øker særlig sterkt. Det er imidlertid stor usikkerhet i utviklingen framover i antall uførepensjonister, ikke minst fordi det har vært en markert økning de siste årene. I framskrivingene foran er det forutsatt konstante tilgangsprosenter av uføre i hver aldersgruppe (observert 1989). Befolkningsframskrivingen fra SSB som dette bygger på er hentet fra 1990 framskrivingen (Alternativ KM1, dvs SFT=1,89 og konstant nettoinnvandring på 5000 personer).

Det er som nevnt presentert flere framskrivinger i de siste årene og det kan ha interesse å sammenligne disse. Framskrivingene som ble presentert i Nasjonalbudsjettet 1989 (St.meld nr.1 1988-89) bygger på konstant fruktbarhet, netto innvandringsoverskudd på 4000 personer. Denne framskrivingen er metodemessig noe annerledes ved at den bygger på beregninger av andelen uføre innenfor hver aldersgruppe. Disse andeler er antatt å øke fram til år 1995 og deretter holdt konstant. Sammenlignet med tabell 3 viser denne beregningen noe høyere tall for alderspensjonister men lavere tall for uførhet.

Tabell 4: Anslått utvikling i antall alders og uførepensjonister 1000 personer. Utarbeidet 1988.

	1987	1990	2000	2007	2020
Alder	589	615	616	591	726
Uføre	206	235	288	333	357
Sum	795	850	903	924	1083

Kilde Nasjonalbudsjett 1989 St.meld nr 1 (1988-89) tabell 8.3

I en offentlig utredning om uførepensjon (NOU 1990:17 Uførepensjon) er det presentert mange alternative beregninger av uførepensjonister fram til år 2020. Beregningene bygger på ulike alternativer som dels skiller i metode og dels skiller mellom forutsetninger om konstante tilgangsprosenter til uførhet, økende eller avtakende tilgangsprosenter. Betydningen av om en bygger modellen på uføreandeler i aldersgrupper eller tilgangsprosenter i aldersgrupper kan vi få belyst ved å sammenligne alternativ 0

og alternativ 1 i denne framskriving. Alternativet (alt 1) som bygger på konstante tilgangsprosenter gir et betydelig høyere tall på uføre enn når en framskriver basert på konstante uføreandeler i de ulike aldersgrupper.

I utredningen om uførepensjon (NOU 1990:17) er det som nevnt laget mange alternativer og i år 2020 varierer tallet på uføre fra omkring 200 000 personer til 800 000 personer avhengig av forutsetningene. Den viktigste usikkerheten er åpenbart ikke knyttet til de demografiske variable, men til utviklingen i tilgang av uføre og levealder blant uføre.

I disse analysene er tilgangsprosentene avhengige av alder og kjønn. Bestanden vil i tillegg avhenge av avgangen som i all vesentlighet avhenger av dødeligheten blant de uføre. Siden vi regner med at forventet gjenstående levealder er lavere for populasjonen av uføre enn ellers, vil framskrivingen av bestanden også avhenge hvordan vi har estimert dødelighetsrater betinget av uførhet og hvilke forutsetninger vi gjør om disse ratene. Det er pekt på at en av årsakene til den økte bestand av uføre ligger i økt gjenstående levealder for uføre.

Det ble også lagt fram beregninger av framtidig pensjonistbestand i en offentlig utredning om trygdefinansiering i 1984 (NOU 1984:10). For uførhet og alderspensjonister viste denne framskrivingen følgende bilde. Den faktiske utviklingen fram til 1990 viser et høyere tall på uføre enn denne framskrivingen.

Tabell 5: Alders og uførepensjonister 1983-2040. Framskriving utarbeidet 1984.

	1983	1990	2000	2020	2040
Alderspensj	542	618	608	702	835
Uførepensj	173	190	200	251	223

Kilde: NOU 1984:10, Trygdefinansiering.

