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Fertility Trends in Denmark in the 1980s

A Register Based Socio-demographic Analysis of Fertility Trends

Lisbeth B. Knudsen

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Preface

This report presents the results of a socio-demographic analysis of Danish fertility trends in the 1980s. The analysis is based on information extracted from the Fertility Database in Danmarks Statistik.

The Fertility Database was established by Danmarks Statistik in 1991-1992 with a grant from the Danish Social Science Research Council. The database comprises information on all indviduals in the reproductive age groups in Denmark for the period 1980-1988. Access to the data is available on payment of a fee and provided certain conditions are met.

The study has been carried out by Lisbeth B. Knudsen. The establishment of the Database and the analysis itself have been followed by a stearing group with the following members: Professor Niels Keiding and Research Assistant Jørgen Holm Petersen from Statistical Research Unit, University of Copenhagen, Professor Poul Chr. Matthiessen, Statistical Institute, University of Copenhagen, Senior Researcher Ole Bertelsen, Danish National Insitute of Social Research, Sanne Ipsen, Ph.D. (sociology), University of Copenhagen, Anne Rancke-Madsen, MD., National Board of Health, Deputy director Niels Kr. Rasmussen, Ph.D. (sociology), Danish Institute for Clinical Epidemiology and from Danmarks Statistik: Director Lars Thygesen, Head of Division Otto Andersen, Head of Division Lene Skotte, Anita Lange, Head of Section and Hanne Spøhr, Head of Section.

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1. Introduction

This report presents the results from a socio-demographic analysis of Danish fertility trends in the 1980s. The analysis is based on information extracted from the Fertility Database established by Danmarks Statistik in 1990-1992. The Fertility Database has made it possible to conduct a more differentiated analysis of fertility trends than previously and to relate the trends to specific social characteristics of women as well as men.

The Fertility Database comprises information on all women and men, in the reproductive age groups, resident in Denmark in the 1980s, the number of children they have and an annual classification of their socio-demographic conditions.

Data for the Fertility Database have solely been retrieved from national population based registers. Use of the unique person number has made it possible to identify children, born by the women in the study population, their fathers and to retrieve information on each adult from various registers on social characteristics.

Demographic description

The demographic aspects of trends in fertility among women in Denmark are described thoroughly in the already existing annual statistics covering all children born in Denmark by women with a permanent address in Denmark.

The current population statistics contain information on age of women giving birth, their parity (number of previous live births), residence and marital status. Thus, it has been possible to calculate fertility rates for age and marital status groups and regions. The statistics also contain calculations of cohort fertility and parity distribution among women by year of birth at a given age, based on these cross-sectional statistics (Vital Statistics, various years).

A number of special investigations have been published in addition to the annual statistics (Appendix I).

In this report data from the current statistics are used to describe demographic characteristics of the fertility development, which is described further by use of data in the Fertility Database, e.g., by the average number of children and proportion of childless women. After the demographic description (chapter 5), the following sections are based solely on the Fertility Database when social characteristics, such as education and socioeconomic position are considered.

What is known about trends in fertility?

The annual statistics reveal a declining fertility level in Denmark from the end of the 19th century to the mid-1930s, a higher level from the early 1940s to the mid-1960s after which fertility declinined to the beginning of the 1980s followed by a still ongoing increase.

Trends in fertility have differed from age group to age group. The first decline, which began before the turn of the century was seen among women over 25, while the decline from the middle of the 1960s affected all age groups, with the sharpest decline occurring among women under 25. This

decline has continued among the youngest women, while fertility rates for women over 25 have increased since the beginning of the 1980s.

The average age of women giving birth has increased, and for each generation (or birth cohort) there is a clear pattern that women give birth to their first child at an increasingly higher age.

Calculations of the average number of live births have shown that in spite of great fluctuations in the age-specific fertility rates and the fertility level in each calendar year, generation fertility, i.e., the total number of live births to each birth cohort of women, has not fluctuated to the same extent.

However, the experience of recent years shows that the 1930s generations of women will give birth to fewer children than previous generations.

A need for more knowledge

Although it has been possible to give a detailed demographic description of fertility trends, the underlying social mechanisms have been analyzed only to a limited extent.

The Fertility Database

The Fertility Database was established by Danmarks Statistik to facilitate socio-demographic analyses of fertility trends. As already mentioned, the Fertility Database comprises information on women, men, their children and on their social characteristics in addition to basic demographic information.

When combining calculated fertility measures and social characteristics, the Fertility Database increases the possibilities of a more differentiated analysis of the relation of fertility trends to women's social background. Furthermore, the Fertility Database makes it possible to analyse the fertility of men. So far, it has only been possible to describe a few characteristics of men, such as age, who were legally married to women giving birth. At the end of the 1980s, only half of the newborn infants were born by married women so that these data were valid only for a group of all fathers.

As the Fertility Database comprises all adults in Denmark in the reproductive age groups, there is now information on the age of fathers at the time of birth of the first child and the number of children they have.

Content of the report

Summary

Following this chapter, there is a brief summary in which the main results of the study are presented.

Data

In chapter 3, a description is given of the structure and data contents of the Fertility Database. This chapter summarizes the basic registers used and the construction of the study population, especially how the relationship between child and parent has been defined.

Evaluation

Furthermore, an evaluation is made of data quality, at the individual level, and comparisons with previously published fertility calculations are made.

Which fertility measures have been used?

In chapter 4, the various fertility measures (total fertility and average number of live births) used in the report are presented and explained. Some of the more common demographic concepts such as A and B groups are also introduced.

Known aspects of fertility trends

This is followed in chapter 5 by an account of the main outlines of fertility trends that could be elucidated before the setting up of the Fertility Database.

The starting-point is the decline in fertility which began before the turn of the century. Thereafter, trends in the 1980s, with a decline up to 1983 followed by an increase are discussed. The last part of the chapter, as well as most of the remaining report, is based on data from the Fertility Database.

Spacing

Chapter 6 deals with changes in the time-interval between each childbirth. Rates of parity progression are calculated and time intervals between births are presented. This longitudinal perspective is possible because the date of birth of all the children are included in the Fertility Database.

Family forms

Chapter 7 describes marital status distributions and family forms. Marital status has so far been one of the most important demographic variables. But, by the end of the 1980s approximately every second child in Denmark was born outside marriage, but almost all of them in a consensual union. These children are born, therefore, into a "family", although the mother is formally unmarried.

The chapter is primarily based on already published statistics. Main features of changes in the family structure in Denmark are also discussed.

Education

In chapter 8, the relationship between education and fertility is analyzed. First, previous knowledge about the significance of educational attainment is outlined. Thereafter, the chapter is based on the Fertility Database and focuses on the significance of general education, but also on subsequent vocational education.

Fertility is analyzed on the basis of the average age of women at the birth of their first and second child, average number of live births at a specific age and the parity distribution and changes in the proportion of childless among women aged 25, 30 and 35 years.

Socioeconomic status

In chapter 9, fertility among women according to socioeconomic status and industry is described.

Moreover, the question of labour market status is also elucidated. Concurrently with the chapter on education, previous knowledge is first outlined and then the fertility is described with the same measures.

Fertility of men

Chapter 10 discusses the main features of fertility of men, which, as mentioned above, have hardly been described before, as only very few data have been available. The chapter primarily discusses basic information, so that trends among men can be compared to those among women. The

significance of social conditions is also included, but is analysed to a smaller degree than is the case for women.

Appendices

A number of Appendices comprise more detailed presentations of some parts of the report.

Relevant references Appendix I includes a list of published investigations on fertility and specific topics dealt with in detail in the annual statistics on population (Vital Statistics).

Underlying figures Appendix II presents the underlying figures used in the graphs in the report.

Source registers The variables retrieved from the source registers are listed in Appendix III and the registers are described briefly.

Parity A detailed validation of the calculated parity in the Fertility Database is presented in Appendix IV. The main results of this validation are included in chapter 3.

Statistical measures Appendix V outlines some standard models in statistical demography. The models are used to point out a correspondance between various fertility measures, and furthermore, an example of a multivariate statistical analysis is presented.

Access to data Finally, Appendix VI outlines the formal possibilities for researchers outside Danmarks Statistik to use the Fertility Database for special analyses.

2. Summary

This report presents the first results of a socio-demographic analysis of fertility trends in Denmark in the 1980s. The analysis is based on data in the Fertility Database in Danmarks Statistik.

2.1. Creation of the Fertility Database

Data for the Fertility Database have solely been retrieved from population based registers with national coverage. By use of the unique Person Number it has been possible to link demographic information on the population (both women and men) with data from various other registers in Danmarks Statistik, characterizing a broad selection of social conditions.

Annual populations

The Study Population consists of all women and men in fertile ages in Denmark (irrespectively whether they have a child or are childless) and their children. Annual populations of women (12-49 years of age) and of men (12-64 years) have been extracted from the Register on Populations Statistics each 1 January 1980 - 1989. These populations comprise approximately 1,400,000 women and 1,800,000 men each year.

Children

All "children" who might be born by a woman in one of these populations were identified by year of birth (1942 onwards) and information extracted from the Register on Population Statistics. This information has been supplemented with data from the Medical Register on Vital Statistics.

The "child"'s record contain a reference to (i.e. Person Number of) mother and/or father. Only children with a reference to parent(s) present in one of the annual populations have been included in the Fertility Database. Each birth cohort of children includes 55.000 - 60.000 births.

References are present for almost 100% of the most recent generations of children. Due to registration procedures no reference is available among children who were 18 years or more at the establishing of Central Population Register in 1968. Also a major part of immigrated children (only children in this respect) has no reference to parent(s). For cohorts born since 1960 the references are considered complete.

Parity

For each woman and man in the populations, the number of identified liveborn children has been counted and a parity status, equalling the number of live births, ascribed to each adult. This parity is used widely throughout the report. Before conducting the analysis, the parity was compared with previous calculations based on annual cross-sectional data on births and to the stated number of live births in the Medical Register on Vital Statistics. These comparisons could only be performed for women as no information of men's children has been available until the establishing of the Fertility Database.

High concordance

More than 95% of all women had the same parity in the Fertility Database as in Medical Register on Vital Statistics. The calculation of parity is considered complete for all cohorts of women and men born since 1945, cf.

that more than 99% of the children born since 1960 have at least a reference to their mother. Also there is a high degree of agreement between the age-specific fertility rates calculated from the two different sources.

Socio-demographic characteristics

The socio-demographic characteristics have been retrieved from various registers describing educational status, occupation, socioeconomic position, income, income compensation benefits and housing conditions. A detailed list of the registers and variables used in the Study can be found in Attachment III. These socio-demographic variables are linked to the basic information on the annual populations by each 1 January through the study period. Some of the data are not available until 1981 which means that most of the socio-demographic characteristics concern the years 1981 to 1988.

2.2. Measures of fertility

Only live births

The various measures of fertility in this analysis are based on the number of live births identified through the register.

In this study calculations of age-specific fertility rates are based on the "same year - same age" principle. When parity-specific rates of fertility are calculated or social characteristics included, however, we use the principle of following a cohort for one whole year: "same year - same cohort".

Total fertility rate

The total fertility rate summarizes the age-specific fertility rates and is an estimation of the number of live births that 1,000 women would give birth to if none of the women died before the age of 50 and at each age they experienced the given year's age-specific fertility rates.

Average number of live births

To estimate the achieved fertility of women at a certain age or point in time, the average number of live births is used. This is calculated as a simple average of the number of children identified for each woman (and man) in the Fertility Database.

Generation fertility

Generation fertility expresses the average number of live births among women in each generation (or birth cohort) at the end of their reproductive period.

For each younger cohort, the average number of live births at any given age is lower than for the previous cohort.

Fertility among women aged 25, 30 and 35 years

Throughout the study, fertility is analysed for women aged 25, 30 and 35. The average number of live births is calculated at these ages through the 1980s. Another measure presented is the number of children born by women aged 25 as a proportion of all the children women have at age 35.

Men's fertility

In principle, fertility among men is described in a similar way. Since men are, on average, two years older than women, when they have their first, second etc. child, the number of live births are analysed at ages 27, 32 and 37 years

2.3. Main trends in fertility in Denmark

The main demographic trends in fertility in Denmark have been followed at a rather detailled level from the routinely collected and published statistics.

Annual number of live births

Since the mid-1960s, the annual number of live births decreased from approximately 75,000 to 51,000 live births in 1983. Since then the annual number of live births has increased to 64,000 in 1992.

Total fertility

This century, total fertility decreased steadily up until the mid-1930s followed by an increase up until the mid-1960s. The level peaked towards the end of the Second World War with a smaller peak in the mid-1960s. The strong decline up until the 1930s was especially seen among women aged over 25, and the older the women the larger was the relative decline in fertility rates. Families with a large number of children became less frequent.

The decline since the mid-1960s, however, was seen in all age groups, but this time the decrease was strongest among younger women. Fertility rates among women aged under 25 are still decreasing at the beginning of the 1990s. But fertility among women above 25 years reached a turning point in 1981 and has been steadily increasing since then.

This decline is attribuable to younger women who postpone their first birth.

On the basis of these two different fertility declines, it can be argued that Denmark is in the second demographic transition. In the first demographic transition the size of the families were diminished as a means to provide better conditions for the offspring. The second transition has been named "the individualistic phase", as the adults' interest is directed towards love and self-fullfilment, the personal relations between the man and woman and also between parent and child. This could be one of the reasons for the still higher age at first birth and the smaller number of children each woman has.

Average age at birth

From 1980 to 1992 the average age at first live birth has changed from below 25 to 27 years. The age-specific fertility rates have decreased for women below 25 years and increased for women above this age. Due to the later onset of childbearing women at a given age have fewer children. The change has been strongest for young women. Women at age 25 had on average 0.8 children each in 1980 and 0.6 in 1988. More than 60% of women aged 25 were still childless in 1988 compared to 45% in 1980.

Considering women at age 35 who have almost completed their fertility 10% were childless in 1980 and 15% in 1988. Only 19% had more than two children in 1988 compared to 26% in 1980.

Calculations of cohort fertility clearly indicate that the generations from the late 1940s will end the fertile period at a level below 2 children per woman.

The main trends in the 1980s are thus a decline in total fertility until 1983, increasing fertility for women over 25, increasing average age at first birth and a substantial postponement of the first birth. This result in a still lower

average number of children, a concentration of families with two children and a larger proportion of childless women.

2.4. Spacing and parity progression

Previous generations of women had a completed fertility level of an average of more than two children but the present generations of childbearing women will not reach this level. The proportion of women with at least one child at a given age has declined from generation to generation.

Age-specific first birth rates have decreased for young women and increased for women in their late twenties and above.

For women under 28, the proportion of women with one child (only) has decreased from 1980 to 1988 whereas is has increased for women aged over 28.

In 1987, age- and parity specific second-birth rates were higher for women under age 19 and women over 28 in 1980.

The proportion of women aged 22 at their first birth having their second child within five years decreased up until 1981, after which an increasing proportion has had their second child within three years.

2.5. Family forms

In the late 1980s, approximately 50% of all newborn infants in Denmark were born "out of wedlock". This illustrates the significant change in family structure in Denmark which began in the late 1960s with the increasing popularity of consensual unions, especially among the youngest couples. Based on interviews it has been estimated that in the mid-1980s approximately 75% of women and 85% of men aged 20-24 years were living in consensual unions.

The observed changes in family structure meant that adjustments of the routine statistics to include a man and a woman with a joint child and joint address in the concept of family were made.

Because of the changes in family forms, calculations of marital and extra marital fertility are not very informative in Denmark, but the rates do illustrate the changing patterns of family formation.

Fewer women at each age were married throughout the 1980s, and the proportion unmarried was higher the older the women. In 1988, 31% of 25 years old women were unmarried. In 1980, the corresponding figure was 21%.

The younger the women the larger the difference between the average number of live births among married and unmarried women. In 1988

married women aged 25 had - on average - four times as many children as unmarried women of the same age.

By the end of the 1980s, the most common family size was two or one child(ren). In the early 1970s, young married women had indicated in interviews that they would prefer to have two or three children. When considering women in the Fertility Database belonging to the same birth cohorts as these interviewed women, it is obvious that the "expected" two or three children-family has become a "realized" one or two child-family.

2.6. Women's educational status

Information on educational status is available for the period 1981 to 1988. Educational status as of 1 January 1981 refers in fact to status as of October 1980. The variables used characterize women's level of completed general as well as vocational education.

More than one third of women aged 35 in 1988 had completed 10 to 11 years of general education and twenty out of 100 women had an upper secondary examination.

Comparing women with the short (9th class) and the long (Upper Secondary Examination) general education, it is clear that the longer the general education, the higher the age of women at the birth of their first child. During the 1980s, this age increased from 26.3 to 27.2 years among women with Upper Secondary School Examination, but remained stable among the still decreasing proportion of women leaving school after 9th class. Beyond age of 27, the parity-one age-specific rates are higher for women with the longer education.

The average number of children also varies according to women's level of general education. The group of women with 9th class already has - on average - one child each at age 25 and almost two at age 35, whereas 25 years old women with Upper Secondary School Examination had 0.2 child on average and by age 35 they had approximately 1.5 children.

A larger proportion of women with long general education are childless at age 35 - in 1988 almost 25% compared to 10% among women with 9th class. The proportion of one-child mothers among women with at least one child has increased among women with the longer education.

If we now consider women's continued vocational education, the differences in fertility levels according to the level of general educational status still exist. Average age at birth increased through the 1980s both for women with short and for women with long further education. It should be mentioned here that typically these women will be in their late 20s by the time they have completed a long further education.

Age at first birth for women with commercial and especially with clerical education decreased steadily during the 1980s.

Regardless of vocational educational status the number of children born by 25 year and by age 35 has declined. By age 35, women with commercial education have the highest number of children - on average 1.84 children.

Considering various combinations of general and vocational education it is seen that at the age of 35 years women who left school after 9 years of general education have more children than women who completed upper secondary examination even if they continue with the same level of vocational education.

Among 35 years old women with long further education 32% were childless in 1988. Among women with commercial education less than 10% were childless.

2.7. Women's occupational status

Most women in fertile age in Denmark were gainfully employed during the 1980s. A large part of the earlier fertility decline could be related to the increasing level of vocational educational status which led to employment outside the home. The largest occupational group of 35 year old women in 1988 comprised salaried employees or unskilled workers. Less than 10% had a leading position and 10% were outside the labour market for various reasons.

The average age at birth of the first child was lowest among workers - 24 to 25 years in 1988 (apart from women still studying) and highest among women in superior positions which at least to a certain degree reflects the longer education or several years experience required to achieve a leading position.

For those aged 35, the highest average number of live births was seen among the small group of assisting spouses while pensioners and salaried employees in upper levels had the lowest number (1.27 and 1.31 respectively). Unskilled workers had a high number as well (1.97).

More than 25% of the 35 years old salaried employees in upper levels were childless in 1988 compared with 10% among unskilled workers. Among women with at least one child, two children were most common. In relative terms, twice as many unskilled workers as salaried employees in upper levels had three children.

Industry-specific differences in fertility are not as significant as the socioeconomic specific differencies. Women working in the bank or service sectors had the highest average age at birth of first child (26.8), while the lowest age was seen among women in the retail trade sector or farming.

The lowest average number of live birth was seen among women working in banking or in transportation and the highest number among women in farming.

As far as women with at least one child were concerned, almost 10% in farming had more than 3 children while the majority in banking had approximately 2 children (60%) with only 10% having more than 2 children.

2.8. Men's fertility levels

While female fertility trends have been analysed extensively there has been no research in Denmark with regard to the fertility levels of men. The Fertility Database, however, makes it possible to conduct such analyses. This report describes a few aspects of men's fertility levels in the 1980s.

Studies have shown an increasing participation of men in everyday activities at home and regarding the care of children. Since 1984 fathers of newborn babies have been allowed to take up to 10 weeks leave from their job.

As is the case with women men's age-specific fertility rates have increased at higher ages. Men are approximately two years older than women when they have their first child - in 1980 the average age at first live birth was 26.9 and in 1988 28.0 years. At a given age men have had a constantly decreasing number of children during the 1980s.

The proportion of childless men has increased most strongly among the youngest. In 1988, 67.8% of men aged 27 had no children compared with 53.9% in 1980.

With regard to educational status men with Upper Secondary Examination have fewer children than women with the same educational status, but there is a particularly striking difference as far as men with only 9th class are concerned. These have experienced a very strong increase in childlessness while women with the same educational status remained almost unchanged during the 1980s.

The differences in the number of children between various socioeconomic groups are smaller among men than among women. It is striking that men who are outside the labour market for reasons other than registered unemployment have the lowest number of children.

3. Data

In this chapter, the registers used in the study and the creation of the study population is described. An evaluation of the calculated parity in the study is presented.

Data for the study have solely been retrieved from various registers in Danmarks Statistik. All the registers are based on administratively collected data and contain personal identification. By use of the unique 10-digit Person Number (PN), data concerning the same person from various registers have been linked. The study comprises (with certain age limitations) the total resident population in Denmark from 1 January 1980 to 1 January 1989.

Two registers have been used to create the study population(s):

- Register on Population Statistics
  and
- Medical Register on Vital Statistics.

Social background is described by use of data from the following registers:

- Educational Classification Module
- Employment Classification Module
- Register on Income Statistics
- Register on Building and Dwelling Statistics
- Register on Income Compensation Benefits.

Appendix III presents an overview of the source registers. Further description of the registers can be found in Thygesen & Jensen (1985) and Landstabelværk (1981).

3.1. Basic Registers

Register on Population Statistics

The Register on Population Statistics in Danmarks Statistik is based on data from the Central Population Register (CPR), which covers the total resident population in Denmark. The CPR has been in force since 1 April 1968, from which date each inhabitant in Denmark has had a unique identification number - the so-called Person Number (PN). From CPR Danmarks Statistik receives an annual file with the population status as of 1 January and weekly information on population movements (births, deaths, migrations etc.).

In the Register on Population Statistics each record contains the individual's own personal identification and references to (= Person Number of) spouse and parent(s). These references are used in the Fertility Database.

For each member of the study population, variables have been retrieved relating to a selected number of demographic characteristics such as sex, marital status, country of birth, citizenship, municipality of residence and date of immigration and/or emigration.

It is possible to define and describe families by way of code of address and identification of (an existing) spouse. Consensual unions are only identifiable in cases with a joint child, where the reference from child to mother and father have been used. The family situation of each woman and man in the study population is described by status in family (head of family, spouse), and the composition of the household, is described in terms of individuals living at the same address.

Medical Register on Vital Statistics

The Medical Register on Vital Statistics comprises data on all births and deaths in Denmark. For this study, the date of death from death certificates has been used to determine changes in the annual populations.

Information on newborn children is based partly on birth notification forms completed by midwives, and partly on information from the Central Population Register. For each child, live- as well as stillborn, the mother's Person Number is included in the Medical Register on Vital Statistics.

Educational Classification Module

Information on the educational status of every inhabitant aged 14 and over is collected in the Register on Education Statistics and the Educational Classification Module.

These registers have been updated annually since 1970 by using notification forms or electronic data files from each educational institution, specifying ongoing education or degree achieved for each pupil, student and trainee, identified by Person Number.

The Educational Classification Module, which was first established in 1980, combines information gathered in the Register of Education as of 1 October every year since 1970 with information on the educational status of the entire population gathered in the national population census of 1970. It contains data on completed education for all persons under the age of 60 on 1 January 1981 as well as data on persons participating in an educational course of at least 80 hours duration.

In the present study, educational status recorded as of 1 October in a particular calendar year will be used as an indicator for the status as of 1 January in the following calendar year. So, when education is analyzed here, it characterizes the person's educational status at the beginning of the calendar year in question.

For each individual in the study population the most important educational variables retrieved describe current training, the highest completed general education and type of completed vocational training. Each educational course has a specific 8-digit course code. These have then been grouped, indicating the level of education, normally equivalent to its length. These groupings are used in most of the analyses concerning education but the existence of the detailed identification makes it possible to analyze in more detail the relationships between educational achievements and fertility.

Employment Classification Module

Data in the Employment Classification Module include all members of the population aged 16 years and over regardless of whether or not they are economically active. The module is updated annually. The data are obtained from various registers, notably registers of the withholding - tax system and

the Register of Enterprises and Establishments. The Employment Classification Module covers activity since 1976.

Occupational activity is primarily defined as the main job and occupation during the year. The classification of occupation in a particular calendar year is used in this study as an indicator of socioeconomic position as of 1 January the following year. The study population as of 1 January 1983 is thus classified according to socioeconomic status during the year 1982.

The data retrieved for the Fertility Database include a detailed classification of occupation, industry and socioeconomic status. Occupation is classified according to the Danish Occupational Code (1979) and industry is classified according to the Danish edition of International Standard Industrial Classification of All Economic Activities (ISIC) (Erhvervsgrupperingskode 1977).

The socioeconomic grouping used in this study is a regrouping based on occupation and number of subordinates.

Register on Income Statistics

To supplement information on economic activity and socioeconomic position data on income have been retrieved from the Register on Income Statistics, which is primarily based on income tax returns, including surplus and deficit on real estate and self-employment.

Income is registered at the individual level and can be characterized by amount and type for every inhabitant in Denmark.

Register on Buildings and Dwellings

On 1 January each year throughout the 1980s, information on each dwelling in Denmark was collected and stored in the Register on Building and Dwelling Statistics. The facilities in the dwelling as well as type of building is linked to individuals using the exact address.

Register on Income Compensation Benefits

The Register on Income Compensation Benefits is based on registers identifying various kinds of social assistance by type and duration, e.g., benefits in case of unemployment, pregnancy/maternity and early retirement. The various basic registers have all been established in the course of the 1980s. Information is stored for each individual receiving at least one of the benefits in question. For this study, data have been retrieved for the period from 1984.

Data on housing conditions and income compensation benefits have not been included in the analysis presented in this report but are available for future studies based on the Fertility Database.

3.2. Creation of the study population

The study population consists of women (being mothers as well as childless), men (fathers and childless) and children. Data on women and men relate to 1 January each year during the Study Period (1980-1989).

Population

Women

Annual populations of women have been extracted from the Register on Population Statistics. The women selected for the study are in the fertile age groups, defined as 12-49 years. Following these definitions, data on women born from 1 January 1930 to 31 December 1967 have been retrieved as of 1 January 1980. For each new year, the oldest cohort has been excluded and a new young cohort included. Women living in Greenland or the Faroe Islands have been excluded from the population.

Dates of emigration, immigration and deaths have also been extracted from the Register on Population Statistics and included in the Fertility Database.

Men

The population of men has been created parallel to that of women as described above. The age (or birth cohort) criteria for inclusion in the population are, however, slightly different. The lower limit is still 12 but as previous statistics have shown that men become fathers above age 60 the upper limit has been defined as 64 years (Vital Statistics 1991). The men in the first data retrieval (1980) were thus born in the period 1916-1967.

Identification of children

The creation of the population of children was performed in two major steps.

As the first step, data on cohorts born each year in the period 1942-1989 were extracted from the Register on Population Statistics and the Medical Register on Vital Statistics. Secondly, these data were worked up especially concerning reference(s) to biological parent(s) in order to establish the most valid parent - child relation which is the basis for the measure of parity in the study.

Register on Population Statistics

From the Register on Population Statistics, data have been retrieved for all residents in Denmark born from 1 January 1942 onwards. This retrieval was performed for each year, starting with the file of 1 January 1989, expanding with children identified each year back to 1979. In the resulting file (Children's File), each child has only one record containing the latest updated information from the Register on Population Statistics.

All individuals in the above mentioned cohorts, who died before 1 January 1979 could not be included in this data retrieval as they are not included in the population status as of 1 January 1979.

Birth Registration

These data have been supplemented with information from the Medical Register on Vital Statistics concerning all live- and stillborn infants born in Denmark in the period 1973-1989.

The Children's File

The Children's File comprises all children except those born before 1973 and those who died before 1979. Only children with a reference to either mother, father or both, and where the parent(s) is included in one of the annual populations have been included in the analysis.

Data from the Register on Population Statistics include a reference to (= the Person Number of) mother and (or) father. Data from the Medical Register on Vital Statistics include only the mother's PN. Parity has been calculated from these references.

Parity in this study is defined as biological parity and only liveborn infants are counted.

Calculation of parity

From the annual files of the study population, two files were constructed which included identification of the union of women respectively men present in at least one of the annual populations.

A match was performed between the Children's File and the unionfile using the mother's (respectively father's) PN as reference. Through this linkage, a new file - the parity-file - was created. In the parity-files, each woman and man can appear more than once - either with a single record stating that no children have been identified or with a record for each child identified with the help of the above mentioned procedures.

Changes in identification over time may occur. The first registration of a newborn child may be incorrect due to mistakes in sex or date of birth and the stated birthdate of immigrating children may be incorrect. To correct such irregularities, a control was included in the formation of the Parity-File, and each case where the same woman had two singleborn children who were born with less than five months' interval were listed and corrected by comparison of records. The oldest reference(s) to parent(s) was then kept and only children's identifications were changed.

After these corrections, parity was calculated for each woman (and man) by simply counting their number of liveborn children before the index child.

Parity status

All childless women and men have been assigned a parity value of zero, the record with the first child: parity one, second child: parity two and so on.

For each woman and man in the study population a parity status is thus given as of 1 January each year during the study period.

3.3. Evaluation of the parity information in the Fertility Database

The concept of parity is widely used throughout this analysis, so it has been necessary to evaluate the validity of the calculated parity. This has been done at the micro-level by investigating the coverage of the basic reference from child to parent (both women and men) in the Population Statistics Register and by comparing the calculated parity with the number of previous live births of the mother as recorded in the Medical Register on Vital Statistics. Information on number of previous live births is based on the birth notification form completed by the midwife (Knudsen & Børlum Kristensen 1986).

At the macro-level, the distribution of parity at given ages and previously published calculations have been compared.

Coverage of references from child to parent(s)

Parentship has been established using the reference from child to mother and father in the Register on Population Statistics as described above.

Basic references

The coverage of these references has changed over time. When the Central Population Register (CPR) was established in 1968, there was no reference from child to parent(s) for all individuals aged 18 and over, i.e. all birth cohorts born before 1951, and in the early stages of CPR the reference was removed from the Register when "the child" reached 18 years of age. This practice ended in 1978 when the CPR was revised.

The most recent data show that the first time the number of persons with reference to parent exceeds the number without is in the birth cohort of 1954. In all cohorts from 1960, over 90% have a reference.

References in the Children's File

The Children's File in the Fertility Database was created from various sources (see above). In the total file, 69.4% of all individuals, born from 1942 onwards have a reference to their mother, 67.1% to their father and 30.2% no reference at all.

In the study only children with at least one reference to a parent have been included as this link forms the basis of the calculation of parity.

Table 3.1. shows the proportion of children with and without reference.

Table 3.1

Proportion of children with reference(s) to parent(s) in the Children's file. Births 1942-1989

Type of reference	Among liveborn children born		
	1942-1989	1960-1989	1973-1989
	%		
To mother	69.4	96.7	99.3
To father	67.1	93.9	96.4
To both	66.6	93.5	96.2
No references	30.2	2.9	0.6
Total number of children	**3,603,738**	**2,138,554**	**1,062,157**

Immigrants without references

When the material is divided according to the child's country of birth, it is apparent that most of the missing references (for cohorts born 1960 onwards) to one or both parents are found among immigrants who might have arrived in Denmark as adults and without parents.

Among cohorts born in Denmark after 1960, less than 5% have no reference to the father. A reference to the mother is present for almost everybody.

Based on these distributions, the coverage of reference from child to parent in this study is considered complete for children born in Denmark since 1960. Thus, calculation of parity is considered valid for all cohorts of women in the study population born in the period 1945 to 1977 giving birth in Denmark (Knudsen 1993).

The calculation of parity is validated further in the following sections.

Evaluation of the calculated parity among women

If the reference is missing due to incorrect registration, the calculated parity of the woman or the man will be underestimated. As far as the female population is concerned, it is possible to evaluate the validity of the calculated parity. A detailed evaluation is included in Appendix IV.

Comparing with previous live births

The calculated parity of each woman can be compared with the number of previous live births stated in the Medical Register on Vital Statistics.

Due to the design of the basic notification form for this register, it was not possible to distinguish between the number of previous live- and stillborn infants until deliveries after 1 January 1978.

Therefore, an evaluation of parity has been performed for two separate groups of women - those who were too young to give birth before 1978 (1965-1975-cohorts) and all other women. Errors may of course occur on the notification forms as well as in the Fertility Database.

The group of women only with births in the period 1978-1989, constitutes a total of 430,832 women in the Fertility Database. The women were aged 13-23 years in the period under consideration. They were born in the period 1965-1975 and gave birth to 39,612 liveborn singletons in Denmark in 1978-1989.

Almost total accordance

A total of 39,329 births (99.3%) are given the same parity in both sources.

The results of the comparison for births 1978-1989 for women born before 1965 and who may also have given birth before 1978 shows an accordance at the same high level.

According to the Fertility Database, these women experienced a total of 617,636 liveborn singletons during 1978-89. Less than half of these children (44%) were firstborn, while more than one third (38%) were second-born.

For 97.7% of their births, the two sources are in total accordance, compared with 99.3% for the younger group. A higher proportion of these older

women have four or more children. When parity 4+ is split into parities: 4,5,6,7,8 and 9+, only 0.2% of these are not in accordance in the two sources (Knudsen 1993).

Comparison with previously published statistics

Finally a comparison was made between the parity distribution and fertility rates based on the Fertility Database and the measures previously calculated on the basis of cross-sectional compilations of women giving birth and included in the current statistics.

First, age-specific fertility rates based on age at the time of event were compared. Subsequently, the parity distribution and the proportion of childless women were compared.

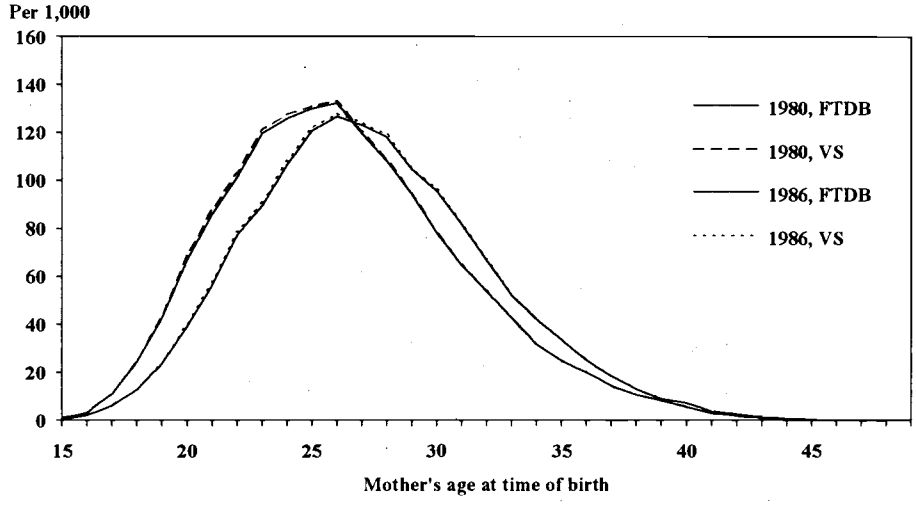
Age-specific fertility rates

One-year age-specific fertility rates for women have been calculated and then compared with previously published figures (Vital Statistics 1990). These fertility rates are calculated on the basis of maternal age at time of delivery and compiled for each calendar year.

Figure 3.1 illustrates the degree of agreement between the previously published fertility rates and data in the Fertility Database in 1980 and 1986. These two years were selected because they indicate the beginning of the study period and the middle of the period.

Figure 3.1

Age-specific rates of fertility based on data in the Fertility Database (FTDB) and from Vital Statistics (VS)



The graphs show the changes in the age-specific fertility rates during the period, but in the present context, it is more significant that the figures from the two various sources are almost identical in the two years.

Parity distribution

Until now, parity distribution was known only for women who gave birth in the year in question. The parity distribution among all Danish women was not known.

On the basis of the cross-sectional compilations, the parity distribution in the cohorts of women have been estimated up to a given age (Hoem 1979). Since then, these distributions have been updated annually and included in the current Vital Statistics.

Fertility Database

Table 3.2 shows the difference between the previously calculated parity distribution (Vital Statistics) and the parity distribution appearing from the Fertility Database. The figures comprise women aged 30 years at the beginning and end of the period, from cohort 1950 and 1957, respectively.

Table 3.2 **Parity distribution among women aged 30 years from the Fertility Database (FTDB) and Vital Statistics (VS). Cohorts 1950 and 1957**

	Cohort 1950		Cohort 1957	
	FTDB	VS	FTDB	VS
0 children	18.7	17.6	27.0	28.8
1 child	25.5	26.0	27.5	26.1
2 children	43.6	44.0	36.3	36.4
3+ children	12.2	12.3	9.2	8.8
	100.0	**100.0**	**100.0**	**100.0**
Average no of live births	**1.52**	**1.51**	**1.29**	**1.25**

The distributions are almost identical, which might indicate that the validity of the calculated parity in the Fertility Database is comparable to that of the data in Vital Statistics. The average number of live births is calculated from this parity-information. Following this, calculations of the average number of live births give almost identical results from the two sources.

In conclusion, the new measure of parity can be considered valid.

3.4. Size of Population

Tables 3.3 and 3.4 illustrate the various changes in the annual populations of women and men. The annual female population varies from 1,350,000 to 1,410,000 women and the male population from 1,800,000 to 1,860,000.

Table 3.3 **Female population aged 12-49 each calendar year in the study period, by vital event**

	Present all year	Immi-grants	Emi-grants	Deaths	Others	Total
1980	1331,700	8,076	8,005	1,564	3,066	1352,411
1981	1338,257	7,576	8,296	1,486	2,736	1358,351
1982	1344,163	7,737	7,896	1,425	2,699	1363,920
1983	1350,576	7,913	7,456	1,465	2,344	1369,754
1984	1359,512	8,420	7,512	1,489	2,252	1379,185
1985	1367,855	9,969	7,977	1,505	2,428	1389,734
1986	1375,641	10,761	8,308	1,476	2,502	1398,688
1987	1382,954	10,720	8,859	1,435	2,540	1406,508
1988	1387,796	10,249	10,693	1,533	2,877	1413,148

Table 3.4 **Male population aged 12-64 each calendar year in the study period, by vital event.**

	Present all year	Immi-grants	Emi-grants	Deaths	Others	Total
1980	1773,778	9,298	9,615	8,516	4,173	1805,380
1981	1779,870	8,726	9,774	8,521	3,652	1810,543
1982	1784,550	8,957	9,149	8,273	3,774	1814,703
1983	1789,927	9,215	8,563	8,495	3,329	1819,529
1984	1797,795	10,306	8,231	8,353	3,188	1827,873
1985	1806,685	14,271	8,791	8,395	3,294	1841,436
1986	1813,984	15,149	9,390	8,305	3,517	1850,345
1987	1821,535	12,495	10,756	8,375	3,843	1857,004
1988	1827,003	11,837	12,253	8,029	4,059	1863,181

4. Measures of fertility

This chapter describes the various measures of fertility used in the study and how they are calculated from the Fertility Database.

Fertility measures in this study are based only on live births defined as children showing evidence of life at time of birth (Vital Statistics). Stillbirths, fetuses born with a gestational age of 28 weeks or more without showing any signs of life are not included in the analyses. Data on stillbirths and date of death during the first year of life are, however, included in the Fertility Database and can be used in special studies.

4.1. Principles behind the calculation of age-specific fertility rates

Age-specific fertility rates

Age-specific fertility rates are calculated simply by dividing the number of births by the number of person-years related to a specific age group of women. However, different principles can be used to build up the data and this is best illustrated by a so-called Lexis diagram.

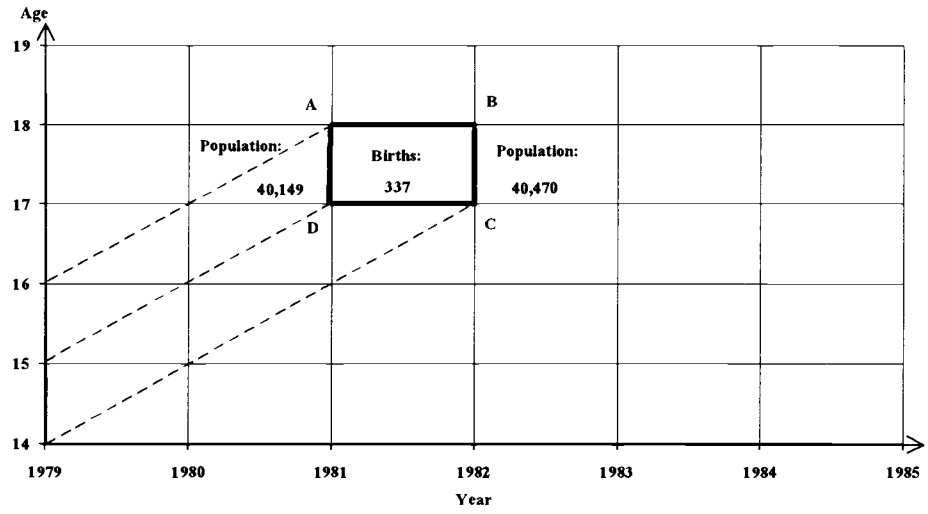
Principle: "same year - same age"

In a Lexis diagram, time is shown on the horizontal axis and age of the women on the vertical axis.

In figure 4.1, the births counted in the rectangle ABCD occur among women giving birth at the age of 17 in 1981. From the diagram, it is obvious that two cohorts of women are involved, namely those born in 1963 and 1964. This is a calculation based on the so-called "A-group" in Danish demographic studies.

Figure 4.1

Illustration of the calculation based on same year - same age (A-group)



The number of personyears relating to this group of women is approximated by the mean population in 1981, i.e. the average of the number of women whose life-lines cross DA and BC, respectively.

Referring to the numbers in figure 4.1, the calculation is as follows:

$$f_{17} = \frac{337}{(40149+40470)/2} \times 1000$$

The age-specific fertility rate thus calculated is then attributed to age 17.

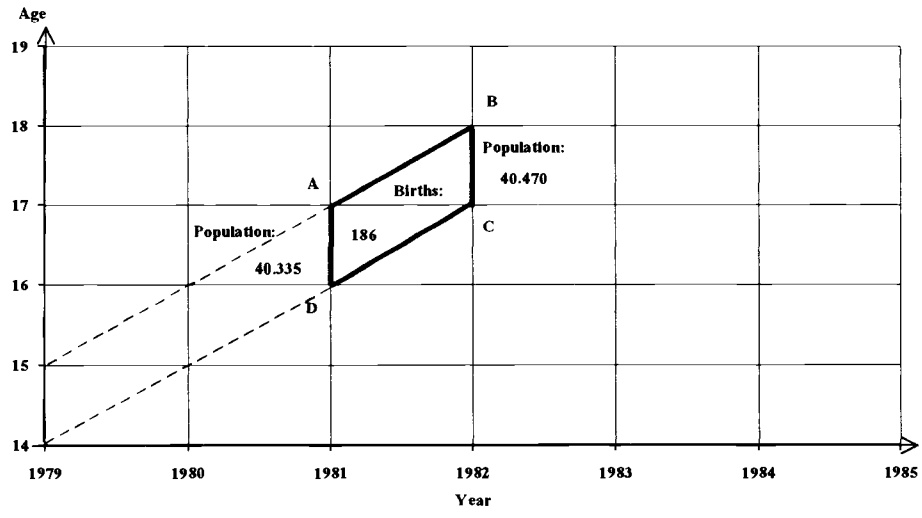
In this study, calculations of age-specific fertility rates are based on this "same year - same age" principle. When parity-specific rates of fertility are calculated or social characteristics included, however, another principle based on a cohort during one whole year, has to be used: "same year - same cohort".

Principle: "same year - same birth cohort"

This principle is illustrated in figure 4.2.

The number of births by the 1964-cohort of women in the year 1981 is "counted" in the parallelogram ABCD. These women will be aged either 16 or 17 in 1981. Women from the same generation will have the same age at the end of a calendar year. This calculation is based on the so-called "B-group" in Danish demographic studies.

Figure 4.2 **Illustration of the calculation based on same year - same birth cohort (B-group)**



The number of person-years relating to this group of women is the average of the number of women whose life-lines cross DA and BC, respectively.

The number of person-years relating to this group of women is the average of the number of women whose life-lines cross DA and BC, respectively.

Referring to figure 4.2, the calculation of a parity-specific fertility rate is as follows:

$$f_{16} = \frac{186}{(40335+40470)/2} \times 1000$$

This rate is attributed to age 16.

When social background variables such as educational status are used the principle "same year - same age" is used since it is impossible to define the exact point of time when a change in these variables takes place.

4.2. Other definitions

Total fertility rate

The total fertility rate accumulates the age-specific fertility rates and is an estimation of the number of live births that 1,000 women would give birth to if none of the women died before age 50 and at each age experienced the given year's age-specific fertility rates.

Average number of live births

The cumulated fertility of women at a certain age or point in time is defined as the average number of live births calculated as a simple average of the number of children who have been identified and counted for each woman (and man) in the Fertility Database.

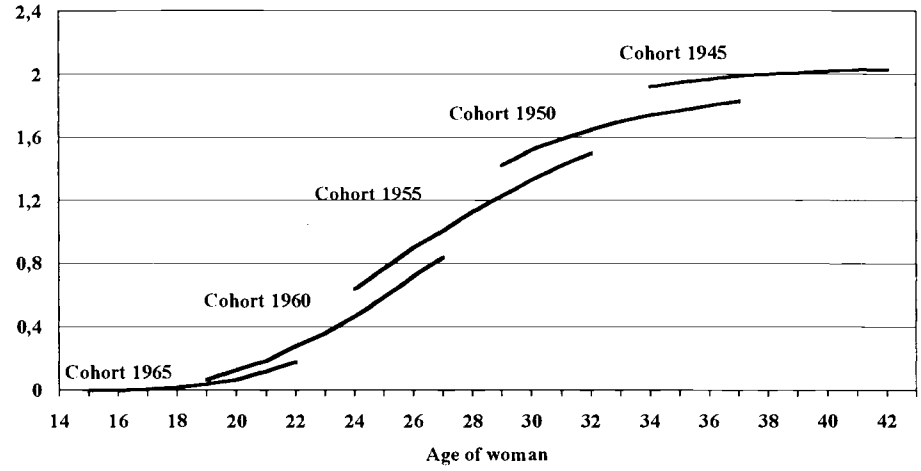
The connection between the average number of live births and the total fertility rate is discussed in Appendix V.

Generation fertility

Generation fertility expresses the average number of live births among women in each generation (or birth cohort) at the end of their reproductive period.

Figure 4.3 illustrates the fertility in each generation of women up to a certain age by calculation of the average number of children. The curves show the average number of live births among women who were born in 1945, 1950, 1955, 1960 and 1965 at different ages through the 1980s.

Figure 4.3 **Average number of live births to women in different cohorts**



These curves are based on the cross-sectional data in the Fertility Database. The fertility level at a given age is based on the number of women from the generation in question, who were alive and included in the annual population at that point in time. It can be seen that the younger the cohort, the lower the number of live births at a given age.

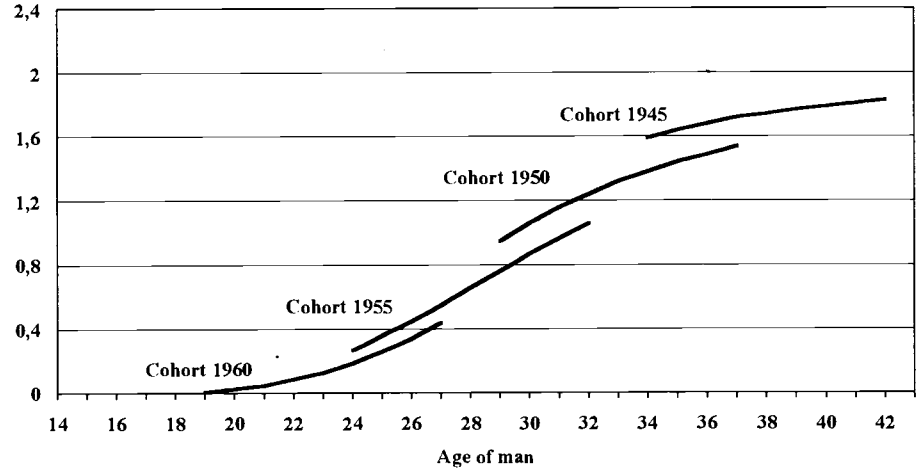
Comparing birth cohorts

For the women included in the study, children have been identified in cohorts from 1960 onwards as described in chapter 3. The number of live births to each woman (or man) is considered valid for all generations of women born from 1945 onwards.

The selected generations of women shown in figure 4.3 are those for which it is possible to describe the social background of the women. The figure also shows for which ages a comparison between generations can be performed.

Figure 4.4 shows the average number of children among men in the study population. At a given age the average number of live births to men is lower than to women at the same age. As is the case for women, each younger cohort of men has a lower average number of live births.

Figure 4.4 **Average number of live births to men in different cohorts**



Average age at birth

The average maternal age at time of birth is calculated as a simple average of the age (completed years at the day of birth of the child) of women giving birth or men becoming fathers through the year. This measure is influenced by the age distribution of the women in the population at risk, e.g., if some of the generations are much larger in numbers than others.

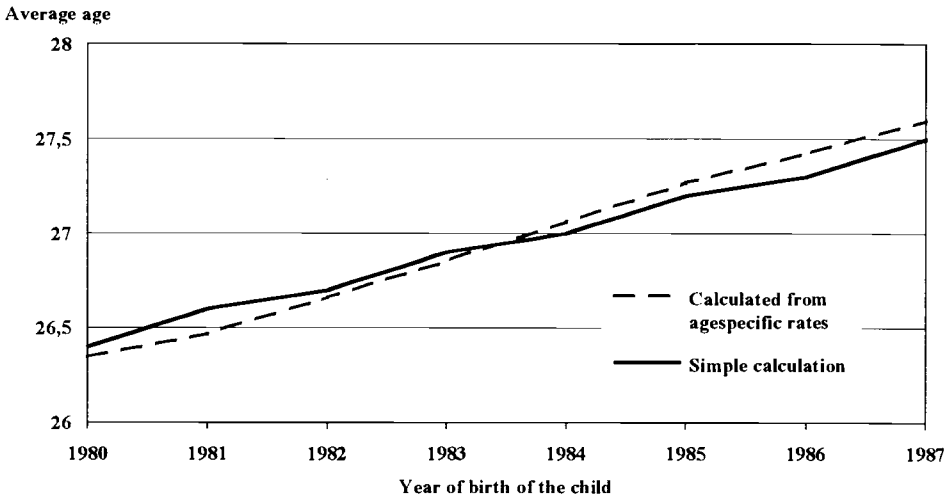
The relatively large generations born in the 1960s (cf. chapter 5) entered the reproductive age groups in the 1980s. The calculated average age at childbirth would then be too low if the age distribution is not considered.