Det er arbeidet noe med å forbedre stønadsmodellen inkludert modell for pensjonsutbetalinger i den makroøkonomiske planleggingsmodellen MODAG jf Bowitz (1992). Som en del av dette modellarbeidet er det gjort økonomiske analyser av sammenhengen mellom tilgangen til uførhet og bl.a. arbeidsløshet. Dette kan bygges inn i framskrivinger hvor en kan gjøre tilgangen til uførhet betinget av økonomisk utvikling deriblant arbeidsløshet.

Noen problemstillinger omkring framskrivinger av folketrygdens utgifter

Selv om det i et stabilt pensjonssystem basert på utligningsprinsippet vil være en sammenheng mellom forholdstallet mellom de yrkesaktive og antall pensjonister og det inntektsnivå en ønsker å sikre pensjonistene, vil ikke utgiftsveksten strengt følge antallet pensjonister. Det skjer over tid endringer i det

gjennomsnittlige pensjonsnivå. Dette er beskrevet i Andreassen et al 1988.

For å lage modeller for utgifter og inntekter må modellene utvides i mange retninger. Når en skal beregne de framtidige utgifter til alderstrygd viser erfaringer at en i mange år framover er nødt til å ta hensyn til de ulike overgangsregler. Dette gir relativt kompliserte regelmoduler i beregningsapparatet. Utviklingen av utgiftene eller de trygdedes pensjonsinntekter vil også avhenge av framtidige pensjonspoeng (inntektsutvikling) og fordelingen av disse, herunder andelen som har full opptjeningstid. Tidligere hadde SSB en modell MAFO til slike framskrivinger for alderspensjonen. Modellen bygde på data fra Rikstrygdeverket for fordelinger av pensjonsgivende inntekter for ulike år for de ulike fødselskohorter. Modellen hadde imidlertid en svak rutine for framskriving av inntektsfordeling. Den ble ikke brukt til framskrivinger lenger fram enn til omkring år 2000. Når en var avhengig av lengre framskrivinger, kjedet en sammen beregningene med RTV beregninger (Se Andreassen et al 1988). Modellen MAFO er ikke lenger oppdatert. (En lignende modell for alderspensjon lar seg utvikle som en regnearkrutine basert på data for pensjonspoengfordelinger og en regelmodul. Et slikt arbeid er i gang i SSB, jf Holtsmark (1992).)

I ulike offentlige meldinger og utredninger om trygder (vist til foran) er det også lagt fram beregninger over utgiftsutviklingen. Slike beregninger er kompliserte og må bygge på en lang rekke forutsetninger. Det er imidlertid en svakhet at vi hittil ikke har hatt et heldekkende, dokumentert og gjennomprøvd modellsystem som ivaretar både bestands- og utgiftsanslag. Ideelt sett trenger vi for slike modeller opplysninger om:
-sluttpoengtallet, basert på eksisterende regler.(for simulering av regel endringer vil en ha interesse ikke bare av de tyve beste årene men fordeling av inntekt over livsløpet)
-antall opptjeningsår
-trygderegler
-familiestatus
-uføregrad etc

Ved siden av å beregne brutto pensjonsutgifter er det viktig å ta hensyn til at pensjonistene betaler skatt slik at en kan beregne nettoutgiftene for det offentlige. Folketrygden kan betraktes som et omfordelingssystem og det er klart at fordelingsvirkningene også er viktige.

I Revidert nasjonalbudsjett 1991 er det stilt opp følgende tall for utviklingen i en sentral størrelse nemlig gjennomsnittlig bruttopensjon. Sammen med bestandsprognoser kan en da lett regne ut bruttoutgifter til pensjon.

Tabell 6: Gjennomsnittlig bruttopensjon 1990 kroner

	1990	2000	2010	2025
Alderspensj	61 670	71 372	81 466	92 978
Uførepensj	69 755	77 078	83 125	86 910
Etterlattepensj	38 958	37 143	39 565	40 080
Gj snitt	62 389	71 296	79 444	88 141

Kilde: Revidert nasjonalbudsjett 1991, St meld nr 2 1990-91

Disse beregninger er basert på en forutsetning om konstant grunnbeløp G. Det er også laget beregninger som bygger på makroøkonomiske beregninger over vekst i inntekt for yrkesaktive Bygd på slike beregninger har en så laget framskrivinger av utgiftene når G reguleres i samsvar med denne vekst. Det er deretter beregnet skatteinntekter fra de utbetalte pensjoner og et netto finansieringsbehov. Sammen med antagelsen om veksten i inntekten til de yrkesaktive, gir dette grunnlag for beregninger av den nødvendige økning i trygdeavgiftene. Denne veksten i belastningen på de yrkesaktive er regnet som bekymringsfull og det er derfor satt i gang tiltak som skal dempe skatteøkningen ved å dempe utgiftsveksten.

En kort oversikt og presentasjon av MOSART-T.

I SSB har vi arbeidet med framskrivinger av utdanning og arbeidsstyrke i mange år. Disse beregningene har tidligere blitt stilt samme med trygdeberegninger for å si noe om belastningene på den yrkesaktive befolkning av utviklingen i antall alderspensjonister og veksten i alderspensjoner, jf Andreassen et al 1988. For en oversikt over modellutviklingen i SSB vises til Ljones 1992.

I de siste årene er dette modellarbeidet konsentrert om videreutviklingen av en mikrosimuleringsmodell MOSART.
Dette vil gi oss en framskriving for en reel modellbefolkning av:
-demografiske variable, familiedannelse
-utdannigsaktiviteter og utdanningskapital
-yrkesdeltaking og arbeidstid
-inntekt
-trygdestatus, uføretrygd og alderstrygd.

Framskrivingen baserer seg på at vi for hvert år simulerer de begivenheter som inntreffer for individene som er med i modellbefolkningen.

Opplegget i grunnversjonen er beskrevet i Andreassen og Fredriksen 1991, hvor et strømdiagram beskriver hovedtanken i modellen.

Vi arbeider nå med å utvide MOSART til også å la modellen omfatte trygdestatus og inntekt. Mens overgangen til alderspensjon er betinget av oppnådd pensjonsalder vil overgangen til uføretrygd

være langt mer usikker. I en foreløpig analyse (Fredriksen 1992) er det vist en del resultater for hvordan overgangen til uførhet avhenger av variable som alder, kjønn, utdanning og stabilitet i yrkeskarrieren etc.

Modellen sikter mot å gi oss et verktøy som gjør at vi kan lage konsistente framskrivinger av arbeidsstyrke, elevtall, befolkningen etter utdanning, uførhet og alderspensjonister. Ved siden av bestandsprognoser over trygdede framskriver vi for hvert år pensjonsgivende inntekt noe som innebærer at inntektshistoriene sammen med en regelmodul kan brukes til å simulere pensjonsinntekter (dvs bruttoutbetalinger til pensjonene fra det offentlige). Vi er for tiden inne i en første avsluttende fase med testkjøringer av både bestand- og pensjonsprognoser. Resultatene så langt virker lovende.

Vi har funnet at tilgangsprosenten til uførhet avhenger både av alder og utdanning (jf Fredriksen 1992) slik at de med høy utdanning vil ha lav sannsynlighet for overgang til uførhet. Som en del av framskrivingen bygd på observerte utdanningsoverganger får vi en betydelig økt andel som har høy utdanning. Dette vil i denne modellen bidra til en viss demping i tilveksten til uførhet.

Kommer den demografiske utvikling som en overraskelse ?