To estimate this influence, a standardized average age has been calculated assuming that each age group is of the same size.

The trend in the average age at childbirth from 1980 to 1989 based on these two calculations is illustrated in figure 4.5. The differences are minor, indicating that the overall results are independent of the measure used.

However, it can also be seen that the simple average age is lower than the standardized average age in which the age structure of the female population is taken into account.

Figure 4.5 **Average age at childbirth expressed by two measures**



Fertility among women aged 25, 30 and 35 years

Throughout the study, fertility is analysed for women who are 25, 30 and 35 years old. Average numbers of live births are calculated at these ages through the 1980s. Another measure presented is the number of children born by women aged 25 as a proportion of all the children they have at age 35.

Men's fertility

In principle, fertility among men is described in a similar way. Since men are, on average, two years older than women when they have their first, second child etc., numbers of live births for men are analysed at ages 27, 32 and 37 years.

5. Main outlines of fertility trends in Denmark

In the 1980s, Denmark experienced a turning point in fertility trends. In 1983, total fertility reached a low of 1,377 with 50,822 liveborn children, corresponding to 9.9 per 1,000 inhabitants and 40.3 per 1,000 women in the reproductive agegroups (15-49 years). This constituted the lowest fertility level observed in Denmark in this century in absolute as well as in relative terms.

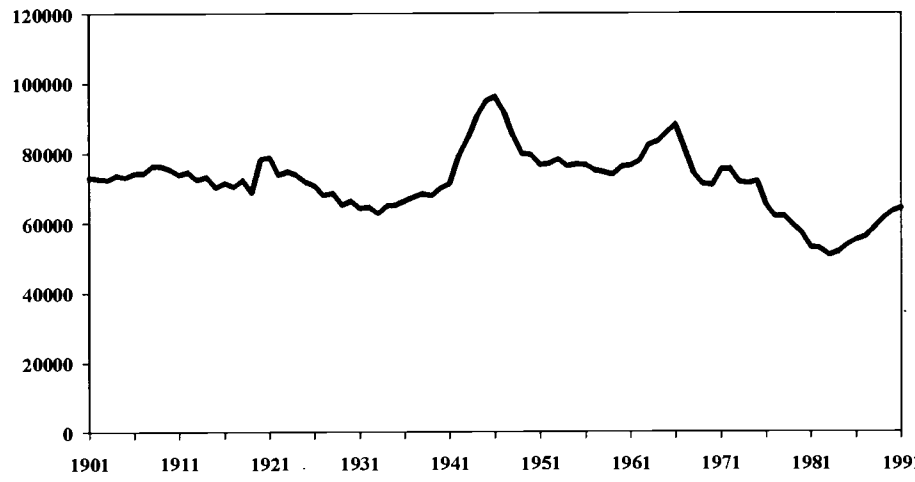
5.1. Number of live births and total fertility

Live births

At the beginning of the century, there were 72,000 to 73,000 live births a year and by the 1930s the number had declined by approximately 10%. The increase around 1920 was partly due to the fact that the Southern part of Jutland was reunited with the rest of Denmark after the end of the First World War. During the baby boom at the end of the Second World War, the annual number of births reached more than 96,000, which was 50% higher than in the mid-1930s.

Figure 5.1 shows the development in the number of live births in the period 1901-1991. It appears from the figure that there was another increase in the 1960s, when women born during the baby boom in the 1940s had reached childbearing age. Since the mid-sixties, there has been an almost constant decline until 1983, after which the number of live births increased to 63,358 in 1991, an increase of approximately 25%. The number of live births in 1992 was 64,358.

Figure 5.1 **Number of live births. 1901-1991**



Sources: Befolkningsudvikling og sundhedsforhold 1901-1960. Vital Statistics, various years

The figure illustrates annual fluctuations in the number of live births which is dependent on, among other factors, size and age structure of the female population. The total fertility rate, which is calculated on the basis of age-specific fertility rates, gives a better picture of trends over time.

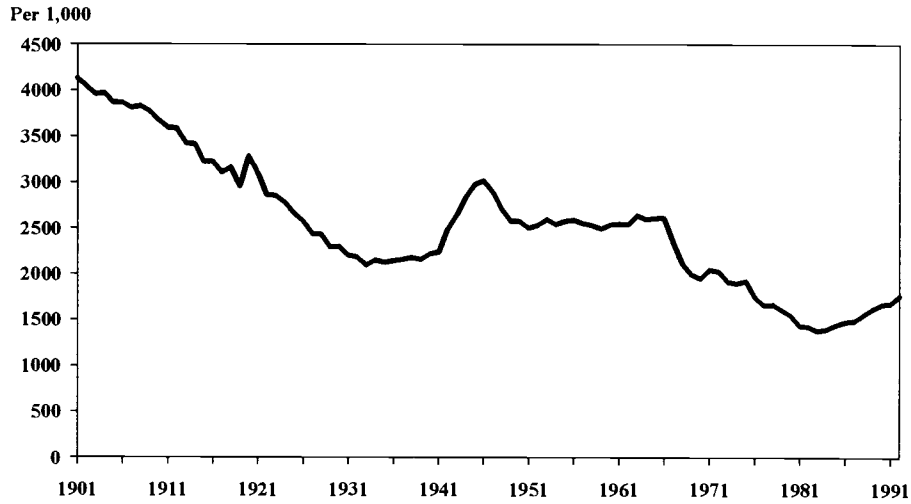
Total fertility

In 1983, total fertility reached a low of 1,377 live births per 1,000 women, but, as already mentioned, the trend was reversed after 1983 and in 1992 total fertility was 1,762.

In spite of this increase, total fertility is still below 2,100 per 1,000 women, which is the approximate level needed for maintaining the size of the population in the long term. The present low fertility level is attributable to the long decline in fertility, which became predominant at the end of the 19th century. Figure 5.2 shows the trends in total fertility since 1901.

Figure 5.2

Total fertility rate. 1901-1992



Sources: Befolkningsudvikling og sundhedsforhold 1901-1960. Vital Statistics, various years

During the 1970s, total fertility declined to below 2,000 and was below the level of reproduction for the first time since the 1930s. The fertility level then decreased gradually until 1983. This can be attributed to a continuous fertility decline for women over 25 and a sharp decline for women aged 20-24 at the end of the 1960s.

5.2. Two periods with a decline in fertility

It appears from figure 5.2 that there have been two periods this century with an almost continuous decline in fertility, albeit with breaks of increasing fertility in the 1940s and again in the 1980s. The first period with a decline ends in the mid-1930s and the next decline, which led to the low level in 1983, began in the mid-1960s.

The recent increase in the fertility level is seen clearly in the figure. However, at this stage, it is not possible to judge whether this is the beginning of a longstanding, permanent change of level or just a short-term fluctuation.

There are some characteristic differences in the fertility structure in these periods.

Decline among women over 25

The decline in fertility which took place up until the mid-1930s could be observed especially among women over 25 (figures 5.3 and 5.4). It can be seen that the older the women, the larger the relative decline in fertility rates. For women over 40, fertility rates in 1930 were only 1/3 of the level in 1900, and for women aged 30-40 the fertility level was more than halved in the same period.

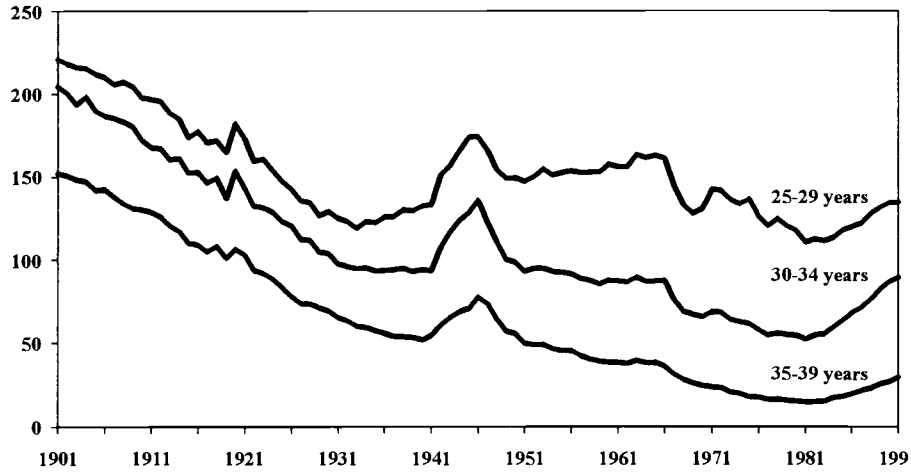
Increase in all age groups

Fertility began to increase again around 1934-35 for women in their late 20s, while the increase among women over 30 did not start until the beginning of the 1940s, but both increases peaked towards the end of the Second World War. After this peak, fertility increased slightly for women aged 25-30 but decreased for the older age groups.

Figure 5.3. shows the fertility rate (live births per 1,000 women) in selected age groups each year from 1901 to 1991 for women aged 25 years and over. These women are characterized by a very uniform development, and it was for these three groups that fertility increased in the 1980s.

Figure 5.3

Live births per 1,000 women in 5-year age groups. Women aged 25 and over. 1901-1991

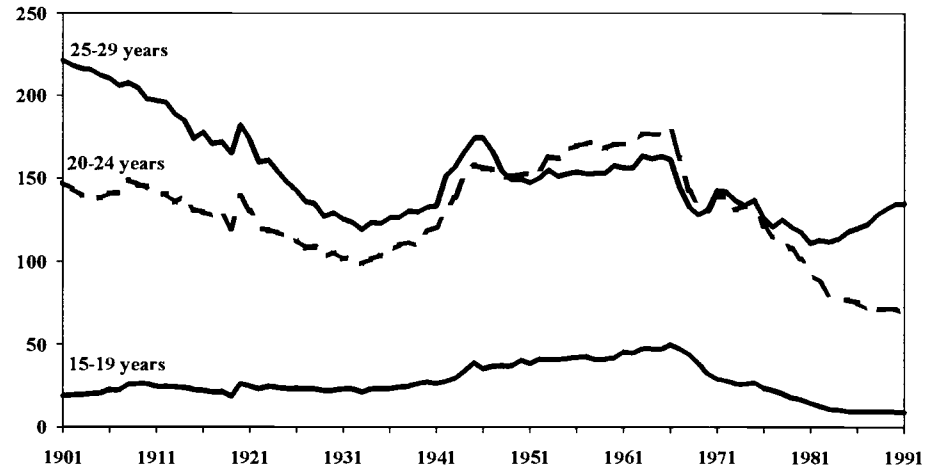


Sources: Befolkningsudvikling og sundhedsforhold 1901-1960. Vital Statistics, various years

Women aged 25-29 had the highest fertility level throughout most of the period (figure 5.4). There was, however, a change in the fertility structure in the 1950s and 1960s, where women aged 20-24 had the highest and increasing fertility, and where fertility among teenagers also increased. This can be seen from figure 5.4.

Figure 5.4

Live births per 1,000 women in 5-year age groups. Women under 30. 1901-1991



Sources: Befolkningsudvikling og sundhedsforhold 1901-1960. Vital Statistics, various years

Total fertility is calculated on the basis of the age-specific fertility rates for a specific calendar year. This measure does not indicate the total fertility level that will be reached by each generation (or birth cohort) of women, as the reproductive period of their lives lasts 30-35 calendar years.

Despite the fertility decline, it appeared, for example, that some of the women who contributed to this decline in the 1930s reached, a total fertility of 2.3 children per woman during their remaining reproductive period, i.e. the same level as previous generations (Bertelsen 1981).

Decline also among younger women

The fertility decline which began at the end of the 1960s and which reduced total fertility to less than 2,000 was different from the earlier decline. Fertility declined in all age groups in the 1970s, but it appears from figures 5.3 and 5.4 that the fertility decline was highest for women under 25. In the ten-year period from 1970 to 1980, fertility for women aged 20-24 declined by 22%. For women under 20, who had experienced steadily increasing fertility levels in the 1950s and 1960s, the fertility was halved from 1970 to 1980 from 32.4 to 16.8 per 1,000 women.

Increase among women over 25

Increasing fertility among women over 25 accounts for the increase in total fertility which began in 1983. In fact, age-specific fertility rates for these women began to increase shortly after 1981, a few years before the increase affected total fertility levels. This is largely explained by the fact that those women who were young girls in the 1970s postponed births, so that they did not begin to have children until the 1980s, by which time they were in their late 20s. It will be discussed whether or not it is likely that the fertility decline in the 1970s will be compensated by women giving birth at a later age.

The structure of the decline in fertility has changed

Although changes in total fertility are characterized by a relatively simple picture with a continuous decline, with a few exceptions, the fertility rates among women in different age groups show, in contrast, that the structure of the decline in fertility has changed.

At the beginning of the century, fertility was declining among the oldest women in the reproductive age groups. Unlike previous generations, women who had given birth to 2-3 children no longer had more children.

In contrast, the next sharp, almost constant decline from 1970 can be attributed to younger women. As it will be shown later, it is now particularly women who have not had any children that caused a decline in total fertility by postponing their first birth.

5.3. Two demographic transitions

The above-mentioned differences in changes in age-specific fertility have to be considered in relation to other changes in society - demographic and social changes as well as changes in attitudes.

The first part of the fertility decline (the historical decline) described above was part of what is called the demographic transition. This transition began at various points in time in different countries, and the subsequent development of events also varied slightly. In spite of this, there are so many similarities in the observed trends that they fall within the same concept (Matthiessen 1970).

The demographic transition

The demographic transition began with a mortality decline resulting from improvements in hygiene, public health and the combating of diseases in the latter half of the 18th century (Matthiessen 1984). This was followed by a fertility decline from about 1900. As described above, it was the number of high order births that were reduced.

It is this transition from a society with high mortality and high fertility to a society with low mortality and low fertility which has been labelled the demographic transition.

The fertility decline occured when society was changing from an agricultural to an industrial society. For the rising middle class, it was advantageous to have fewer children. Investments in the children's upbringing, their education and future and the wish not to share the family's assets among too many children all spoke in favour of fewer children.

The growing working class in the expanding cities could also benefit from limiting the size of their family. Low wages, unemployment and small dwellings all acted in favour of smaller families. Even if all members of the family were gainfully employed, it was difficult to obtain a reasonable standard of living.

The second demographic transition

The later fertility decline is not closely linked to this demographic transition.

The continuous fertility decline in Denmark reduced total fertility to a constant level below 2.1 children per woman, and Denmark was one of the first countries where the number of deaths exceeded the number of births. This later development with a low fertility level among younger women and total fertility below the level of reproduction has been considered by some demographers to be so fundamentally different from the earlier development

that the concept of "the second demographic transition" was introduced (Lesthaege 1991, Van de Kaa 1987).

Fertility pattern

The fertility pattern in the second demographic transition is characterized by later first births, i.e. an increasingly older age at the first child's birth and a lower frequency of births after the second child.

The economic and social possibilities for both men and women to live together (either married or in consensual union) and to decide not to have any children is one of the most important characteristics of the second transition. Sexuality and family formation is no longer closely linked with continuation of the family and the economic possibility of supporting a household.

Historically childlessness has never been uncommon, but this childlesness was not optional but a consequence of either economic constraints on family formation or of the fact that woman who choose a career (teacher, nurse etc.) simply could not do this and have children.

The changed position of women

Another main characteristic of this later phase of the fertility decline is the changed position of women, both socially and economic.

The increasing level of education and women's entry into gainful employment outside the home changed the needs, the position and the dependency of women.

From altruism to individualism

Relations between child and parents have changed during the transitions. Investments in the children's future, in the course of those parent's sacrifices for the sake of their children have been labelled the "king-child and parent" situation (Van de Kaa 1987). This situation characterized the first transition. Fewer children in a family made it possible, however, to concentrate more on the individual child, and the parents' altruistic attitudes strongly supported the future of the child.

The present situation with couples choosing to live alone without children is related to demands made with regard to the quality of the partner relation, to living conditions and to self fulfilment (Cliquet 1991).

This era is the "king-parents-child" period, also called the individualistic society in contrast to the altruistic society during the first transition (Lestaghe 1991).

From birth control to family planning

With regard to family formation and childbirth, it is worth noting that the availability of safe contraceptives and abortion on request have improved couples' possibilities of planning the time for and the number of births by avoiding births at unwanted points-in-time.

It has of course always been possible to exercise some form of fertility control, but the advent of the contraceptive pill in the mid-1960s and since 1973 abortion on request increased the efficiency of birth control. A substantial postponement of the first birth became possible, and increasing fertility levels for women over 25, which characterized the 1980s is part of the second demographic transition.

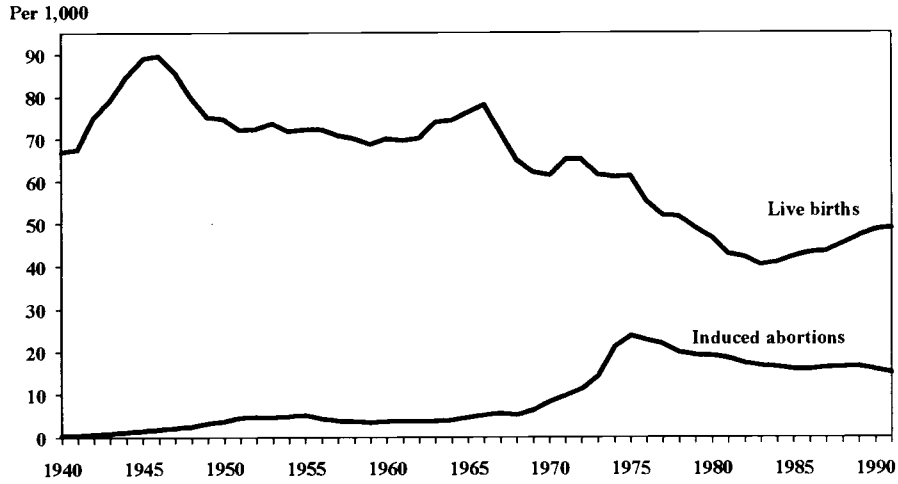
Abortion on request

In Denmark, woman aged 18 or over have had the right to have their pregnancy interrupted - abortion on request - since 1 October 1973. Previous revisions of the Law on interruption of Pregnancy had gradually broadened the criteria for abortion.

During the first years after the new law there was a sharp increase in the rate of induced abortions, peaking at around 28,000 in 1975 corresponding to 24 per 1,000 women in fertile ages (15-49 years). In 1991, the number of induced abortions was 19,729. The trend of induced abortions is illustrated in figure 5.5.

Figure 5.5

Rate of induced abortions and live births per 1,000 women in fertile age groups (15-49 years). 1940-1991



It is remarkable that the rate of induced abortions in the 1980s has been almost constant. The increase experienced from the late 1960s to 1975 was due to the changes in the law.

The preliminary work on the legislation relating to abortion on request was based on the attitudes that characterized the first transition. The main content of the law revision in 1970 still focused on women who already had children, although a direct social indication was also being formulated. Induced abortion was now possible, if the woman was considered unable to take care of her child in a satisfactory manner because of unfavourable living conditions (Rasmussen 1983).

The introduction of abortion on request gave the women a legal and safe possibility to halt the growth of their families.

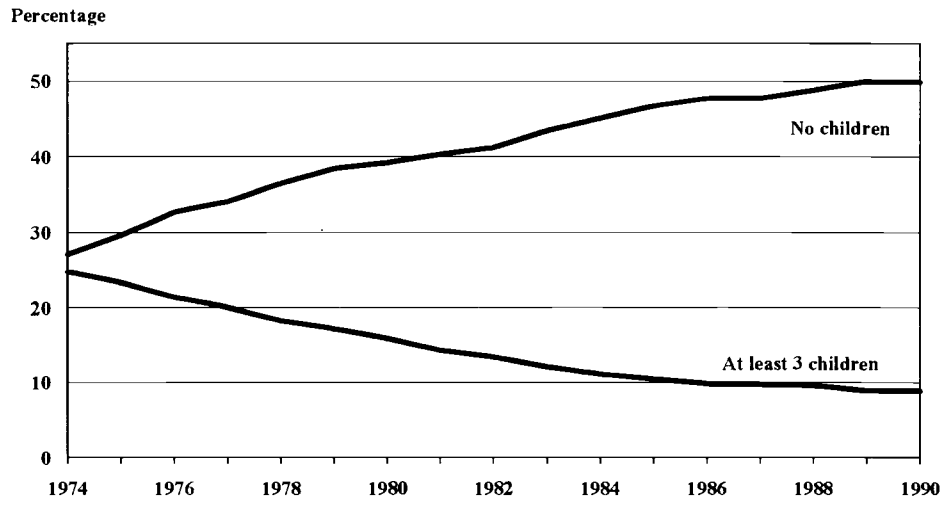
The National Council for the Unmarried Mother and Her Child, which referred women to induced abortion, did not give any kind of guidance in respect of induced abortion at that time. But the reduction of the high order births formed the basis of a gradual acceptance of increasingly more effective methods of birth control.

The introduction of induced abortion on request in 1973 marked the change towards the planning of the time and number of birth which characterizes

family formation in the second transition. This is illustrated by the changing distribution of parity among women having induced abortions - 25% had at least three children and 25% had no children when the law was introduced, but in subsequent years an increasing proportion of these women had no children, indicating postponement of the birth of their first child. In 1990, approximately 50% of women having an abortion were childless, cf. figure 5.6.

Figure 5.6

Percentage of women having an abortion who had either no children or at least three children. 1974-1990



Source: Statistik om prævention og aborter.

5.4. Main trends in the second transition

The average age of women giving birth

The average age of women giving birth increased from 26.2 in 1970 to 26.9 in 1980 and 28.3 in 1991. The sharpest increase occurred in the 1980s. Due to a change in the registration form, the validity of information changes in 1978.

Table 5.1

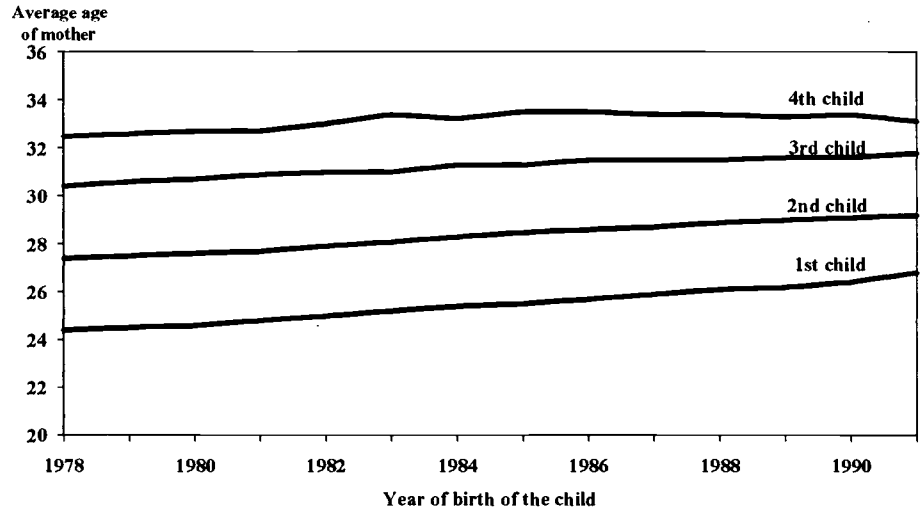
Average age of women at 1st to 5th birth. 1970, 1977, 1983 and 1991

	1970	1977	1983	1991
1st child	23.4	24.1	25.2	26.8
2nd child	26.0	27.3	28.1	29.2
3rd child	28.6	30.2	31.0	31.8
4th child	30.5	32.2	33.4	33.1
5th child	35.1	33.4	34.8	34.5
Total	**26.2**	**26.6**	**27.4**	**28.3**

Source: Vital Statistics 1972, 1978, 1985 og 1993.

Figure 5.7 shows trends in the average age of women giving birth to their 1st to 4th child from 1978 to 1991. In the 1980s, there was a relatively larger change in the age of women giving birth for the lower birth orders (parities), whereas the high order births accounted for the substantial change in the 1970s.

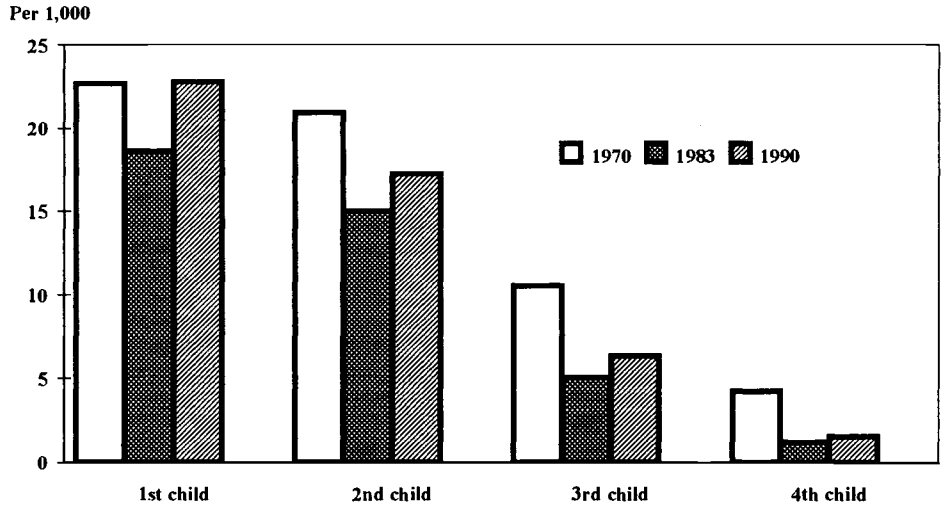
Figure 5.7 **Average age of women giving birth, by parity. 1978-1991**



The calendar year in which total fertility reached its lowest level (1983) did not differ from the general trends as the average age of women giving births was 27.4 years.

It appears from figure 5.8 that fertility rates for first and the second births was relatively low in 1983, so the subsequent increase can be attributed especially to the low parities.

Figure 5.8 **Live births by parity per 1,000 women aged 15-49 years. 1970, 1983 and 1990**



Sources: Vital Statistics 1972, 1985, 1992

5.5. Fertility trends in the 1980s

As already mentioned, fertility trends were reversed in 1983. Although older women contributed primarily to this change, which marks the beginning of an increase, the age and parity distribution among women giving birth in 1983 does not differ markedly from the distributions before or after 1983.

Increase for women over 25

In the 1980s, fertility rates decreased steadily for women under 25, whereas the rates increased for women over 25, cf. figures 5.3 and 5.4. The decline among younger women is relatively sharper than the increase recorded among older women.

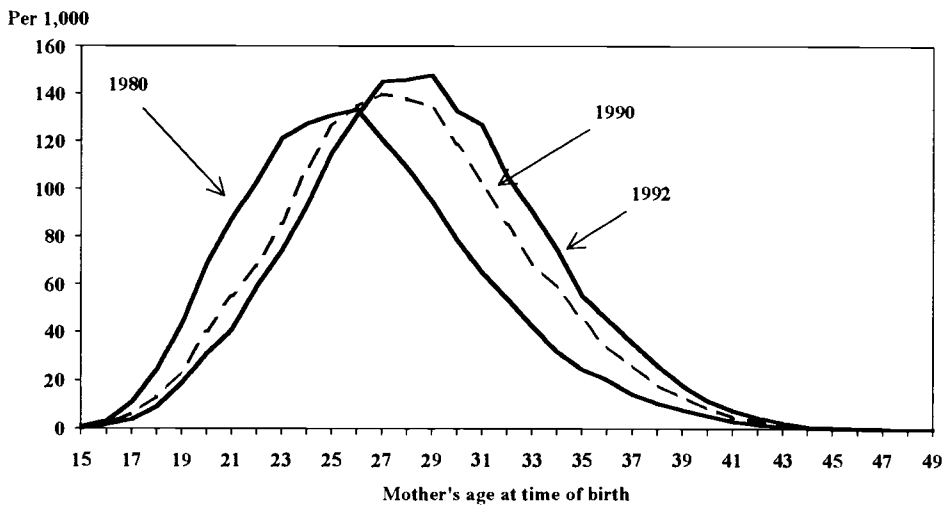
The average age of women giving birth had increased by about 2 years from the end of the 1970s to 1991 (table 5.1). As this was also the case for the average age at birth of first child, it is pertinent to ask whether this can merely be regarded as a postponement of childbirths or whether women in the two age groups in 1980 and 1990 respectively will also have fewer children than women from earlier years.

Age-specific fertility rates

Figure 5.9 shows age-specific fertility rates for women in Denmark (by age at time of birth of the child) at the beginning and end of the study period, 1980, 1990 and 1992, respectively.

Figure 5.9

Age-specific fertility rates for women. 1980, 1990 and 1992



Sources: Vital Statistics 1982, 1992. Data in Danmarks Statistik

Fertility increases steadily for women aged 27 and over. The increase for those over 27 has been relatively greater than the decrease for those under 27. The most marked increase is seen for women in their early 30s.

In the light of fertility rates based on calendar years and the parity distribution among women giving birth, calculations have previously been made of the proportion of childless women in each age group (generations) and a distribution by number of live births (Hoem 1979, Vital Statistics 1990).

As was seen in chapter 3, there is a high degree of consistency between the previous numbers and the calculations made on the basis of information derived from the Fertility Database. Consequently, the remaining part of this section is based exclusively on the Fertility Database.

Average number of live births

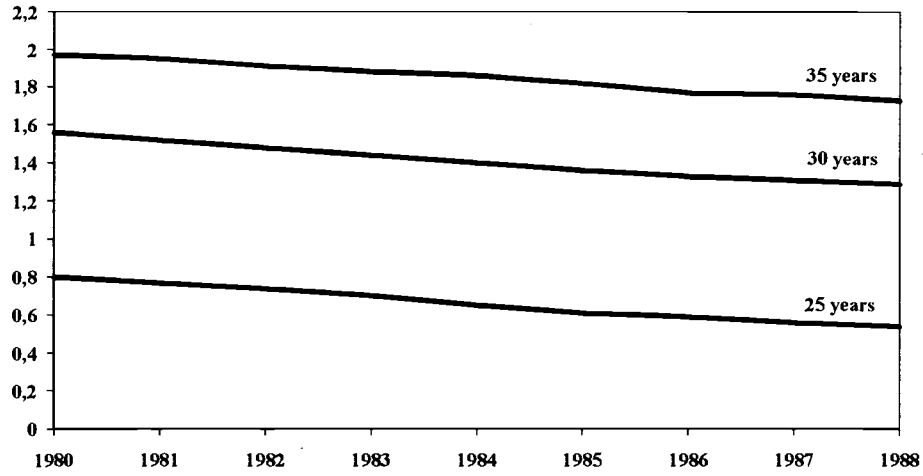
For women included in the Fertility Database, a parity has been estimated for each year based on the number of liveborn children identified in the registers used (see chapter 3). The average number of live births per woman has also been calculated. In the present report this measure is used for comparing fertility among selected groups of women, e.g., birth cohorts.

Figure 5.10 shows the average number of liveborn children to women aged 25, 30 and 35 years throughout the period.

In 1981, women aged 35 years had given birth to two children, on average, and this number had fallen by 1988. There are similar trends for all three age groups. On average, each woman had 0.5 child at the age of 25 in 1988.

Figure 5.10

Average number of children to women. Ages 25, 30 and 35 years



It was stated in chapters 3 and 4 that the reliability of the calculated parity is highest for younger women in the population, as references from child to mother among older women are not available. Consequently, the stated fertility may well be too low for older women, but correspondance between the number of identified children and actual children is greatest for women aged 25 in 1988. The difference recorded in 1988 would, therefore, be greater, if there was no difference in the registration.

The figure shows that during the 1980s women at a given age have had - on average - fewer children.

Number of children

Another way of illustrating the recent fertility decline is by considering the distribution of women at a given age by number of children. Table 5.2 illustrates this distribution for women aged 25 and 35 in 1980, 1984 and 1988.

Table 5.2. **Percentage distribution of women in Denmark aged 25 and 35 years, by number of liveborn children. 1980, 1984 and 1988**

	1980	1984	1988
25 years			
0 children	45.2	54.1	61.8
1 child	32.7	29.0	24.8
2 children	19.4	15.0	11.7
3 children	2.4	1.8	1.5
4+ children	0.3	0.2	0.2
35 years			
0 children	10.7	11.9	15.0
1 child	15.6	18.1	20.2
2 children	46.9	48.0	46.3
3 children	20.9	17.6	14.9
4+ children	4.7	3.4	2.7

At both ages a smaller proportion had more than one child in 1988 than in 1980.

In 1980, 22% of the women aged 25 had already at least two children, as opposed to approximately 13% in 1988.

The differences are not so pronounced for women aged 35 although they do show the same tendency: fewer women with more than two children, an increase in the proportion of childless women or women with one child in 1988, and an unchanged proportion of women with two children.

If the distribution for women aged 35 and with children is considered, just over 50% of them had two children, while the proportion with 1 child had increased from 17.5% to 23.8%.

Table 5.3 **Percentage distribution of women aged 35 with children. 1980, 1984 and 1988**

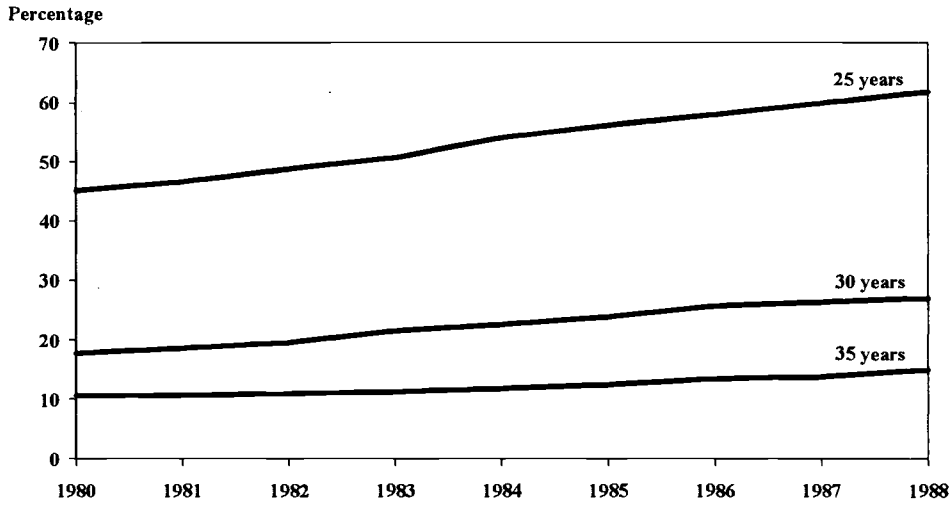
	1980	1984	1988
1 child	17.5	20.6	23.8
2 children	52.5	54.5	54.5
3 children	23.4	20.0	17.5
4+ children	6.6	4.9	4.1

In the ten-year period covered by the study, the steadily increasing proportion of childless women at each age is attributable to the constant postponement of the first birth. However, even for women aged 35 years, the majority of whom have had all the children they are likely to have, there was an increase in the proportion of childless women from 11% in 1980 to 15% in 1988.

Figure 5.11 shows the proportion of childless women aged 25, 30 and 35 years. More than 60% of women aged 25 were childless in 1988, and the largest changes can be observed for this group of women.

Figure 5.11

Proportion of childless women at ages 25, 30 and 35. 1980-1988



Fertility among women over 30

Since 1981, fertility rates increased for women over 30 years and also for those over 35. Two cohorts are followed throughout the 1980s in order to analyze differences in the average number of live births at age 35 and the total number of children these women will give birth to.

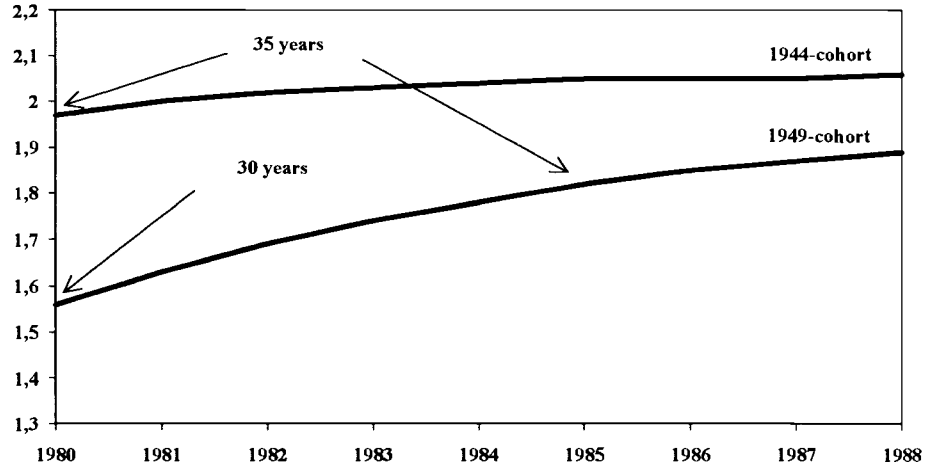
Women born in 1944 were all aged 35 at 1 January 1980. This is the oldest generation that can be followed in the Fertility Database with an adequate coverage of the number of registered children.

Figure 5.12 shows changes in the average number of liveborn children among women aged 35 (born in 1944) and 30 (born in 1949) on 1 January 1980. The 1944 generation was aged 43 at the beginning of 1988 and had completed their fertility career.

The figure shows that the number of live births at age 35 is considerably higher than at age 30, and that fertility after age 35 is of little importance. However, this "late fertility" appears to become increasingly important in the youngest cohorts.

In other words, women aged 30 in 1980 already had 86% of the children they would have as 35-year-olds, while women aged 35 had 96% of the children they would have as 40-year-olds.

Figure 5.12 **Average number of children to women aged 30 and 35 years, respectively. Cohorts 1944 and 1949**



The most significant change in the number of liveborn children after age 35 is recorded for women who gave birth at a high age and who had a relatively low number of children between age 30 and 35 years. Later, it will be shown that women aged 35 and with an upper secondary education had only 94% of the children they would have as 40-year-olds, while women who had left school after the ninth form already had 97-98% of their children by age 35.

5.6. Cohort Fertility

Although most of the description above has concentrated on fertility by calendar year and age of women, it is equally important and illustrative to analyse the fertility in various cohorts of women.

It has been mentioned that previous generations of women had a completed fertility of approximately 2.1 children per woman. Present generations in the childbearing agegroups will, however, not reach this level (Matthiessen, 1990).

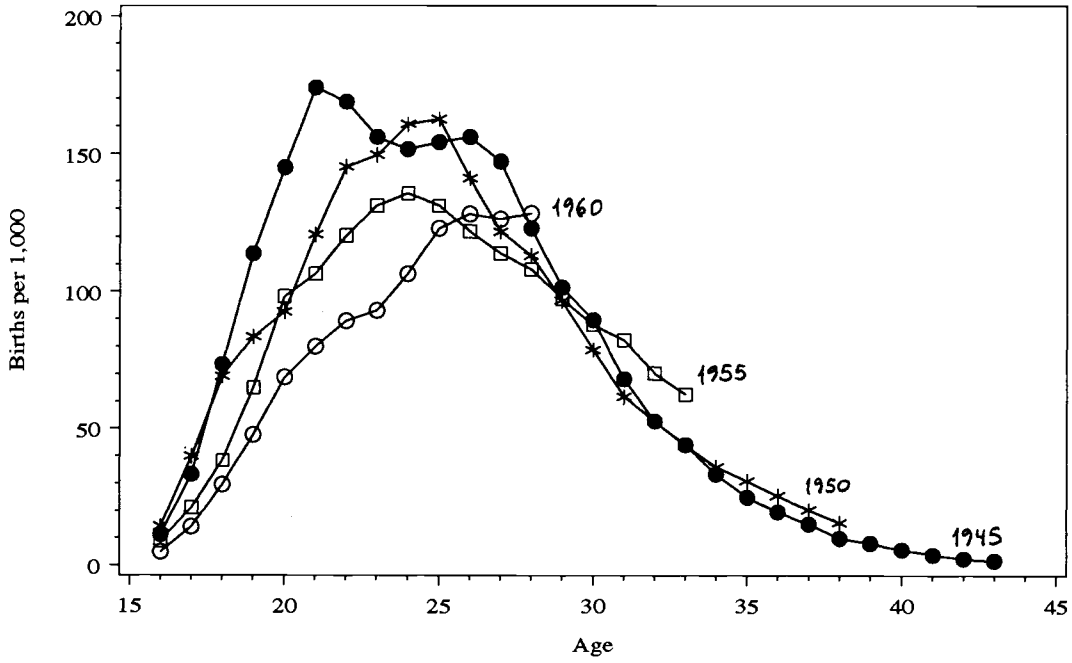
On the basis of previously published data (Vital Statistics), age-specific fertility rates for one-year cohorts of women have been analysed (Holm Petersen, 1992).

Figure 5.13 illustrates the age-specific fertility rates of the cohorts of women born in 1945, 1950, 1955 and 1960.

As it can be seen from the figure, the fertility curves are clearly increasingly shifted to the right for the later cohorts. In general, the level of fertility has been decreasing. The fertility rates are especially low for the two youngest cohorts (1955 and 1960).

The figure also shows that the younger cohorts have higher fertility rates in their 30s. The 1960 cohort has higher fertility rates after age 26 than is the case for the 1955 cohort.

Figure 5.13 **Age-specific fertility rates at given ages. Cohorts 1945, 1950, 1955 and 1960**

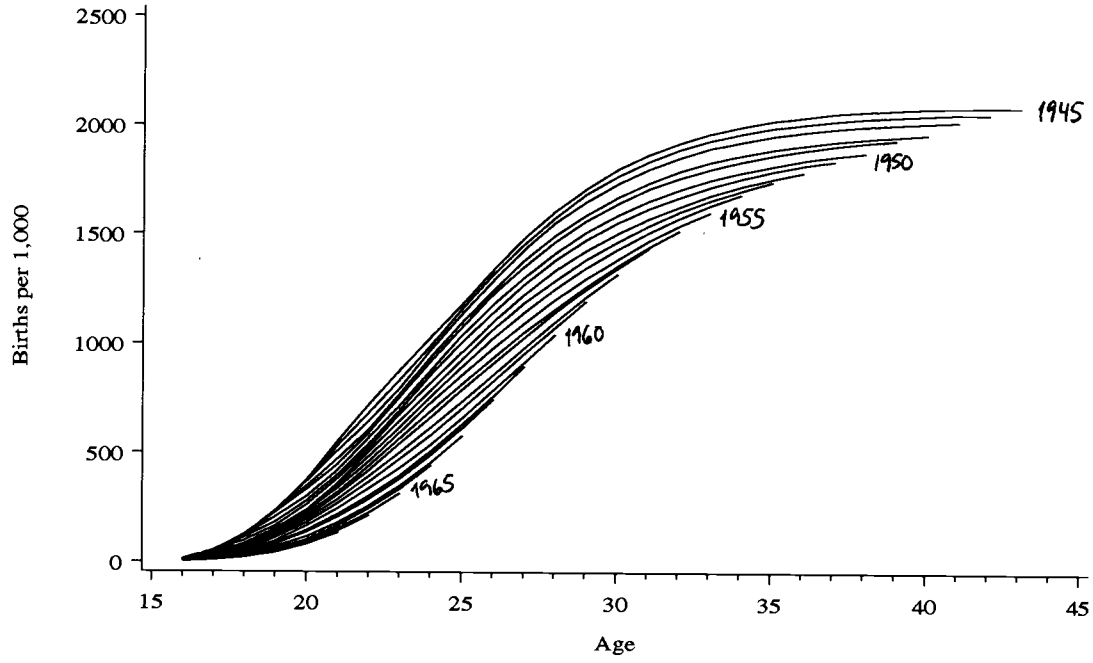


The age-specific fertility rates can be summarized for each cohort, estimating the average number of live births per 1,000 women up to a given age. This calculation equals the total fertility level obtained when no account is taken of mortality among women in the fertile age groups. This cumulated fertility is shown in figure 5.14.

It should be noted that the shapes of the curves change towards the end of the reproductive period, clearly indicating that the total fertility is declining in the younger cohorts compared to previous cohorts.

This does indeed seem to be an overall tendency, but it can only be said definitely of the oldest cohorts (from the 1940s) that these women do not catch up with their "deficit" in the number of live births. None of the curves in figure 5.14 for the oldest cohorts cross each other. This would seem to indicate that each of these cohorts will conclude their childbearing with fewer and fewer children (cf. chapter 6).

Figure 5.14 **Cumulated fertility among women at given ages. Cohorts 1945, 1950, 1955, 1960, 1965**



Main outlines of fertility trends

Fertility trends in the 1980s are thus characterized by a decline in total fertility up until 1983, increasing fertility rates among women over 25 years, an increasing average age at delivery, and a substantial postponement of the first birth. This has resulted in a steadily lower average number of children, particularly among younger women, a concentration of families with two children and a larger proportion of childless women.

Among the younger cohorts, total fertility will end at a level below 2 per woman.

6. Spacing patterns and parity progression

The most essential features of the latest fertility trends have been women's increasingly higher age at birth of the first child and the lower average number of children per woman.

In the present chapter, the time-intervals between births are discussed. It will be evaluated whether this so-called "spacing" varies with the woman's age at first birth and whether the recorded pattern has changed in the course of the 1980s.

Furthermore, age-specific transition intensities from one parity to the next will be presented.

6.1. Spacing

Spacing has an effect on the calendar-based fertility

If the spacing between births changes considerably, calendar-based fertility will increase or decline accordingly whereas generation fertility may remain unchanged. Analyses of spacing patterns can, therefore, contribute to an explanation of current changes in fertility.

As an example of this, analyses of the sharp increase in birth rates observed in Sweden at the end of the 1980s can be mentioned. This increase, which raised the total fertility level to more than 2.1 children in 1990, was related to the recent improvements of women's possibillities of maternity leave (Martinelle 1990). If the woman became pregnant again before termination of her maternity leave, she could continue her maternity leave until birth of the next child and then take another normal maternity leave.

A shorter time-interval between births could be clearly observed, but it has still not been clarified whether or not generation fertility will also increase (Martinelle 1990).

How spacing can be described on the basis of the Fertility Database

The date of each child's birth is recorded in the Fertility Database, and it has therefore been possible to calculate the number of days between the same woman's (or man's) two successive births.

On the basis of the overall data set, it is possible to analyse birth patterns for women born from 1945 onwards and who had their first child in 1960 at the earliest, cf. chapter 3. However, these women are only included in the data set if they were alive and resident in Denmark in 1980 or one of the following years. When the social background conditions are considered more detailed analyses can be conducted for the 1980s.

Parity progression

Parity progression (or transition intensity) illustrates the proportion of women moving from one parity to another - in other words, the proportion of childless women (at a given point-in-time or at a given age) who give

birth to one child or the proportion of mothers with one child who give birth to their second child.

Analyses conducted in various countries have shown that the strongest impact of socio-demographic conditions on fertility is found at the time of the birth of the first child (Kravdal 1989).

Parity progression is calculated as parity-specific fertility rates; for example, the number of births of third children is expressed in relation to the number of women with two children.

Transition intensities in the Fertility Database

Clearly, these calculations demand knowledge of the number of women in the population with a certain number of children and therefore cannot be conducted using the Fertility Database as far back as the spacing analysis, but only for the 1980s.

First and second child

How many women have one child?

The figures presented here are most complete and reliable for the 1980s, but even so, they still illustrate the development prior to 1980.

For the generations of women included in the study, a continuously declining generation fertility as well as a still lower fertility at a given age have been observed cf. chapter 5.

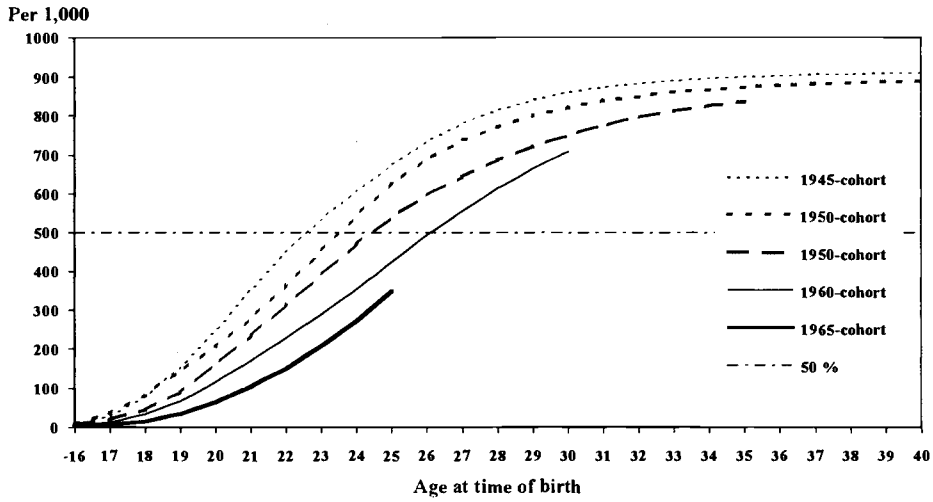
Figure 6.1 shows the number of women from selected years of birth with at least one child at a specific age. The figure is based on calculations from information about the age of women giving birth for the first time in each calendar year (Vital Statistics 1990).

For generations from the end of the 1940s, who have, generally speaking, completed their childbearing during the 1980s, nearly 10% had no children in 1990. Postponement of the first birth has changed the slopes of the curves. Half of the women from 1945 had given birth before they were 23 years old. The generation born in 1955, was more than 24 years old before half of them had children, and the 1960 generation was over 26.

For the youngest generations, the slope of the curve is somewhat steeper, but there is still a smaller proportion with children. If one considers individual generations with single year intervals and not as here 5 year intervals, for some of the generations from the late 1950s women in their mid-30s have surpassed the previous generation (Vital Statistics 1990) as regards the proportion with at least one child.