Dette spørsmål er også behandlet av Hatland (1991). Han omtaler framskrivingene som er gjengitt i Ot prp 17 (1965-66) tabell 11. I denne framskrivingen er det forutsatt at dødelighet er som i årene 1956-60. Årlig antall fødsler pr 1000 kvinner 15-44 år er forutsatt å synke fra 90 (1966-70) til 80 (1991-95 og seinere). Det er ikke regnet med inn og utvandring.

Tabell 7: Befolkningsframskriving fra 1966 sammenlignet med faktisk utvikling. 1000 personer

Aldersgruppe	Progn 1966	Faktisk utv	Avvik
0-19 år	1 366	1 120	-246
20-69 år	2 560	2 638	+78
70 år +	439	475	+36
I alt	4 365	4 233	-132

Kilde: Hatland 1991

I pensjonsutredningen av 1962 er det gjengitt en annen framskriving (tabell 22 Innstilling fra pensjonsalderkomiteen av 1962, Gjengitt i St.meld nr 75 (1963-64).

I denne er det forutsatt et konstant fødselstall satt til 63 000 barn pr år fra og med 1961. Det er videre forutsatt samme dødelighet som i 1951-55, og ingen inn eller utvandring.

Disse to framskrivingene viser en noe forskjellig utvikling. I den første framskrivingen som fra et metodemessig synspunkt er klart primitiv, får en et lavere antall unge enn i den andre framskrivingen hvor det er forutsatt en viss nedgang i den alminnelige fruktbarhetsrate. Den primitive framskriving har dermed truffet bedre enn den andre framskriving som var metodemessige bedre.

Uansett svake metoder i befolkningsframskrivingene kan en si at det i begge dokumentene som lå til grunn for vedtaket om opprettelse av folketrygden er ofret plass på omtale av den forventede økningen i andelen eldre i forhold til yrkesbefolkningen. En har imidlertid bommet på mange forhold når det gjelder demografi; fruktbarheten har blitt lavere, levealderen noe høyere men til gjengjeld har en fått et helt annet innvandringsbilde. Et annet område som en har bommet på er utviklingen i yrkesdeltaking.

Uten å ha regnet på det vil jeg tro at de alvorligste avvik fra folketrygdens opprinnelige forutsetninger ikke ligger i demografisk utvikling. Effektene av lavere tilvekst til arbeidsstyrken er heller ikke bare negative jf f.eks. Holtsmark og Aamdal (1992). Lav tilgang til arbeidsstyrken bidrar isolert sett til redusert behov for investeringer noe som frigjør ressurser som kan brukes til konsum.

Mange avvik fra de opprinnelige forutsetninger for folketrygden kan skyldes økt tilstrømming til enkelte grupper trygdemottakere av andre grunner enn demografiske (jf uførhet). Det har også skjedd en opptrapping av minsteytelsene med store konsekvenser.

Oppsummering.

Vi har i Norge som i andre land vedtatt velferdsordninger i form av pensjonssystemer. Dette er nasjonale pensjonssystemer som uansett finansieringsform dreier seg om hvordan fordele årets verdiskapning mellom ulike befolkningsgrupper og mer presist hvor stor andel av denne som kan disponeres av de yrkespassive.

Ordningene kan sies å sikre mot inntektsbortfall som enten kan være ventet eller uventet. Et av problemene med slike ordninger er at andelen av befolkningen som faller inn under ordningene øker sterkt. Dette kan skyldes strukturelle utviklingstrekk f.eks helse, arbeidsløshet, eller det kan skyldes at incentivstrukturen er slik at tilstrømmingen til ordningen øker, eller det kan skyldes demografiske årsaker. Denne demografiske sammenheng er lett å se i forhold til alderspensjon - som jo også er den viktigste del av pensjonssystemet.

Mulighetene til å opprettholde en sosial kontrakt som sier at inntekten til en generasjon pensjonister skal finansieres av de yrkesaktives inntekter mot at de når de selv blir pensjonister skal få sin inntekt opprettholdt etter de samme prinsipper, avhenger av aldersfordelingen. Hvis den påfølgende generasjon er større enn den foregående er det lett å se at byrden ved

alderspensjonen er mindre for de yrkesaktive enn når generasjonene avtar i størrelse.