Figure 6.1

Accumulated proportions of selected generations of women, with at least one child at a given age



Source: Vital Statistics

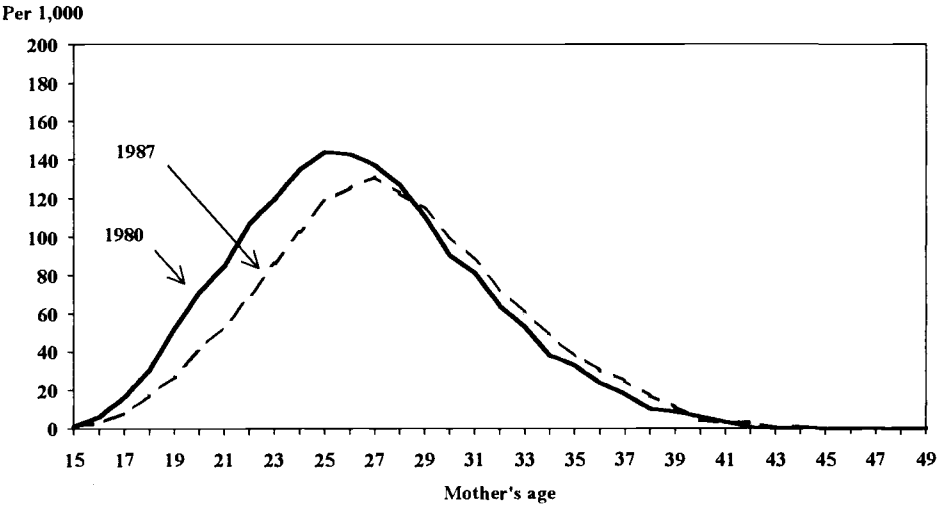
Age-specific birth rates for first births

As already mentioned, transition from one parity to another can be described by means of age and parity-specific fertility rates.

Figure 6.2 shows the age-specific birth rates of first births for women in Denmark in 1980 and 1987. Age is calculated as of 1 January.

Figure 6.2

Age-specific birth rates for first birth. 1980 and 1987



By the end of the 1980s, fertility was lower among younger women than it had been at the beginning of the 1980s, and there was a higher proportion of childless women in their 20s. The lower rates in 1987 are partly attributable to the fact that the group of childless women in the denominator is relatively larger than it was in 1980.

Of 1,000 childless women aged 25 in 1980, 145 had a child within a year. The corresponding number was 119 in 1987. The figure shows that younger women accounted for the greatest differences.

The latest fertility increase, which has continued into the 1990s, has obviosly not yet made an overall impact on this figure as only 1987 is included.

During the 1980s, a continuously increasing number of women aged 35 were childless or had only one child, whereas the proportion with two children was relatively stable and the proportion with a large number of children had declined drastically.

If only women with children are considered, the figures reveal an increasing proportion only ever having one child. In 1980, 18% of women aged 35 with children had only one child compared with 26% in 1988.

Age-specific fertility rates for second child

Age-specific birth rates for second births can be calculated in exactly the same way - the number of women giving birth for the second time as a proportion of the number of mothers with one child.

The proportion of women with one child increased for women aged over 27 during the 1980s, but declined for younger women.

Figure 6.3 shows the proportion of women with one child among all women at a given age. At the beginning of the 1980s, there was a larger proportion of younger women with one child than in 1987. For older women, i.e. women in their late 20s and early 30s, there is a continuously increasing proportion with only one child.

Figure 6.3

Proportion of women with one child according to age. 1980 and 1988

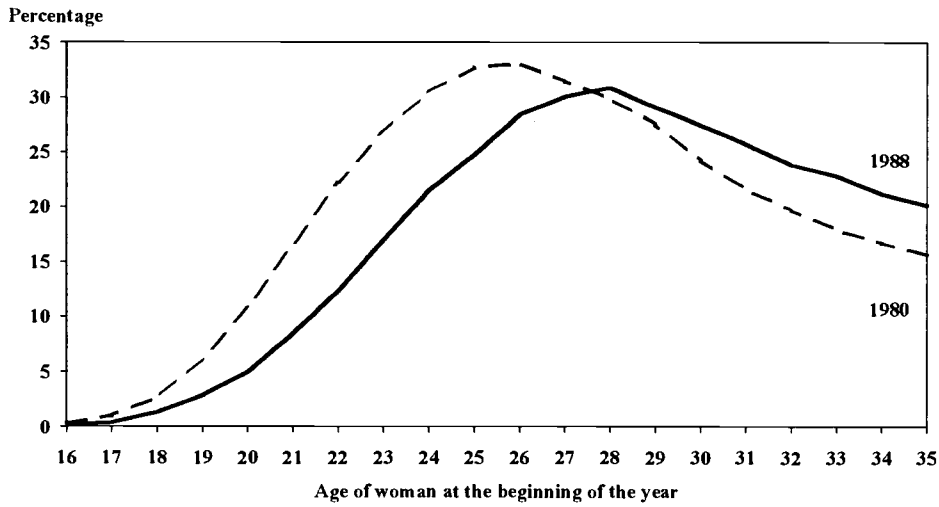
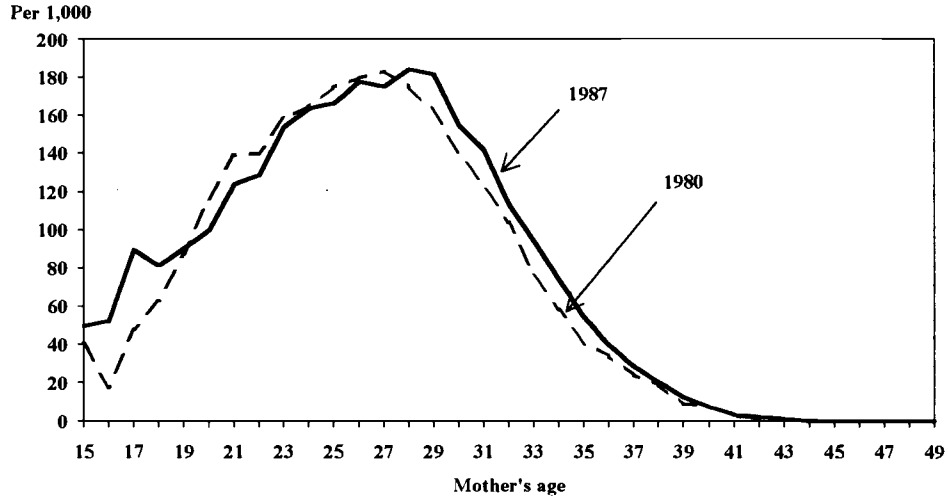


Figure 6.4. shows these rates for second births per 1,000 mothers with one child in 1980 and 1987, respectively.

Figure 6.4

Age-specific fertility rates for second birth. 1980 and 1987



A larger proportion of mothers aged less than 20 years with one child had their second child in 1987 than in 1980. In absolute numbers, 100 women had their second child as a teenager. At the same time, there was a larger proportion of women aged over 27 with one child who had their second child in 1987.

The figure suggests that women who had their first child at a young age made up a more special group in 1987 than in 1980. Figure 6.3 showed that only 5% of the women gave birth before age 20.

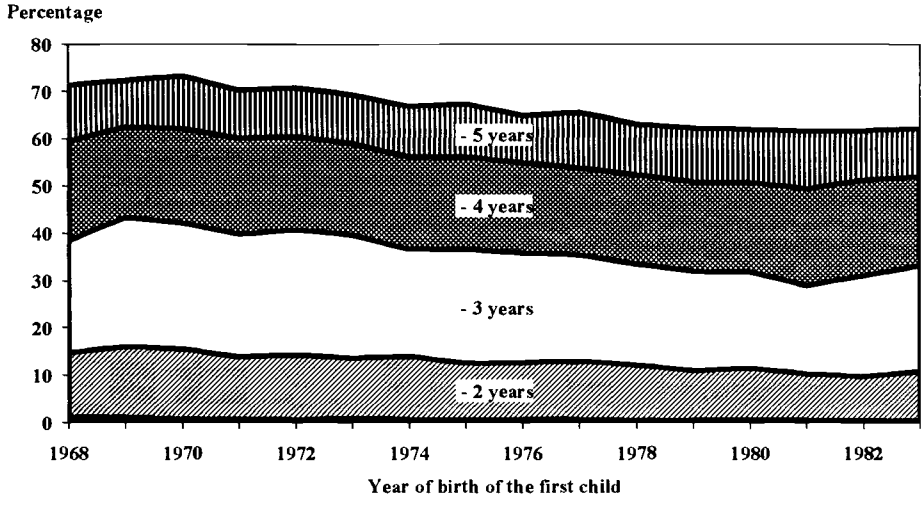
Time-intervals to second child

The average age of women at birth of the first child was 22-23 years in the late 1960s. Figure 6.5 shows the percentage of women who had their first child at the age of 22, who later had a second child, and the time-interval between the birth of the first and second child.

The figure comprises a follow-up period of 5 years which makes it possible to make comparisons up to and including the women who have their first child in 1983.

Generally speaking, the figure illustrates that up until the beginning of the 1980s, there was a still smaller proportion of women with one child, giving birth to a second child within 5 years. The figure is based on accumulated percentages, and the fall can especially be observed within the first 3 years after the birth of the first child.

Figure 6.5 **Percentage of women having their second child within specific time-intervals. Women aged 22 years at beginning of the year of first birth**



In the 1980s, there seems to be a different pattern as an increasing proportion has a second child within the specified intervals. Unlike Sweden, cf. above, this cannot be accounted for by a change in the rules concerning maternity leave.

In figure 6.6, a combination of age effect and period effect is shown. The two solid lines show the time-interval to the second child among women aged 25 and 30 respectively at 1 January 1980 when they had their first child, and the broken lines show the same for 1984.

In both years there was a larger proportion of women aged 25 than of women aged 30, who had a second child within 5 years. If one considers each age group separately, there was a larger proportion in 1984 than in 1980 who had a child during that period.

For the purpose of analysing trends in the 1980s, births among women born in 1960 are described in greater detail in figure 6.7. For these women, the time-interval of up to 5 years can be analysed for women aged 20-24 when they had their first child. The figures reveal that the older the women were when they had their first child, the larger the proportion of women who had another child within 3 years (31%-36%).

This generation of women born in 1960 showed different patterns from 1st to 2nd child, dependent on age at first birth - at least for the ages considered here.

Figure 6.6 **Percentage of women by age and calendar year of first birth and time to the second birth**

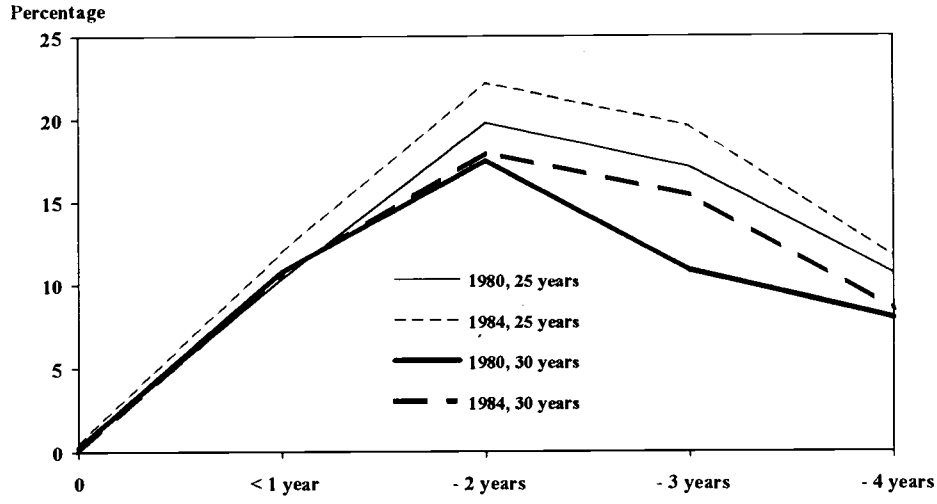
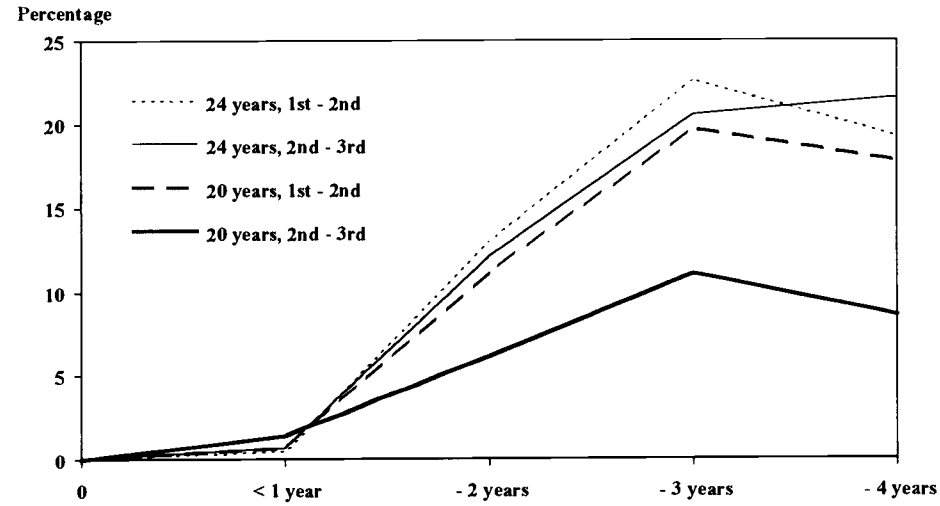


Figure 6.7 shows the proportion of women from the 1960-cohort who had their second or third child within specific time intervals according to their age at the index-birth.

Figure 6.7 **Percentage of women from the 1966-cohort by age at first or second birth and time to the next birth**



A larger proportion of those women who were 24 at their first delivery had a second child within 3 years compared to those giving birth for the first time at age 20.

Only a very small proportion of women having their second child as teenager has a third child within 4 years while this is the case for more than half of the 24 years old women, who deliver for the second time.

Consequently, the age at time of birth within the same cohort has a considerable effect on the time-interval to the next child.

6.2. From second to third child

It has been observed that the proportion of women with two children remained largely the same during the 1980s, whereas the proportion with 3 children has declined. There are thus fewer women at the end of the period with more than 2 children, cf. table 5.2.

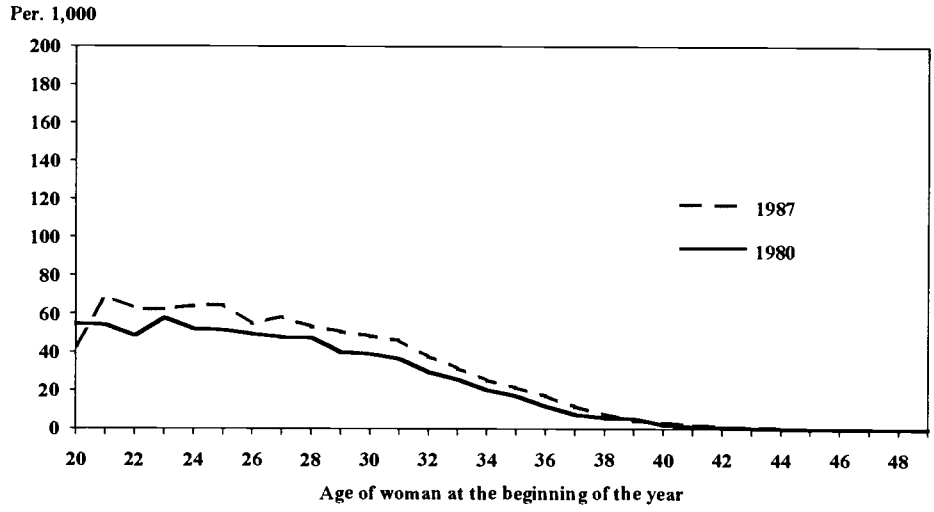
When is the third child born?

The average age at birth of the third child was approximately 31.5 years at the end of the 1980s (cf. chapter 5).

Figure 6.8 shows fertility rates for third births for women who already had two children. The rates have not been calculated for women under 20 years as the absolute number, who give birth to a third child at this age is so small that the curve shows substantial fluctuations.

Figure 6.8

Age-specific fertility rates for third birth. 1980 and 1987



The figure shows that there was a higher frequency of third births among women with two children in 1987 than was the case in 1980.

Main trends

Through the 1980s, each younger generation of women has had fewer children than previous generations at a given age. Recent years indicate that women from the late 1950s have surpassed previous generations.

Parity specific fertility rates have increased for higher ages, and for second and third births.

7. Marital status and family forms

Extramarital fertility, which had been increasing since the low level in the 1950s, continued to increase considerably throughout the 1970s as total fertility in general declined.

In 1970, 11% of liveborn children were born by an unmarried (or divorced) mother, whereas in 1983 the proportion was 40.6% and in 1990 almost half of all births (46.4%) were outside marriage (Vital Statistics 1992).

New family forms

However, this increase in extramarital fertility does not reflect the fact that relatively more women are living alone when they have their children, but instead the result of a substantial change in family forms over the past 20 years. These changes have been so fundamental that traditional demographic statistics based on marital status are no longer relevant in Denmark. New statistical classifications have been developed to replace statistics on marital status.

Changes in family forms and improved methods to monitor the ongoing changes with the help of routine statistics are discussed below. The first parts of this chapter (7.1 and 7.2) are based on previously published data, while the remaining parts are based on data from the Fertility Database.

7.1. Changes in family forms

Fewer married men and women

Approximately 40% of women aged 25-29 were married in 1989, compared to 25% of men of the same age. Since 1980, there has been a decline, from 63% among women and 43% among men.

Table 7.1 presents some summary figures describing the changes that have occurred. The 1970s saw the sharpest decline in marriages. From 1970 to 1982, marriage rates were halved for women as well as men. This was followed by a minor increase so that the level at the end of the 1980s corresponded to that of the early 1980s.

Table 7.1 **Key Statistics on Marriage in Denmark**

	1965	1970	1980	1990
Number of marriages contracted	41,693	36,376	26,448	31,000
Rate of marriage[1]				
Women	59.9	50.5	28.7	27.6
Men	81.4	67.2	36.7	33.3
Average age at 1st marriage				
Women	22.9[2]	24.6	24.8	27.6
Men	26.0[2]	27.3	27.5	30.2
Percentage of marriages Bachelor with Spinster[3]	83.3	75.7	62.3	62.2

[1]per 1,000 never married
[2]1960
[3]1971. No data available for 1970
Source: Vital Statistics 1971, 1972, 1982, 1992

The most significant change in the contracting of marriages occurred at the end of the 1960s, whereas the change in the average age at first marriage took place at a later time - the average age at first marriage increased by approximately 2.5 years throughout the 1980s. The majority (approximately 2/3) of the marriages are still contracted between never married men and women.

However, it is worth nothing that the average age at marriage was low in the 1960s. At the beginning of the century average age at first marriage was approximately 28 for men and 25 for women. For both sexes this age was more or less constant up until the late 1940s where a decrease began. In 1960 the average age at first marriage was 26 for men and 23 for women.

A study on marriage covering the period from 1878 to 1882 showed a variation in men's average age at first marriage (in Copenhagen) ranging from 29 to 34 years, with the highest age in the upper social class. The variation among women, according to their husbond's social position, was minor (Rubin & Westergaard 1890).

The decreasing popularity of legal marriage in the 1980s is not a result of an increased propensity for young adults to live alone or to live with their parents.

Cohabitation

Living as a couple, "sharing bed and table", but not being legally married has gradually become socially as well as legally accepted and is now considered equal to matrimony - also with regard to childbirth - which has changed cohabitation from a premarital trial to a permanent, or at least a long-lasting arrangement.

In the beginning, it was only possible to describe the number of couples living together on the basis of interview surveys as there was no statistical registration of this phenomenon. Statistical methods to analyse the different

forms of cohabitation and family formation were considered by Kaysen Petersen (1985) and Skotte (1989), among others.

Table 7.2 shows the percentage of men and women cohabiting according to interview surveys in the period 1976-1988 when it was impossible to describe the development using routine statistics.

Table 7.2 **Men and women cohabiting as a proportion of all couples living together (married as well as cohabiting)**

	Men			Women		
	20-24 years	25-29 years	30-34 years	20-24 years	25-29 years	30-34 years
	pct.					
1976-77	69	30	10	49	19	10
1978-79	73	38	15	56	26	12
1980-81	73	48	22	64	32	13
1982-83	79	54	24	68	38	18
1984-85	83	56	31	72	40	19
1986-88	85	61	34	77	44	21

Source: Omnibus surveys referred in Vital Statistics 1990.

From the beginning of the 1970s, cohabitation was mainly predominant among younger people. As these men and women aged (in 1976-77 they were 20-24 years, in 1986-88 they were 30-34 years old) some still lived in consensual unions, but among those aged 30-34 years, the proportion of cohabiting couples was not as large as when these same men and women were ten years younger (Vital Statistics 1990).

The proportion of consensual unions had to be estimated from surveys as censuses in Denmark have been based on registers since 1976.

The earliest classifications of a non-married nucleus of a family in vital statistics only covered cohabiting couples with at least one joint child. The use of this definition gave figures comparable to the data from the various surveys. An operational definition of a family which also includes a man and a woman living together at the same address but not legally married and where the difference in age is less than 15 years and where there is no biological relationship between them has been used since 1 January 1991, in order to improve the current statistics. These data are unfortunately not available for the present study period.

Social changes in respect of legislation and attitudes have tended towards legalizing cohabitation. In the 1970s, it was still necessary in many municipalities to be married in order to be entitled to a flat. In 1990, cohabiting couples are given almost the same legal status as married couples with regard to right of inheritance, for example. However, a legal acknowledgment of paternity has to be effected in respect of cohabiting couples before the man can be registered as the father of a child.

7.2. Extramarital fertility

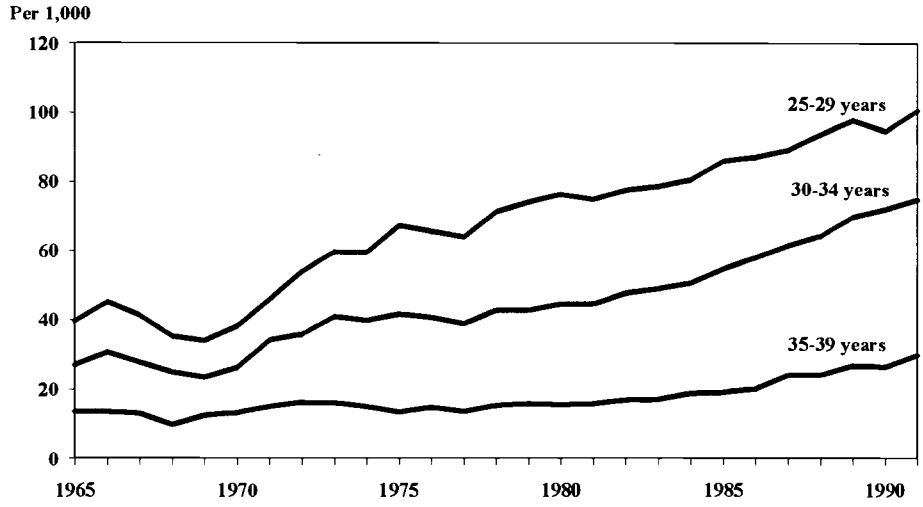
There are hardly any births outside marriage among women aged less than 20 in Denmark. It was seen in chapter 5 that a very small proportion of teenagers give birth to a child in Denmark, and among the teenagers who do give birth to a child nearly all of them are married. Only 6-7 of 1,000 unmarried teenagers gave birth to a child in the late 1980s. And this proportion has been steadily declining (cf. table 7.3).

Increased fertility among unmarried women over 25

However, there have been large increases in the number of births outside marriage among women over 25 since the beginning of the 1970s. This can be seen from figure 7.1, which shows the age-specific fertility rates for unmarried women aged 25-39 years.

Figure 7.1

Age-specific fertility rates for unmarried women. 1965-91



Source: Vital Statistics, various years

Fertility among unmarried women has shown an upward trend for women over 25. Comparing changes in fertility rates for unmarried versus married women, it can be seen that the increase among unmarried women in the age groups 25-29 and 30-34 has been considerably larger than the increase among married women of the same ages, cf. table 7.3.

Fertility rates for married women are, apart from women aged 35-39, considerably higher than for unmarried women. The younger the women, the larger difference.

Table 7.3

Age-specific fertility rates per 1,000 married and unmarried women. Selected years

Age	1970	1975	1980	1985	1990
Married					
15-19 years	639.5	430.6	390.7	240.4	259.0
20-24 years	225.1	272.6	232.5	224.4	254.8
25-29 years	150.9	162.3	147.1	159.5	198.1
30-34 years	71.6	65.9	57.7	69.0	97.0
35-39 years	26.4	18.9	15.7	18.2	27.7
40-44 years	5.8	3.4	2.5	2.6	6.4
Unmarried					
15-19 years	17.7	19.6	13.5	7.6	6.6
20-24 years	30.9	64.8	63.9	54.5	54.3
25-29 years	38.2	67.2	76.2	86.0	94.7
30-34 years	26.2	41.7	44.6	55.0	72.1
35-39 years	13.2	13.3	15.5	19.3	26.5
40-44 years	3.2	3.1	2.4	3.8	4.7

Source: Vital Statistics, 1982 and 1992

As already mentioned, increasing extramarital fertility does not, however, indicate that women live alone when they have a child. It is more a case of family forms in Denmark changing, and the fact that legal marriage is no longer the predominant form of living together in all age groups (Knudsen 1992).

7.3. Family forms among women aged 25, 30 and 35 years

Chapter 5 dealt with the average number of live births and the parity distribution for women aged 25, 30 and 35 years.

In the following the family forms of these women in selected years in relation to their fertility are described. The data are extracted from the Fertility Database.

Fewer married women

Table 7.4 shows that at each age fewer of the women were married in 1988. The greatest change took place among the youngest women, where the proportion of married women in 1988 constituted only approximately 60% in relation to 1980. There was a relative fall of only approximately 15% for women aged 35.

Table 7.4

Proportion of married women aged 25, 30 and 35 years in 1980, 1984 and 1988

	1980	1984	1988
25 years	52.5	38.2	31.4
30 years	75.6	64.7	57.9
35 years	82.1	76.9	69.7

Fewer married than unmarried women are childless

The proportion of childless women at the three selected ages is only approximately half as great among married women as among all women throughout the period. In 1988, there was a higher proportion of childless women in both groups than in 1980, but the greatest change is seen for married women. In 1988, 31 % of married women aged 25 were childless (as opposed to 21 % in 1980). The corresponding figures for unmarried women were 77 % and 74 %, respectively.

Table 7.5

Married[1] and unmarried women aged 25 and 35, according to number of children. 1980, 1984 and 1988. Percentage

	1980		1984		1988	
	Marr.	Unmarr.	Marr.	Unmarr.	Marr.	Unmarr.
25 years						
0 children	21.3	73.6	25.4	73.4	31.3	76.8
1 child	42.4	20.9	41.3	20.6	39.4	17.6
2 children	31.8	5.0	29.2	5.6	25.4	5.1
3+ children	4.5	0.4	4.0	0.5	4.0	0.5
35 years						
0 children	5.8	62.5	6.1	53.6	7.2	46.8
1 child	13.5	24.9	15.2	27.7	16.5	28.4
2 children	51.2	9.8	54.0	14.6	54.1	20.5
3+ children	29.3	2.8	19.9	4.0	22.3	4.2

[1)]Including separated

The largest difference between the number of live births among married and unmarried women can be observed for younger women.

Young married women have relatively more children

As can be seen from table 7.4, there was a decline in the proportion of married women, especially among the youngest women. At the same time,as can be seen in table 7.2, there are more men and women in relative terms among the young who live together without being legally married. On the whole, this indicates that women who marry at an early age still constitute a special group. Presumably, young couples marry if they decide to have children.

However, it appeared from table 7.3 that while there were, generally speaking, no unmarried teenagers in 1990 who gave birth to a child, fertility rates for married teenagers and women aged 20-24 were considerably higher throughout the period than fertility rates for unmarried women of the same age.

Table 7.6 shows the average number of live births among married and unmarried women aged 25, 30 and 35 years in 1980, 1984 and 1988.

Table 7.6 **Average number of children to married and unmarried women aged 25, 30 and 35 years in 1980, 1984 and 1988**

	1980		1984		1988	
	Marr.	Unmarr.	Marr.	Unmarr.	Marr.	Unmarr.
25 years	1.20	0.32	1.13	0.33	1.03	0.29
30 years	1.79	0.53	1.71	0.64	1.64	0.68
35 years	2.12	0.54	2.03	0.70	1.97	0.83

The table shows that at all ages the difference in 1988 is less than in 1980. The greatest change in the relative difference in the number of live births between married and unmarried women can be observed for women aged 35 years.

This is in accordance with table 7.3 which showed an increase in fertility rates for unmarried women aged over 20. It can be seen that the older the women, the larger the increase in fertility rates, and the increase was twice as large for women aged 30-34 than for women aged 20-24.

7.4. Women had fewer children than they had expected

In 1970, The Danish National Institute of Social Research interviewed a sample of married women regarding how many children they expected to have. In general, the women interviewed in 1970 expected to have 2 children, a number stated by 53% of the women aged 15-19 and 42% of the women aged 20-24 (Bertelsen & Ussing 1974). Women, aged 20-24 in 1970 were born in 1945-49. In 1988, they were 38-43 years old and had more or less completed their fertility, cf. figure 5.10.

On the basis of the Fertility Database, it is possible to consider the fertility that was attained by women from the birth cohorts included in the interview survey in 1970.

Figure 7.2 shows the percentage distribution of the expected number of children for the married women of these cohorts (1970) compared with the actual distribution among all women in the Fertility Database (1988). The most conspicious characteristic is the increase in the proportion of childless (10.3% as opposed to the expected 0%) and of mothers with one child (16.3% as opposed to the expected 4%).

As already mentioned, the women interviewed in 1970 were all married, which, generally, implies that they already had a higher average number of children than unmarried women of the same age. On the other hand, it was still common practice in 1970 to marry in the early 20s, and consequently, this group was not as selective as that of married women of the same age today.

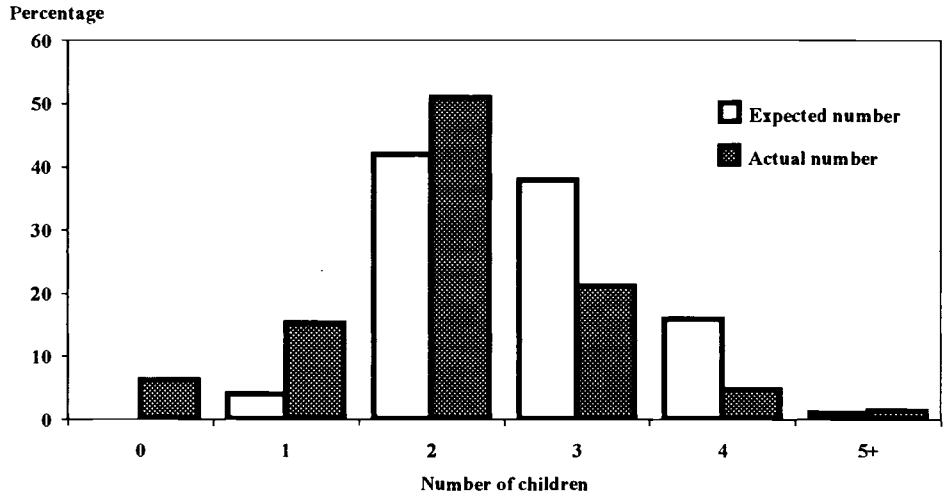
If we consider the proportion of childless women in 1988 in the Fertility Database belonging to the same cohorts, this figure exceeds the expectations of the women.

Consequently, the comparison between interview data and the Fertility Database clearly indicates that the women did not have the number of children they expected.

Various other data confirm this notion. In an interview survey in 1975, about 4% of women aged 18-29 stated that they did not expect to have any children. Of these women, 10.3% (of cohorts 1945-49) and 12.6% (of cohort 1950) were childless in 1988. The women from the 1945-49 cohort do not, generally speaking, have any more children after 1988.

Figure 7.2

Comparison between actual (all women) and expected number (married women) of live births among women born in 1945-49



Source: Bertelsen & Ussing 1974, and Fertility Database

At the end of the 1970s, other interview surveys showed that almost half of the women expected to have 2 children, and that not more than 15% expected 1 or did not anticipate having any children at all, and that only 7% expected to have more than 3 children. On average, the women expected to have 2.0-2.1 children (Andersen 1981), and among the younger women there was a greater proportion who expected to have less than 3 children.

The generations from the turn of the century and up until 1925 had about 2.3-2.4 children per woman (Matthiessen 1970). Their daughters, who started their own family and births in the 1970s, expected - on average - to have 2-2.5 children, i.e. approximately the same number of children as their mothers had.

However, the cohorts of women from the late 1940s had in 1988 on average only approximately 2 children. In other words, they did not have as many children as they had expected to have. Instead of a family with 2-3 children, they had a family with 1-2 children. As shown in chapter 5, these women will have a completed total fertility below 2.

7.5. Attitudes towards the family

This chapter has illustrated substantial changes in family forms and fertility pattern related to marriage. Both men and women marry at a higher age - if they marry - and they are older when they have their first child and they have fewer chiildren.

Following the thesis behind the second demographic transition this development would be a consequence of the individualistic investment in self fulfillment, affective relations between the partners and demands of high quality in the parent - child relation as well (Lesthaeghe & Meekers 1986).

An ongoing European study (European Values Study) has investigated changes in attitudes to various social aspects, e.g., the family, from 1981 to 1990 (Gundelach & Riis 1991). In the study, data for Denmark have shown an increasingly positive attitude towards the family. The relatively strongest increase in this positive attitude was seen among generations below the age of 30.

Qualities like faith, trust and affection are considered more important for a good partnership (or a good family) in 1990 and a stronger wish to have children (at least 2) is expressed. In 1990, approximately 70% agrees that women need children compared to 50%-56% in 1981. This change has occured in all groups of cohorts 1937-45, 1946-54, 1955-63. A similar increasing proportion agrees that children need both their parents (Gundelach & Riis 1993).

These expressed positive attitudes towards the family might at first sight seem incompatible with the higher proportion of men and women living alone at still higher ages, the decreasing number of children and the growing proportion of childless women.

But, in view of the characteristics of the second demographic transition, the increasing importance of family values supports the explanatory value of the transition. The possibilities of planned parenthood imply that childbirth is often postponed until the family as well as the economic frames are satisfactory.

Main trends

Family forms in Denmark have changed as consensual unions have become more frequent. In consequence, extramarital fertility is considerably high. Marital fertility is, however, much higher among women under age 30.

Compared to surveys in the 1970s, the observed cohort fertility shows that women have not had as many children as they wished to have.

In spite of the decreasing number of children, a larger proportion has expressed positive attitudes towards the family in the European Value Study, which supports the idea of a second demographic transition.

8. Education and fertility

In this chapter, the relationship between women's educational status and fertility in Denmark in the 1980s is analysed on the basis of the Fertility Database.

Previously, information on the importance of educational status on women's fertility, number of births and age of women giving birth was obtained mainly from interview surveys. The educational status of women has been included in the fertility surveys conducted by the Danish National Institute of Social Research (Bertelsen 1981, among others), for example.

It has also been possible to use results from Swedish and Norwegian studies based on interviews (Bernhardt 1989) as well as registers (Kravdal 1989). However, the levels of fertility as well as the educational status and occupational distributions are not the same in all the Scandinavian countries, so it cannot be assumed a priori that all of the Swedish and Norwegian results will apply to Denmark.

8.1. Age differences

Differences in educational status implies differences in age distribution

In chapter 5, the relationship between fertility and women's age was discussed. In addition to the large differences in fertility rates in the various age groups, it was a noticeable feature that major changes in the age of the mother at especially first and second births had taken place in the relatively short period covered by the study.

It is important to bear this in mind when conducting an analysis of the relationship between fertility and educational status. Nine years of compulsory school attendance in Denmark implies that most young people are 15-17 years before they can leave school, and 18-20 years before they have completed an upper secondary examination or an education at a similar level. Consequently, there can be large age differences when they commence as well as when they complete a vocational education.

Thus comparisons of age-specific fertility rates for women according to their educational status cannot be made easily, as some women will have given birth to their first child at an age when other women have not yet completed their education.

This will be taken into account in the following analysis. As far as general education is concerned (upper secondary school examination or similar level), the above-mentioned circumstance is of limited importance as only an insignificant proportion of women have their first child before they are 20 years old.

At the same time, "general education" is frequently the only educational variable included in the analyses which the results of the present study are compared with and, therefore, attention will be focused on general education.

In the following, a brief account of the most important results from previous studies will be given. The educational status of the study population is then discussed and this is followed by an analysis of the relationship between educational status and fertility.

Some of the fertility research in medical sociology and preventive medicine have shown that there is a close relationship between the educational status of women and the risk of giving birth to a stillborn child or a child who dies during its first year of life (e.g., Bjerkedal 1980, Ericsson 1984 and Knudsen 1988). In this respect, the educational status of women is interpreted as an indication of general social status and the extent to which women can influence the course of pregnancy and birth in an active way.

8.2. Previous studies

Higher education - later first birth

In general higher education leads to a woman postponing the birth of her first child, and to her having fewer children. However, this may be due to a wide range of interactive factors. Very young women with a child may find it more difficult to complete a vocational education than women with no children. On the other hand, a woman who has not completed her education may well postpone the birth of her first child until she has completed her education, and perhaps even until she has a job.

Having children at a later age may also lead to a lower total fertility level, either because a woman's fecundity (the ability to become pregnant) decreases with increasing age, or because having a job outside the home once one's education is completed is difficult to combine with lots of children, or perhaps with more than just one child.

- shorter spacing between 1st and 2nd child

In Sweden, fertility data reveal, that a later first birth gives in a shorter spacing between the 1st and 2nd birth. Of women born in the period 1930-1945 who had their first child aged 25 years, about 40% of those with higher education (i.e. more than 2 years of education after passing an upper secondary school examination) had their second child within 2.5 years, whereas this is true for only approximately 25% of women without this higher education (Martinelle 1990).

- higher proportion of childless women

Although those with a higher education had their second child sooner there was a higher proportion of childlessness at a given age in the group (Martinelle 1990).

Bernhardt (1989) found in another Swedish data set that frequency rates for first births were much larger for those with a higher education. Births occurred shortly after completion of further education, if the woman did not continue her education, or they were postponed further if she continued her education.

- higher proportion of women have a third child

Hoem & Hoem (1987) have analysed especially how the proportion of women who have a second or third child varies with the woman's educational status. The results of the analysis showed that a higher proportion of

highly educated women with two children also had a third child than comparable women with a short education.

A Norwegian register-based analysis of the effect of socioeconomic factors on fertility trends has shown the same main features with regard to educational status as the previously mentioned surveys: later first birth and, on average, fewer children per woman with increasing educational status.

The general increase in the level of education in Norway accounts for approximately 40% of the fertility decline which occurred from the 1945 to the 1955-cohort (Kravdal 1989).

On average, Norwegian women with further education have fewer childen at age 39 than women with a short general education. These differences are especially attributable to the fact that the proportion of childless and unmarried women is higher among women with higher education. At the same time, age at marriage for women in this group is usually higher. However, for a given age at marriage there was only a minor relationship between fertility and educational status (Kravdal 1989).

The general result, however, is that fertility at all levels of education decreased over time. In other words, a general reduction of the fertility level has occurred. In another analysis of the same data set, where other socio-economic factors are included, it was concluded that ideological changes, i.e. changes in attitude, have played an important part in the development of fertility (de Leon 1990).

Danish studies

The results of Danish surveys are very similar to those stated above in as much, as age at first birth increases with increasing level of education. At the beginning of the 1970s, women with a short general education had their children at a younger age than women with a long general education (Mørkeberg 1976).

Women in the labour market

Any vocational education that may follow the general education plays a decisive part in women's labour market status and thus their overall situation as well as their economic situation in particular. Part of the mentioned relationship between educational status and fertility may be accounted for by vocational education. A long general education gives access to a long vocational education, and women pursuing vocational education will therefore be even older before they have established themselves in the labour market.

The Danish fertility decline in the 1970s was generally accounted for by the steadily increasing proportion of women who completed some form of vocational education. In the same period, there was an indication of increasing fertility among women with no vocational education, but this group was too small to influence the overall trends (Bertelsen 1981).

According to Dirk van de Kaa's description of individualization in the second demographic transition it followed that women did not start a family in the traditional sense, i.e. had their first child, until a satisfactory status in the labour market had been attained (van de Kaa 1987). Consequently, a long education will result in fewer childbirths.

Children or a career

One study has shown that once a child has been born, this has a greater negative effect on a woman's career profile, the higher the level of education she has (Smith 1990). The more children a woman with a long education has, the more she falls behind in relation to men with the same education. At the same time, it is more difficult for women with some form of higher education with 3 children to find a job.

However, among women with a short or medium-length education, the number of children plays a minor part in their career (Smith 1990). This problem will be discussed further in the chapter on occupation and fertility (chapter 9).

The economic model

The analysis made by Smith is based on an economically oriented theory, where any career interruptions on account of births and child care result in a depreciation of the invested human capital in education. In extreme cases, this starting point implies that the planning of childbirths can be regarded as based on an economic calculation.

Although this analysis considers the occupational work of the woman after completion of an education, the considerations are also of relevance in connection with general education, as this determines the character of subsequent education.

The level of general education attained is, as already mentioned, of decisive importance for women's status in the labour market and thus for their overall economic situation as well as life situation.

Attitudes

Other theorists have discussed the importance of changes in attitude and values acquired by women during their education. As already mentioned, de Leon (1990) emphasized that considerable changes in attitudes had occurred. A discussion of the various tendencies can be found in Blossfeld & Huinick (1991).

Complicated causal relationships

The above-mentioned surveys more than suggest the complicated relationships between educational status and fertility, where factors such as family formation, employment and income also play a part.

In the following sections, the importance of general education in particular will be analysed. Fertility among women according to educational status will be described.

8.3. Women's educational status

The analysis of fertility is based primarily on groupings of variables characterizing the highest completed level of general education and the latest

completed vocational education. The contents of the groupings used can be seen in Appendix III.

The most important change in the educational pattern which has an effect on the results of the analysis occurred during the 1970s when compulsory school education was extended from 7 to 9 years, thereby increasing the proportion of each birth cohort with an upper secondary school examination.

In 1988, 1/3 of the women in the study population had left school after 8th or 9th class, whereas 1/6 had an upper secondary examination (or similar level). Compared with 1981, there were fewer women who had the lowest level of education, while more women had an upper secondary examination.

In 1988, 8% of the women had started a vocational training or further education. The smallest proportions were found among the oldest women, while 27% of women aged 20-24 had started some form of further education. Among women in their 20s and 40s, the greatest proportions had completed a clerical education, while, especially women in their 30s had completed a short further education.

General education

In the study, general education is divided into three levels. As only very few women have attended school for only 8 years, in some cases, this level is combined with the level of 9 years. In other cases, 9 years indicates the shortest general education.

Ten or eleven years of school attendance constitute an intermediate level and the highest level of general education is an upper secondary school examination or an examination at a similar level, e.g. so-called HH or HF-examination.

Table 8.1 **Women in the Fertility Database by level of general education. Age 25, 30 and 35 years. 1988**

	25 years	30 years	35 years
8th class	2,537	1,899	5,467
9th class	4,086	3,792	5,865
10th-11th class	17,627	18,178	12,729
Upper secondary examination	12,199	9,257	6,924
No information or receiving education	1,923	3,285	5,614
Total	**38,372**	**36,411**	**36,599**

Most of the women have completed at least 10 years of schooling. The younger the women, the smaller proportion has attended school for less than 10 years.

The relationship between general education and fertility is considered especially for women aged over 20. At this age, all women have their basic

school education except for the relatively few women who supplement their general school examination with a higher examination (e.g. HF) later.

Most women included in the study population are aged over 20 when they give birth to a child. For the study period as a whole, approximately 3%, 9% and 3% of the women giving birth with 8, 9 or 10-11 years of school attendance respectively are aged less than 20. Among women with an upper secondary examination, less than 1% have given birth before age 20 so this group can only manifest itself among women who have at least 9 years of basic school education.

Among women who have at least 9 years of basic school education, most births during the study period are accounted for by those aged 20-24 years, whereas for the other educational levels those aged 25-29 years account for the majority of births. However, among those aged 20-24 years there are relatively more births among women with 10 or 11 years of schooling than among women with some form of higher education.

At the same time, the group of women with 8 years of basic school education distinguishes itself from the other groups in as much as there is a greater proportion with 8 years of basic school education among the oldest women since the younger women have only been able to leave school after 8 years under special circumstances.

8.4. Trends in fertility

Average age of women giving birth

Table 8.2 shows the average age of women giving birth to their first, second and third child in 1981, 1984 and 1988 by level of general education.

Table 8.2

Average age of women giving birth to 1st-3rd child, by level of general education. 1981, 1984 and 1988

Women with	1981	1984	1988
9th class			
1st child	23.1	23.0	23.3
2nd child	26.3	26.8	26.5
3rd child	29.3	29.6	29.9
Total	**25.6**	**25.8**	**25.9**
10th-11th class			
1st child	23.8	24.3	25.1
2nd child	26.5	27.1	28.0
3rd child	29.8	30.1	30.4
Total 25.5	**26.1**	**27.0**	
Upper secondary school examination			
1st child	26.3	26.9	27.2
2nd child	28.7	29.5	30.0
3rd child	31.6	32.0	32.6
Total 27.8	**28.5**	**28.9**	

During the entire period, women with an upper secondary examination gave birth to children at a higher age than women with a short school education. The differences between these two groups increased during the 1980s, so that in 1988 there is an age difference of about 4 years at the birth of their first child.

However, it is worth nothing that in general the average age of women giving birth has not changed among women with the shortest school education.

In contrast, there have been greater changes among women with 10-11 years of schooling. The average age of women giving birth has increased by about 1.5 years during the 1980s. This group is very close to the overall average age at time of first birth, cf. table 5.1.

Age-specific fertility rates

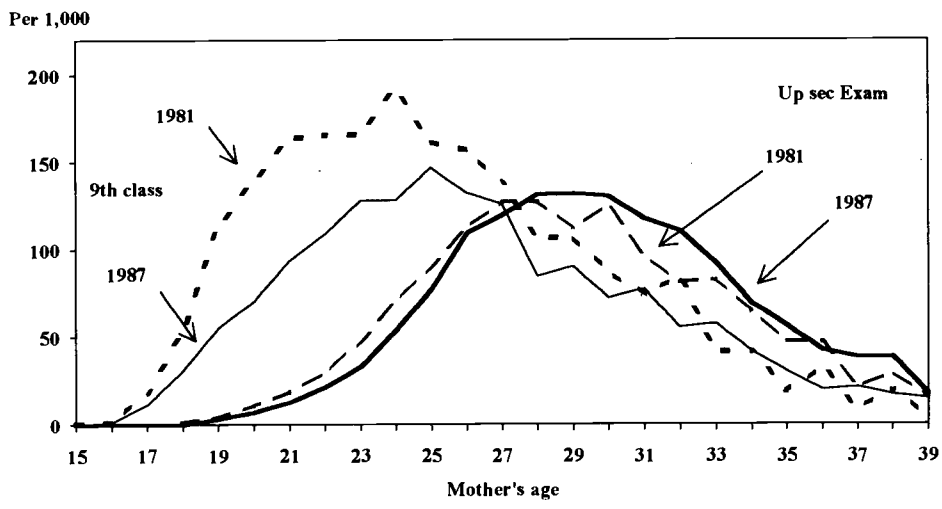
As mentioned above, it is only a small proportion of women who give birth before age 20. However, this number varies somewhat according to the level of general education - from 10-15% among women with the shortest educations to under 1% among women with upper secondary school examinations. These differences influence the age-specific fertility rates for all women.

In the following, only age-specific first birth fertility rates are examined.

Figure 8.1 shows the age-specific fertility rates for first births to women with 9 years of basic school education or an upper secondary examination or similar educational level in 1981 and 1987. This figure shows that up until age 27 the fertility rates for both years are higher for women with the short school education whereas after age 27 the rates are higher for women with a long school education. The age difference between the highest rates is approximately 3 years.

Figure 8.1

Age-specific fertility rates for first birth to women with 9 years of basic school education or upper secondary school examination. 1981 and 1987

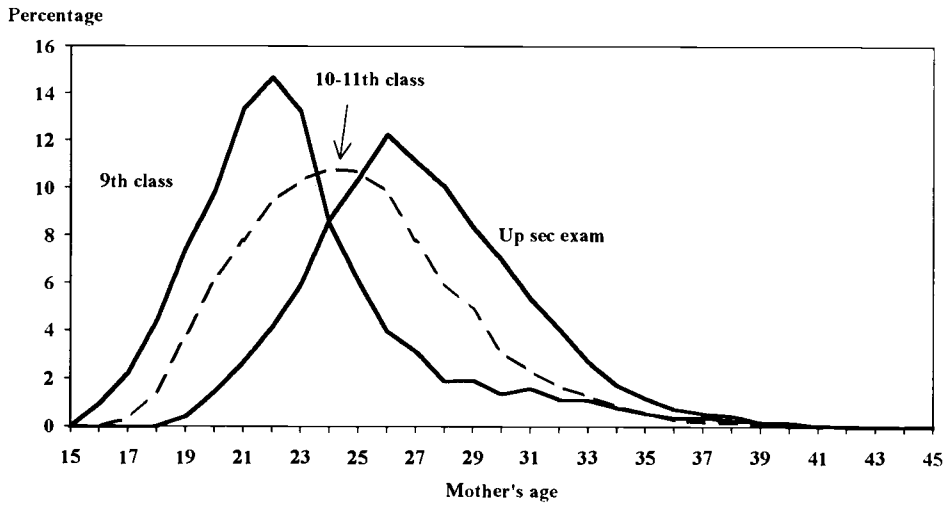


The highest point of the curves in both groups has shifted towards a higher age from 1981 to 1987. However, it is notable that the curves in 1987 are much more similar than in 1981.