Denne type betraktninger har fått Keyfitz og andre til å peke på at folketrygden etter utligningsprinsippet er som et kjedebrev og han har advart sterkt mot å bygge pensjonssystemet på utligningsprinsippet fordi det da ikke vil tåle en overgang til et demografisk regime med befolkningsnedgang. Det er imidlertid ikke slik at de grunnleggende fordelingsproblemer om fordeling av forbruk mellom yrkesaktive og yrkespassive blir betydelig forandret ved å bygge en nasjonal folketrygd på kapitaldekningssystemet. Betyr så dette at når alderssammensetningen endres så må vi avfinne oss med at de eldres lovede inntekter må reduseres. Begrunnelsen for dette behøver ikke være en ren fordelingsdiskusjon, men kan også henge sammen med effektivitetstapet for samfunnet ved de høye pensjonsavgiftene som må pålegges de yrkesaktive.

En side ved en folketrygd etter utligningsprinsippet og varierende generasjonsstørrelse som i aller høyeste grad berører Norge er at belastningen noe forenklet sagt blir større på små generasjoner enn på store. Et rettferdsprinsipp kan være at alle skal få det samme ut av ordningen, men med varierende kohortstørrelse vil altså innbetalingene pr lønnstakere kunne være større for små enn store generasjoner. Slik sett vil altså det en får igjen av den sosiale kontrakten avhenge av generasjonsstørrelsen. For å utjevne denne type variasjoner kan en etablere et fond. Dette var tanken bak det norske folketrygdfondet.

Når det nå er bekymring for folketrygden, faller det sammen med bekymring for hele økonomien, noe tilveksten til arbeidsløshet er ett av flere uttrykk for. Det store samfunnstapet som ligger i de mange som faller utenfor yrkeslivet er et betydelig problem.

Et spørsmål er om høy økonomisk vekst letter overføringene gjennom folketrygden når befolkningsveksten forsvinner ? I Andreassen et al (1988) er en av konklusjonene at hvis grunnbeløpet skal følge den alminnelige inntektsvekst vil økonomisk vekst ikke bidra til å lette problemene ved økt andel eldre og en økt avgiftssats på de yrkesaktives inntekt. Hvis derimot grunnbeløpet følger prisveksten vil sterk reallønnsvekst bidra til å dempe behovet for avgiftsøkning.

Denne type konklusjon rimer ikke helt med utsagn i offentlige dokumenter om folketrygden. I Revidert nasjonalbudsjett 1991 (st meld 2 1990-91) sies det (kap 8):

> *Utsiktene for den økonomiske veksten er sentral når en vurderer folketrygdens framtid. Høy vekst vil lette overføringene gjennom folketrygden fordi de yrkesaktive da kan ha rimelig vekst i sin realdisponible inntekt selv om overføringene til de yrkespassive øker som andel av nasjonalinntekten.*

Nå sier imidlertid det samme dokument et annet sted (s 152)

> *Finansieringsbehovet sett i forhold til pensjonsgivende inntekt for yrkesaktive og pensjoner til tilleggspensjonister vil være uavhengig av forutsetningen om den økonomiske veksten i sysselsettingen så lenge lønn og grunnbeløpet i folketrygden reguleres i takt.*

Problemet med en økt andel eldre og økte pensjons utbetalinger i forhold til de yrkesaktives inntekter kan teknisk løses ved økte skatter på de yrkesaktive. Dette kan vise seg politisk vanskelig å gjennomføre. (I betraktninger om dette bør vi kanskje trekke inn at årsaken til problemet ligger i at det er blitt økt andel i befolkningen som skal motta pensjon.) Et alvorligere problem er om effektivitetstapet ved de høye skattene blir så store at inntektene ikke kan opprettholdes.

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