The age distribution of women who had their first child in 1987 varies, as mentioned, according to the level of education simply because women completed their education at different ages.

Figure 8.2

Age distribution of women having their first child in 1987, by level of general education



Long education - later first birth

Data relating to the average age of women giving birth and the rates in figure 8.1 indicate a higher average at first birth for women with a long education. However, it should be born in mind when interpreting the data that the number of women having children after 9th class who continue their education at a later time is not given here.

Fertility of women aged 25, 30 and 35 years

When considering the average number of live births at a given age for women according to level of education, it is possible to assess whether women with a higher education who are older than women with a basic school education at first birth still end up with the same number of children as the latter group of women.

- fewer children

The average number of live births according to women's level of education at age 25, 30 and 35 is shown in table 8.3. The observed differences at a given age are notably consistent throughout the period.

At age 25, women with 9 years of schooling have, on average, just over 1 child each. Women with 10-11 years of schooling have, on average, fewer children and are very close to the total average. Women with an upper secondary examination have about 1/4 as many children as women with 9 years of basic schooling and half as many as the total.

Table 8.3 **Average number of live births at age 25, 30 and 35 1981, 1984 and 1988**

	1981	1984	1988
25 years			
8th class	1.27	0.97	0.83
9th class	1.09	1.13	0.97
10th-11th class	0.78	0.70	0.59
Upper secondary school examination	0.32	0.24	0.20
30 years			
8th class	1.84	1.78	1.57
9th class	1.64	1.60	1.60
10th-11th class	1.44	1.38	1.35
Upper secondary school examination	1.06	0.99	0.92
35 years			
8th class	2.14	2.07	1.98
9th class	1.92	1.85	1.83
10th-11th class	1.83	1.77	1.68
Upper secondary school examination	1.57	1.52	1.47

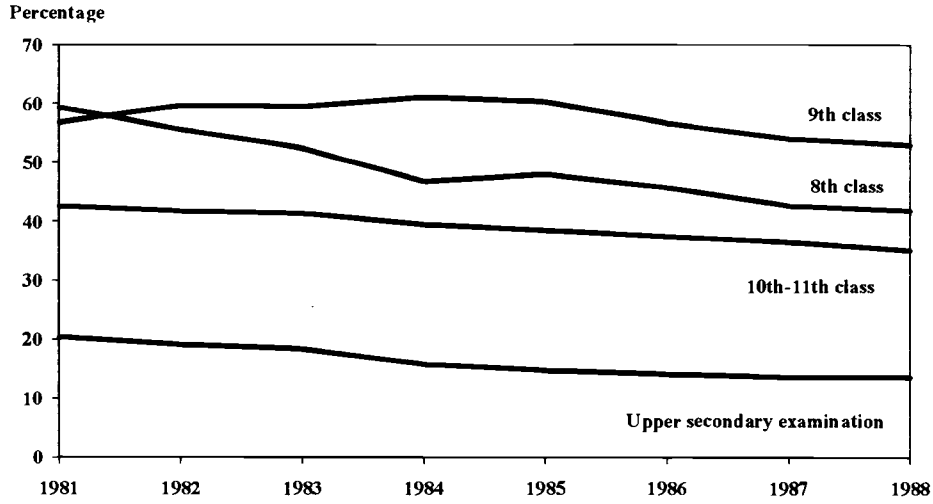
By age 30, the differences all smaller. In particular, the numbers of childbirths for the two groups with the shortest education are almost the same, and those with the longest education now have approximately 1 child each, which is 2/3 of the level for women with 9 years of schooling.

The differences between the groups are also given at age 35, although they are now even smaller. The number of childbirths for women with the longest school education is about 80% of the level for women with 9 years of schooling, but by age 35, the women have had all their children generally speaking. Fertility rates after age 35 are low, and as it appeared from figure 8.1. the rates for first births at age 39-40 are more or less the same regardless of the level of education. Therefore, it is reasonable to conclude that the observed differences at age 35 according to level of education will not change as these women get older.

Figure 8.3 illustrates the relationship between the number of childbirths to women at age 25 and 35. It can be seen that during the 1980s women with a longer school education have had a steadily decreasing proportion of their children before age 25. This is in accordance with the postponement of the first birth previously mentioned. Women with 9 years of schooling have had their children at the youngest ages throughout the period.

Figure 8.3

Average number of children at age 25 as a percentage of the number at age 35. 8th,9th,10th-11th class and upper secondary school examination



Childlessness

- larger proportion of childless women

Also when considering the distribution of women according to number of children, the differences between the women are smaller the older they are, cf. table 8.4.

Table 8.4

Percentage of women with various educational levels, by number of children by educational level. 1981, 1984 and 1988

	1981		1984		1988	
	9th	Up.sec.	9th	Up.sec.	9th	Up.sec.
25 years						
0 children	29.4	73.3	28.0	79.4	37.8	83.4
1 child	36.4	21.5	36.3	17.1	32.0	13.8
2 children	30.1	4.8	30.8	3.4	25.7	2.7
3+ children	4.1	0.3	4.9	0.1	4.5	0.1
35 years						
0 children	7.7	20.1	9.2	20.5	10.4	23.2
1 child	17.8	21.3	18.5	23.2	19.1	22.8
2 children	53.1	42.7	53.4	42.0	50.8	40.5
3+ children	21.4	15.8	18.9	14.3	19.7	13.4

Throughout the period at a given age there is a larger proportion of childless women among those with higher education, and for each level of education irrespective of age the proportion of childless women has increased from 1981 to 1988.

Figure 8.4

Proportion of childless women at various level of education. Age 25 and 35. 1981-1988

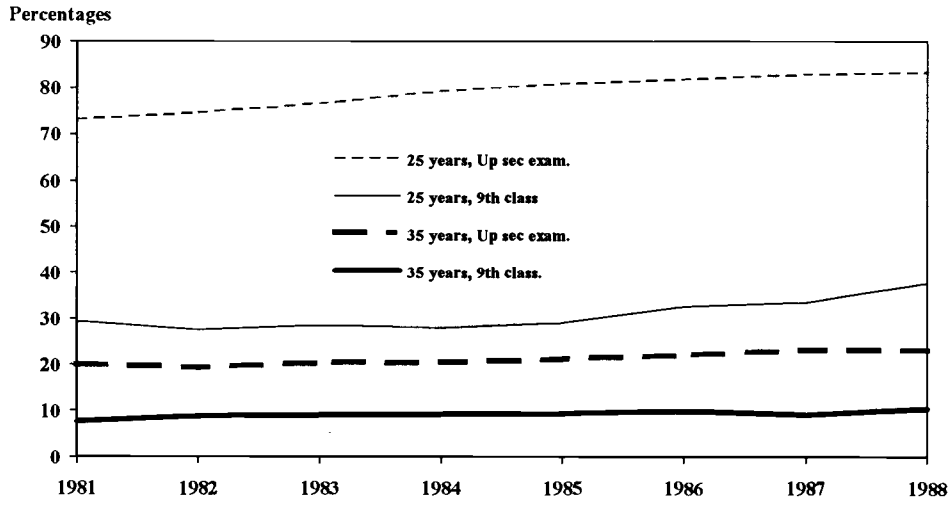


Figure 8.4 illustrates trends in childlessness at age 25 and 35 among women with 9 years of schooling or an upper secondary examination.

In this respect too, there are more pronounced differences among the younger women. Moreover, it can be seen that childlessness among women aged 35 at each level of education has remained relatively unchanged throughout the study period, whereas the younger women especially have experienced an increase in the proportion without children. This increase is more pronounced for women with an upper secondary school education than for women with 9 years of basic schooling.

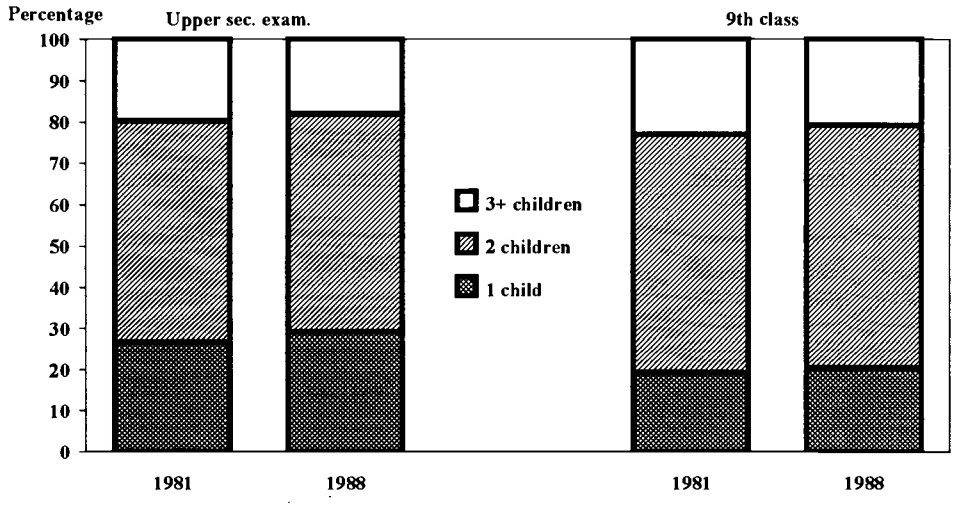
If the distribution of the number of children is considered, there is a significant difference according to the level of education, but at each level there is almost the same distribution in 1988 as in 1981.

Figure 8.5 illustrates the proportion of women aged 35 who have 1, 2 or at least 3 children in 1981 and 1988.

It is a noticeable feature that there is a much larger proportion of women with an upper secondary school examination that have just 1 child both in 1981 and 1988.

Figure 8.5

Distribution of the number of children for women aged 35 in 1981 and 1988



Main results

The average age at birth of the 1st and 2nd child has not increased for women with the shortest education in the period 1981-1988, but at the same time this group constitutes a still smaller proportion of the women. Women with the longest school education, however, have children at a later age, they have generally fewer children, and there is a larger proportion of them without children.

Subsequent vocational education

Women's occupational status and their labour force participation will be considered in the following chapter, so that at this stage only vocational education is considered.

Educational status

A greater but decreasing proportion of the oldest women have left school after 8th class, as can be seen from the distributions in the different years, the proportion for women aged 35 falling from 41% in 1981 to 15% in 1988. Similarly, 19% of women aged 35 had completed school with an upper secondary examination or similar education in 1988, compared to only 9% in 1981.

This increase in the general level of education is also reflected in a change of the distribution of vocational education. Women with a short school education continue typically with a vocational education or a commercial/-clerical education; women with 10-11 years of schooling continue typically with a commercial/clerical education or a short further education, while the largest proportions with medium-length or long further education can be observed among women with an upper secondary school examination.

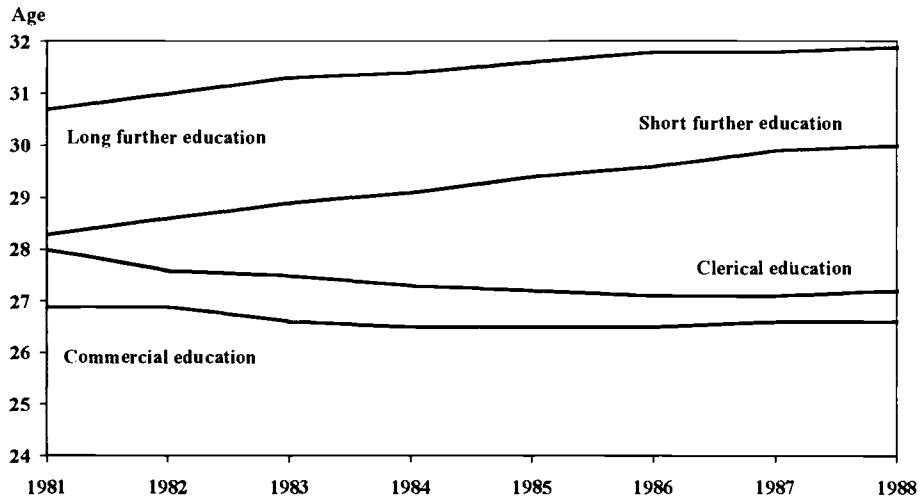
Average age of women giving birth

The average age at birth is higher for women with a long further education throughout the period.

Figure 8.6. shows how the average age at birth has increased for women with short as well as long further education, while there has been a slightly decreasing and more constant level for women with a clerical/commercial education. Consequently, there has been an increase in the difference between the educational levels.

Figure 8.6

Average age at birth for women with different forms of vocational education. 1981-1988



At the same time, there are relatively more women with a commercial education who left school after 9th class.

Average number of live births

Within all groups of vocational education there has been a decline in the number of children the women had at age 25 and at age 35.

It can be seen that the situation is such that the longer the vocational education, the lower the number of live births, which is in accordance with the relationship that was recorded in connection with the levels of general education.

In 1988, the largest groups of women aged 35 with vocational education had attended a short course (more than 5,000 women) or a medium-length course of further education (about 3,200) or they had received a clerical education (about 3,100) or a commercial education (about 2,100).

Table 8.5 **Average number of live births for women aged 25 and 35 years in 1981 and 1988, by completed vocational education**

	1981		1988	
	25 years	35 years	25 years	35 years
Vocational education not completed	0.71	2.07	0.64	1.66
Clerical education	0.62	1.77	0.40	1.60
Commercial education	0.95	1.91	0.61	1.84
Skilled workers, metal manufacturing	0.59	1.75	0.43	1.61
Skilled workers, construction industry	0.76	1.86	0.48	1.83
Skilled workers, other	0.71	1.97	0.46	1.75
Short courses of further education	0.45	1.79	0.22	1.63
Medium-length courses of further education	0.27	1.77	0.16	1.57
Long courses of further education	0.17	1.43	0.08	1.23
Total	**0.77**	**1.95**	**0.54**	**1.73**

As the general level of educational has increased, the general educational background has changed. For example, in 1981, only about 12% of women aged 25 with a clerical education had left school with an upper secondary examination, whereas this proportion had increased to approximately 20% for women aged 25 in 1988.

In spite of the size of the total population, there are restrictions as to the number of types of education that can be combined without the groups becoming too small. However, the figure does reveal differences in the level of fertility, as even among women aged 35 there is a higher average number of live births for women with the shortest general education, irrespective of the character of subsequent vocational education.

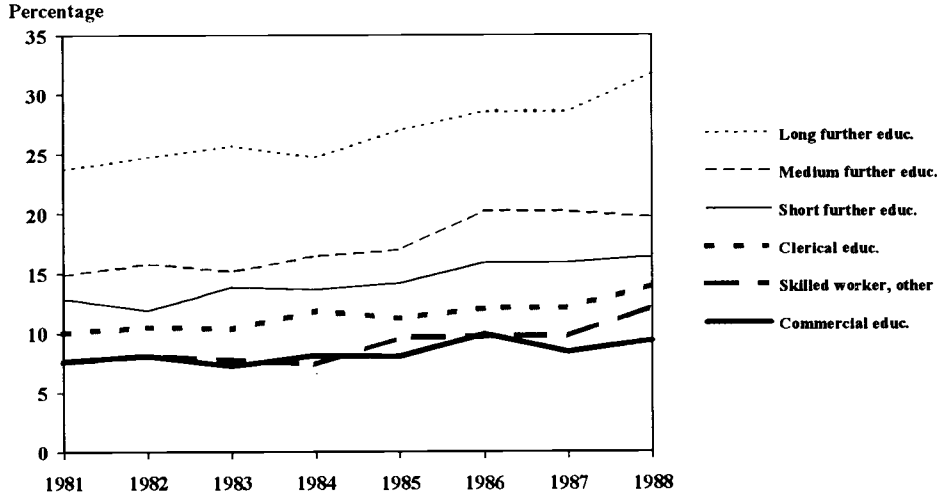
There are particularly large differences in the level of fertility among women with a clerical education, but in this case the group with an upper secondary examination only comprised 134 women in 1988.

However, differences can also be observed among women aged 25 in the same year, and the sub-groups here are much larger since these younger women in particular have experienced the effects of the change in the educational structure. Women aged 25 with 9 years of schooling prior to a clerical education had, on average, 0.84 children in 1984, while those with an upper secondary examination (a total of 1,352 women) only had 0.20 children at the same age.

In 1988, the largest proportion of childless women aged 35 was among women with a long further education (32%). This can be compared with 20% for women aged 35 with a medium-length education.

Figure 8.7 indicates that there is a sharper increase in the 1980s, the higher the proportion of childless women. Among women with a commercial education, which incidentally was the group that had most children (table 8.4), the proportion of childless women ranged from 7.2% in 1983 too 9.4% in 1988.

Figure 8.7 **Proportion of childless women aged 35 with various forms of vocational education. 1981-1988**



Main trends

The level of general education seems to play an important role in relation to fertility levels. Throughout the 1980s, the average age at 1st birth increased for all levels of general education apart from "9th class". Women with this level have experienced a relatively stable development of having their children at an earlier age.

The differences between women with long and with short further education seem to widen towards the end of the 1980s, and the proportion of childless women among those with long further education has increased sharply.

Fertility trends in Denmark in the 1980s

9. Women's occcupational status

The present chapter describes how the level of fertility and the number of children born vary with women's occupational status, socio-economic group and the industry in which they are employed.

Fertility levels are analysed exclusively in relation to the women's own socio-economic group, regardless of the group to which their husbands belong.

By way of introduction results from previous Danish and foreign studies are presented, after which fertility levels in the 1980s among the women covered by the Fertility Database are described.

9.1. Previous studies

Vocational education results in fewer children

As it was seen in chapter 8, part of the Danish fertility decline in the 1970s was attributable to an increase in the number of women receiving some form of vocational education, as this led to increasing labour force participation rates for women. Postponement of the first birth as well as smaller family size were interpretted as an attempt by women to combine obligations in the family and at work (Bertelsen 1981).

Several theoretical explanations have been given for this apparent incompatibility between family life and labour force participants.

Increase in the workload

Initially, occupational employment meant that women assumed an increasing burden of work. The extent of practical work as well as family care obligations did not decrease in line with the increase in occupational employment, as the husband's participation in domestic work only increased slightly. More and more technical aids in the home eased the burden of domestic work somewhat, but, at the same time services such as the delivery of groceries, window cleaning etc. which had previously been available at reasonable prices either desappeared completely or became priohibitively expensive (Haslebo 1982).

Weekly working hours decreased from 48 in 1950 to 40 in 1980. However, in 1980 it was more common that both the man and the woman were working outside the home. So, while in 1950, a family could exist with one adult (the man) working 48 hours outside the home, by 1980, the working time outside the home had increased to 60-80 hours a week, with both adults working thereby giving fewer hours at home.

Women began to enter the labour market in increasing numbers at a time when the welfare and consumer society was developing dramatically. Women's earnings were regarded by many as a means of increasing the standard of living of the family. However, the general increase in the standard of living and consumer prices has meant that two incomes were increasingly considered necessary simply to maintain an acceptable standard of living.

Increasing levels of general education and women's own wish to work outside the home must also be regarded as contributory factors to this development.

The need and desire to take good care of one's children and invest in them and their future (education) have been regarded as a motivating power behind the fertility decline in the first demographic transition (van de Kaa 1987). It was this phase that was influenced by altruistic attitudes, cf. chapter 5, whereas, in the later phase of the fertility decline, it was an orientation towards the adult couple, self-realization and the quality of the mutual relationship between the couple and between parent-child, which contributed to the fertility decline (Lestaeghe & Meekers 1986).

Many women tried to combine work at home with work outside the home by being part-time employed outside the home. Part-time employment satisfied the family's need for the woman's presence at home and the labour market's demand for flexible, intensive labour (Ipsen 1992).

Part-time work

Women found employment mainly in the public sector - service, care of children and older people - which could benefit from women's flexibility with regard to working hours and periods. This same flexibility has been a prerequisite for men to be able to continue their employment in the traditional manner. Women still stayed at home when the children were ill and women chose employment such as "cleaning" with irregular hours if such work with regular hours was not immediately available. In short, women have combined paid employment with obligations in the family as they amaze, while men have continued their employment with no such need to those obligations (Ipsen 1992).

By the end of the 1980s, women were still working part-time to a greater extent than men. In 1989, 32% of employed women had a part-time job compared with only 10% of employed men. About 67% of all part-time jobs were held by women (Statistical Ten-Year Review 1992).

High female employment rate

Unlike women in some Western European countries, Danish women maintain their economic activity status even when they have small children (Federkeil 1992). Recent development have improved the terms of maternity leave for women. In July 1990, it became possible for families with pre-school children to take "parents' leave" for a certain number of weeks per year. The aim of these initiatives has been partly to ease the financial and practical circumstances for families with small children and partly to reduce the number of unemployed.

Analyses of the importance of women's activity status have focused on several phenomena - practical, economic factors and new attitudes to family life, of which women's labour force participation is an indication.

In addition, there is the purely economic aspect. The lower the incomes, the smaller the surplus in a family with children. Children are expensive - there are demands for a better and larger dwelling, and when both parents are working outside the home day-care arrangements have to be made. A family

with two working parents with good salaries is obviously in a better position to meet these demands and may even by able to pay for domestic help.

It is economically less disadvantageous for a woman with a low income to stay at home with her small children for some years than it is for a woman with a high income as she will lose a smaller amount of her income, the lower it is. This alone could be an "incentive" for women with a low level of education in poorly paid jobs to have more than one child.

Danish studies

In a fertility survey conducted in 1970 by the Danish National Institute of Social Research, women were asked about the number of children they expected to have. The survey also looked into the question of actual and preferred working hours for both man and wife. The number of children they expected to have according to the results of this survey was compared in chapter 7 with the actual number derived from the Fertility Database.

Notably, an expected number of 2-3 children was so predominant that it was impossible to deduce any special significance of the family's social conditions. Especially women who were permanently active in the labour market expressed a wish to have no more than 2-3 children, but highly educated women as well as women with relatively poorly paid jobs stated to a great extent that they would like a large family i.e. at least four children (Bertelsen & Ussing 1974).

When the above-mentioned fertility survey was carried out, female labour force participation was still limited. Not until 1975 had employment rates for mothers with small children reached a level of 67% from one of only 15% in 1965. The younger the women, the larger the proportion that found that the ideal situation would be for women to have a part-time job while the children were small.

In the analysis of the survey data the family's overall socioeconomic status was analysed in relation to fertility levels.

A survey of the members of Danish Association of Masters and Ph.D.s in 1983 showed that at a given age married women had fewer children than married men. This was partly explained by the fact that these men were married to women with a shorter education, while the women lived more often in a two-carreer-family Furthermore, there was no relationship between occupation and family situation for these women (Emerek 1986).

Other studies

On the basis of an analysis of the importance of female labour force participation for the birth of the second or third child, Hoem and Hoem (1989) have concluded that income and the possibility of a loss of career can only account for marginal differences, since women's personal values and life strategy are of greater importance for childbearing behaviour.

In Hoem & Hoem's survey, the probability of having a third child was highest among women who had spent part of their economically active years at home, perhaps working outside the home between births. On the other hand, the lowest probability of having a third child was observed among women who had never worked outside the home, and among women who did not become permanently active outside the home until after the birth of their second child.

The Norwegian register-based study on fertility differentials showed that in general the employment status of women had a greater effect on the fertility level than that of men. Women engaged in medical work, pedagogical work or farming had the largest families, and housewives had more children than the women in the study had on average (Kravdal 1989).

As in the previously mentioned study, Norwegian families with two children were analysed further (Kravdal 1992). The interview survey of fertility and occupation showed that mothers with some form of higher education having two children are equally likely to have a third child as other women.

Consequently, fertility levels cannot be explained solely on the basis of economic theories, and are equally likely to be high in low as well as in higher ranking occupations.

A great deal of research indicates the importance of changes in attitude (de Leon 1990). In Denmark (Smith 1989), the explanatory value of economic theories applied to the economic activity status of women is questioned altogether, and the author concludes that there is no relationship between the different theories and that although the constituents of fertility behaviour may well be governed by rational choices, the relationship has not been explained satisfactorily.

9.2. The economic activity status of women in this study

Two classifications

Two main variables of definition are used in this study: a socio-economic classification based on occupation, and a classification of industries based on Danmarks Statistik's industrial classification of all economic activities (Erhvervsgrupperingskode).

Socioeconomic classification

The socioeconomic classification is based on the woman's employment status and job title.

In this study, the socioeconomic classification defines the groups of self-employed, spouses assisting self-employed husbands (assisting spouses), salaried employees (at different levels), blue collar workers (skilled and unskilled) and women outside the labour market (e.g. students, disability pensioners).

Industrial classification

For each woman there is also information on the industry in which the largest part of her income has been earned.

The following industrial groups are used in this study: farming, mining and quarrying, manufacturing, electricity, gas and water, construction, wholesale and retail trade, restaurants and hotels, transport, postal service and telecommunication, banking and financing, services (public sector) and repair services.

The socioeconomic status of women

In 1988, the largest socioeconomic groups of women aged 25, 30 or 35 were lower level salaried employees (approximately 30%), unskilled workers (19%) and managerial level salaried employees (18%).

Table 9.1 presents the classification of these women according to socioeconomic status in 1988. The proportion of both unskilled and skilled workers decreases with increasing age, as does the proportion of students. The group of disability pensioners and of women economically inactive for other reasons is largest among women aged 35.

In 1988, about 90% of self-employed women were over 25 and only 1-2% of senior level salaried employees were under 25. The largest socioeconomic gruop for those aged less than 25 were skilled (36%) and unskilled workers (19%).

Clearly, the numbers of women in some of the groups are so small that they cannot be analysed separately.

Table 9.1 **The number of women aged 25, 30 and 35 years, by socio-economic status in 1988**

	25 years	30 years	35 years
Self-employed persons, in farming and fishing	50	125	163
Other self-employed persons	62	103	146
Assisting spouses	128	438	846
Managers, 20 employees and more	4	2	1
Salaried employees, in senior levels	663	1533	1844
Salaried employees, in managerial levels	4.267	6.059	6.659
Other salaried employees	15.136	14.144	13.593
Skilled workers	1064	656	437
Unskilled workers	9.242	8.130	7.498
Employees, not further specified	1.715	548	351
Students	2.130	540	247
Disability pensioners	361	565	954
Other persons, not economically active	2.670	2.538	2.665
No available information	880	1.030	1.195
Total	**38.372**	**36.411**	**36.599**

9.3. Fertility

Average age at birth

Table 9.2 shows the average age of women according to socioeconomic status at birth of their first child.

Table 9.2 **Average age of women at first birth according to socio-economic status. 1981, 1984 and 1988.**

	1981	1984	1988
Self-employed persons, in farming and fishing	27.4	26.1	27.6
Other self-employed persons	26.5	28.4	27.4
Assisting spouses	27.9	26.7	26.1
Salaried employees, in senior levels	29.8	30.3	30.4
Salaried employees, in managerial levels	27.2	28.0	28.3
Other salaried employees	24.8	25.4	26.0
Skilled workers	23.3	23.9	24.9
Unskilled workers	22.9	23.5	24.1
Employees, not further specified	22.8	23.2	23.0
Students	21.8	22.1	22.8
Disability pensioners	26.8	28.3	27.9
Other persons, not economically active	22.0	22.1	22.9
Total	**24.4**	**24.9**	**25.6**

The highest average ages are seen for managerial and senior levels, which must be considered in relation to the fact that these levels are not usually reached until after some years in the labour market.

The average age of senior level salaried employees in 1988 was about 5 years higher than the average age at first birth for all women regardless of socioeconomic status.

On average, skilled workers, unskilled workers, unspecified employees and students are all younger at the birth of their first child than the national average.

Fertility among women aged 25, 30 and 35 years

In 1988, at age 25 only assisting spouses and the few self-employed women (50) in farming and fishing had at least one child - 1.37 and 1.06 on average respectively.

The lowest average number of children was observed among senior level salaried employees (0.11). The average for students was 0.16, and for managerial levels salaried employees 0.28.

The low number among students is premarkably quite simply due to the fact that very few women have children while still studying, whereas the low number among senior level salaried employees is presumably due to the fact that these women have postponed their births.

A greater difference in the average number of children can be seen for women aged 35, ranging from 1.27 (disability pensioners) to 2.35 (assisting spouses).

Table 9.3 **Average number of children at age 35 in 1981, 1984 and 1988.**

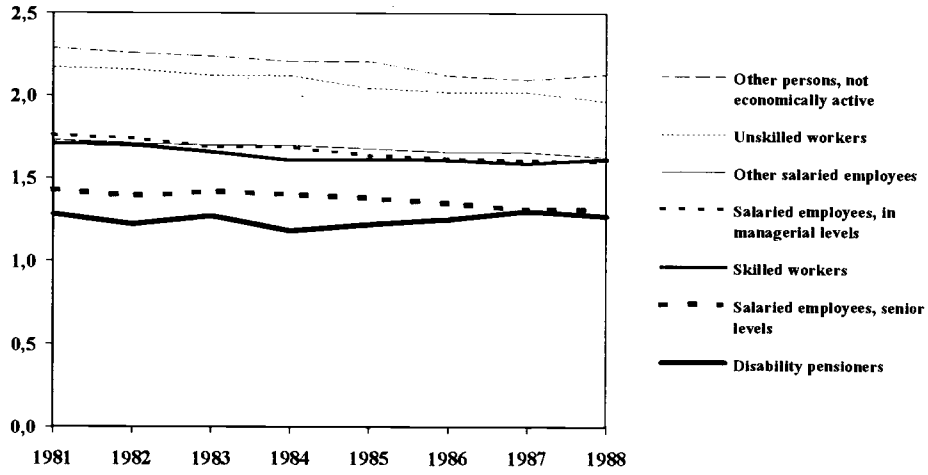
	1981	1984	1988
Self-employed persons, in farming and fishing	2.15	2.28	2.26
Other self-employed persons	2.05	1.92	1.99
Assisting spouses	2.45	2.33	2.35
Salaried employees, in senior levels	1.43	1.40	1.31
Salaried employees, in managerial levels	1.76	1.69	1.60
Other salaried employees	1.73	1.70	1.63
Skilled workers	1.71	1.61	1.62
Unskilled workers	2.17	2.12	1.97
Employees, not further specified	2.13	2.16	1.63
Students	1.56	1.54	1.43
Disability pensioners	1.28	1.18	1.27
Other persons, not economically active	2.29	2.21	2.13
Total	**1.95**	**1.86**	**1.73**

At age 35, economcially inactive women and unskilled workers had on average 2.13 and 1.97 children respectively in 1988. Disability pensioners and senior level salaried employees had the lowest number of children, namely 1.27 and 1.31 respectively.

Figure 9.1 shows the average number of children of women aged 35 years in selected groups in the period 1981-88. The main impression is one of a relatively constant level for each group throughout the period, but also of sigificant differences between the highest and lowest ranking group.

Figure 9.1

Average number of children to women aged 35 in selected socioeconomic groups. 1981-1988

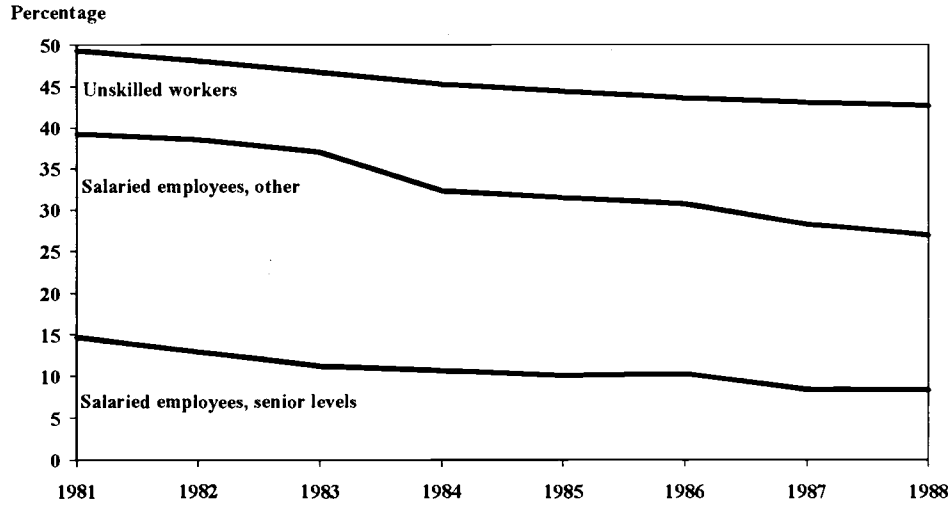


The women with most children at age 35 years had had the greatest proportion when they were 25. In 1981, young unskilled female workers aged 35 had about half as many children as unskilled women at the same age, while senior level salaried employees aged 25 had about 15% of the number of children of women aged 35.

For both of the above-mentioned groups, births have been postponed, as can be seen from figure 9.2 which shows the number of children at age 25 as a percentage of the number at age 35.

Figure 9.2

Average number of children at age 25, as a percentage of the number at age 35. Women in three socioeconomic groups



At age 35 about 25% of the senior level salaried employees in 1988 had no children, compared with less than 10% of the unskilled workers. Table 9.4 shows the distribution of the women in the three selected groups according to the number of children (0,1,2).

Table 9.4

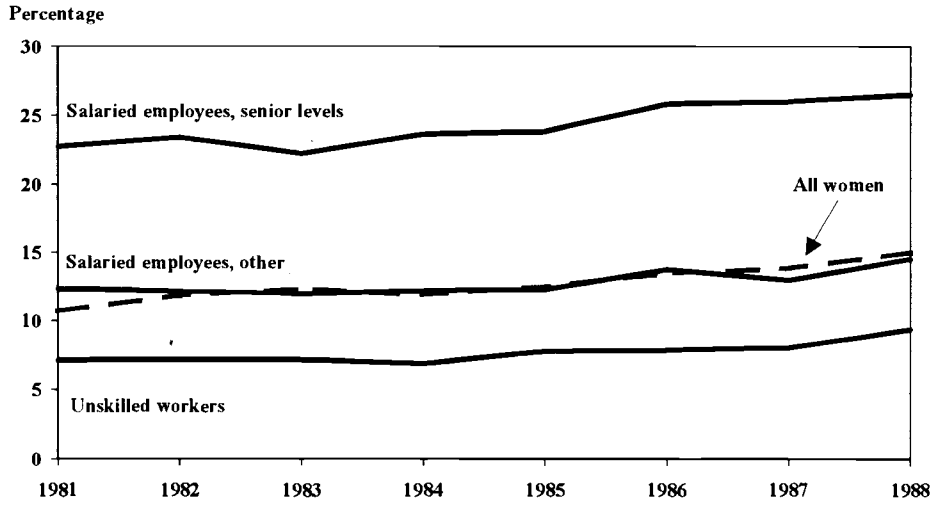
Women in selected socioeconomic groups at age 25 and 35 according to number of children. 1981, 1984 and 1988. Percentage

	25 years			35 years		
	1981	1984	1988	1981	1984	1988
Salaried employees, in senior levels						
0 children	82.3	86.1	89.9	22.7	23.7	26.5
1 child	15.0	12.6	9.5	25.1	25.9	25.7
2 children	2.4	1.1	0.6	39.8	39.0	39.2
3+ children	0.3	0.2	0.0	12.3	11.5	8.6
Other salaried employees						
0 children	47.9	57.1	64.9	12.3	12.2	14.5
1 child	36.7	31.5	26.3	20.7	21.8	22.2
2 children	14.5	10.8	8.3	50.9	52.0	50.0
3+ children	0.8	0.6	0.5	16.0	14.0	13.0
Unskilled workers						
0 children	32.0	36.6	44.0	7.1	6.9	9.4
1 child	34.1	34.3	31.5	12.6	13.4	16.3
2 children	29.8	25.8	21.5	46.4	48.6	48.9
3+ children	4.2	3.3	3.0	33.9	31.0	25.4

At age 35 only approximately 10% of the senior level salaried employees in 1988 had more than two children as opposed to 25% of the unskilled workers. There has been an increase in all three groups in the proportion of women with no children, as illustrated in figure 9.3.

Figure 9.3

Proportion of childless women aged 35. Three socioeconomic groups. 1981-1988



For women with at least one child, the relative distribution according to number of children is very different from group to group. Among senior level salaried employees aged 35 in 1988, there was a strong concentration of families with one (35%) or 2 children (53%).

The largest proportions of women with three (22%) or at least 4 children (5.8%) are to be found among unskilled women. Two or three children was the norm among unskilled workers.

Main trends

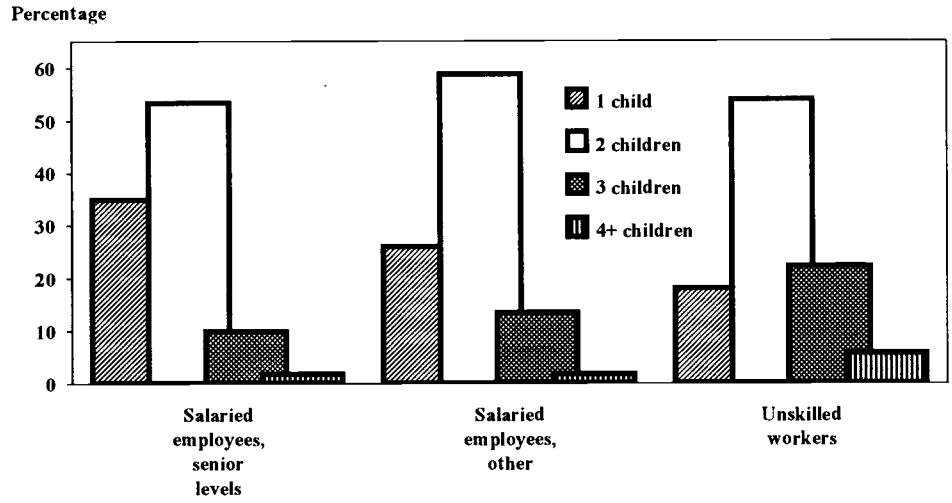
The analyses presented in this chapter reveal several large differences in fertility levels between women in different socioeconomic groups. Average age at first live birth for senior level salaried employees was five years higher than the average age at first birth of all women regardless of socio-economic status.

Women outside the labour market and unskilled women had the highest number of children at age 35. Relatively speaking, these two groups of women had the highest proportion of their children before they were 25 years old.

The proportion of 35 year old women with no children increased from 1981 to 1988, most strongly among women in senior positions.

Figure 9.4

Women aged 35 with at least one child according to number of children. Three socioeconomic groups, 1988



9.4. Fertility distribution according to industry

In table 9.1, the socioeconomic distribution of women in 1988 was presented. In the following, fertility among women in selected industries is discussed.

The predominantly large socioeconomic groups of women - salaried employees and workers - are found in the public sector and manufacturing services (unskilled workers) and in the bank and finance sector (salaried employees). Table 9.5 shows the number of women aged 25, 30 and 35 years in selected industries in 1988.

Table 9.5

Women aged 25, 30 and 35 by selected industry as of 1 January 1988

	25 years	30 years	35 years
Farming	354	316	325
Manufacturing	4.962	4.080	3.913
Construction	464	364	389
Wholesale trade	1.681	1.274	1.157
Retail trade	2.694	1.717	1.621
Restaurants, hotels	1.047	682	516
Transport, postal service, telecommunication	1.671	1.361	1.141
Bank and finance sector	3.416	3.100	3.113
Services, and repair services	14.666	17.682	18.520
Total	**38.372**	**36.411**	**36.599**

Women in retailing, farming or hotels and restaurants had their first child at the lowest age. Table 9.6 shows that the average age at birth of the first child did not increase in all groups. In all three years, the highest ages were

observed for women in the bank and finance sector or in Services and repair services.

However, it is a characteristic feature that there is not nearly the same difference in fertility among the industrial groups classified here as observed among the socio-economic groups.

Table 9.6 **Average age of women at first birth according to industry. Selected industries. 1981, 1984 and 1988**

	1981	1984	1988
Farming	24.0	23.9	24.3
Manufacturing	23.5	24.1	24.6
Construction	24.4	25.1	25.2
Wholesale trade	24.3	25.4	25.7
Retail trade	23.5	23.8	24.1
Restaurants,hotels	22.6	23.2	24.3
Transport, postal service, telecommunication	24.9	25.2	26.2
Bank and finance sector	25.4	26.0	26.8
Services, and repair services	25.4	26.1	26.8
Total	**24.4**	**24.9**	**25.6**

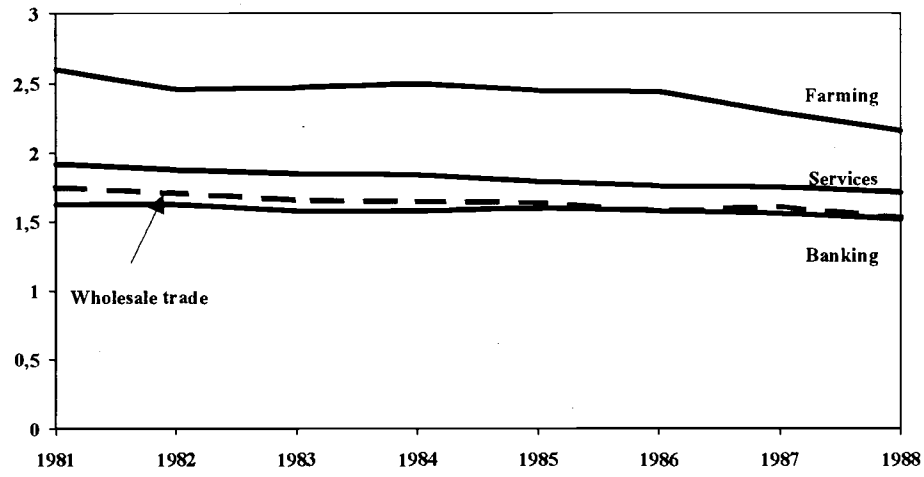
Some of the groups considered here are very small in number, but where the number of women is reasonalbly high, it is found that women in the bank-finance sector have the lowest number of children (1.5 on average) at age 35. Women in farming had the highest number of children (more than 2.5 on average) in 1981 an in 1988 (2.16 children on average).

Table 9.7 **Average number of live births of women aged 35 according to industry. 1981, 1984 and 1988**

	1981	1984	1988
Farming	2.60	2.50	2.16
Manufacturing	1.92	1.84	1.74
Construction	2.08	2.02	1.82
Wholesale trade	1.75	1.65	1.53
Retail trade	1.89	1.82	1.75
Restaurants,hotels	2.02	1.89	1.75
Transport, postal service, telecommunication	1.72	1.67	1.48
Bank and finance sector	1.63	1.58	1.52
Services, and repair services	1.92	1.84	1.71
Total	**1.95**	**1.86**	**1.73**

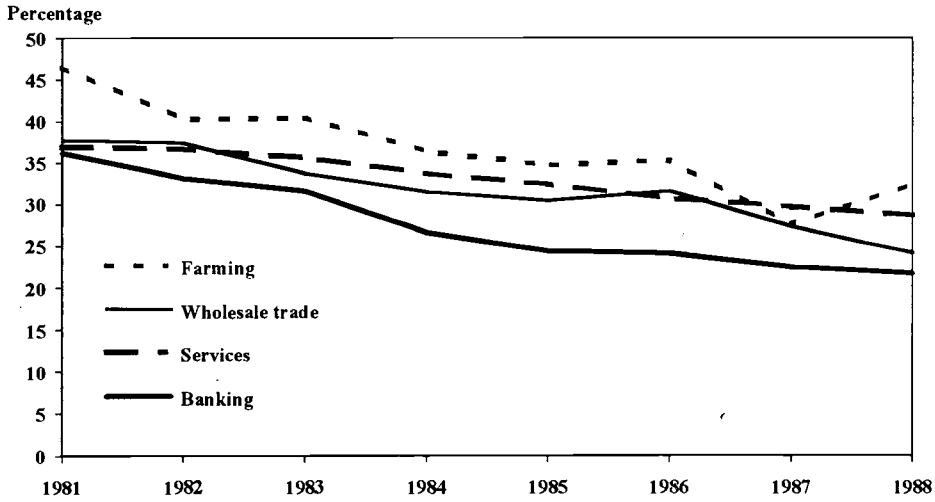
Figure 9.5 shows the trends in the average number of children to women aged 35 in selected industries. Apart from women in farming, of whom the majority have been registered as self-employed, the number of children is almost the same for women in the other industries - between 1.5 and 2.0.

Figure 9.5 **Average number of children to women aged 35 in selected industries. 1981-1988**



As previously shown and as is the case again here, the women with the largest number of children at age 35 had the largest proportion at age 25. However, the decline seen for women aged 25 is equal to that for the women with the lowest number of children (figure 9.6).

Figure 9.6 **Average number of children at age 25 year, as a percentage of the number at age 35. Women in four industrial groups. 1981-1988**



In the 1980s, there were changes in fertility levels and pattern for all groups, so that fewer women aged 25 had only one child, and even fewer, had more

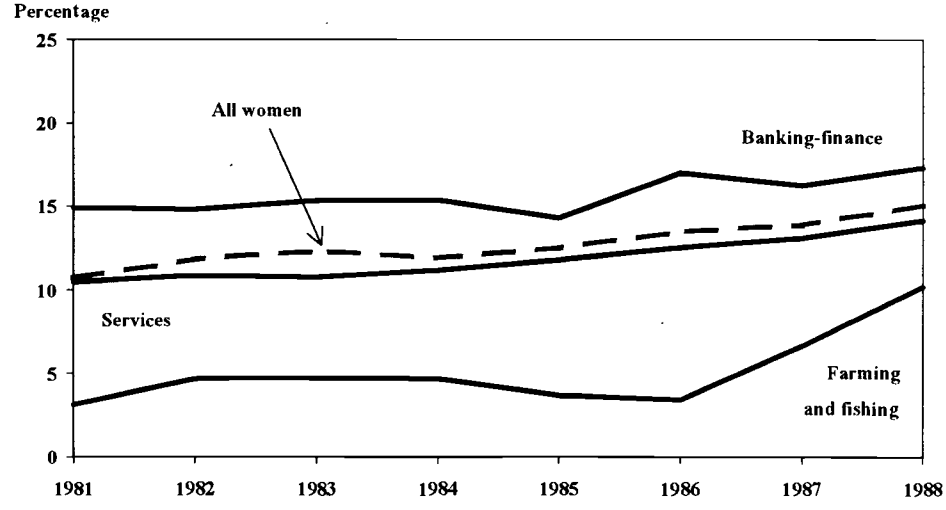
than 0 children. As far as the distribution of women aged 35 according to the number of children is concerned, the changes observed have been more modest (table 9.8).

Table 9.8 **Women aged 25 and 35 in selected industries, according to number of children 1981, 1984 and 1988. Percentages**

	25 years			35 years		
	1981	1984	1988	1981	1984	1988
	%					
Farming						
0 children	31.0	42.9	52.8	3.1	4.7	10.2
1 child	25.1	27.9	26.0	7.5	7.7	12.3
2 children	36.2	24.9	19.2	34.5	37.3	39.1
Bank-finance sector						
0 children	53.7	65.1	73.3	14.9	15.4	17.3
1 child	34.5	27.7	20.9	22.1	23.1	23.9
2 children	11.3	6.9	5.6	50.1	50.5	49.0
Services and repair services						
0 children	49.3	55.0	63.4	10.5	11.2	14.1
1 child	32.4	29.3	25.2	16.2	18.3	20.7
2 children	16.8	14.4	10.3	49.5	49.8	47.9

The proportion of childless women is highest among women in the bank - finance sector and lowest among women in farming. If comparisons on childlessness are made between industrial groups and the group of women on the whole, observed differences are not as great as those observed for socioeconomic groups (figure 9.3).

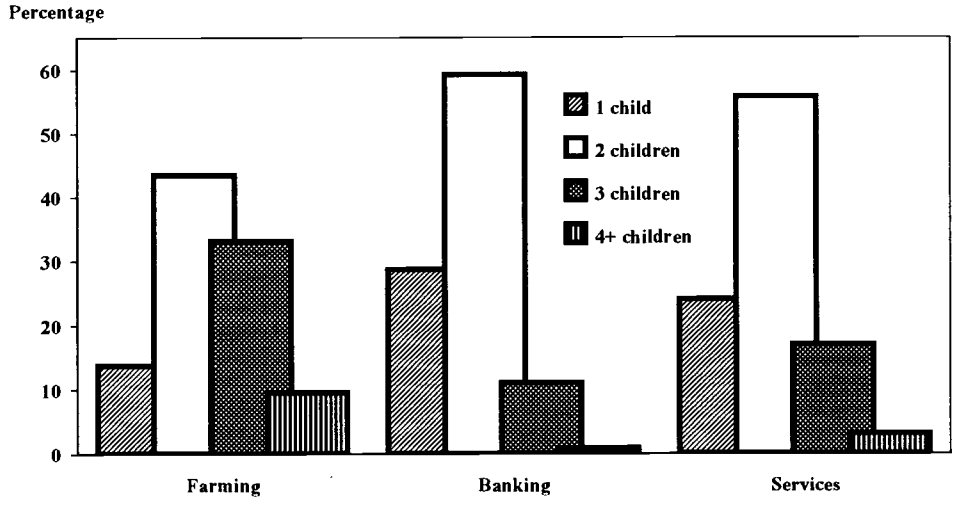
Figure 9.7 **Proportion of childless women aged 35. Selected industrial groups. 1981-1988**



If the industrial groups representing the extremes of fertility are considered, there are characteristic differences in the distribution of the number of children among the women with children. In 1988, by far the majority of women aged 35 in bank and finance sector had two children (60%). Only about 10% of these women had more than two children, whereas approximately 40% of women in farming had more than two children.

Figure 9.8

Women aged 35 with children in three industrial groups according to the number of children. 1988. Percentage



Main trends

The above analysis has revealed that variations in fertility acording to industry were less than those according to socio-economic status. The most significant features perhaps were that women in farming/fishing had the highest number of children and women in banking the lowest number, and throughout the 1980s the age at which this latter group of women had their children increased.

9.5. Socioeconomic groups in various industries

It would seem that socioeconomic status affects fertility levels to a greater extent than type of industry.

Table 9.9 shows the average number of children of women aged 35 in 1981, 1984 and 1988 according to socioeconomic group and industry. Only those groups for which large differences have already been showed are included. The selected industries represent high and low levels of fertility.

Table 9.9 **Average number of children to women aged 35 by industry and socio-economic status. Selected groups. 1981, 1984 and 1988**

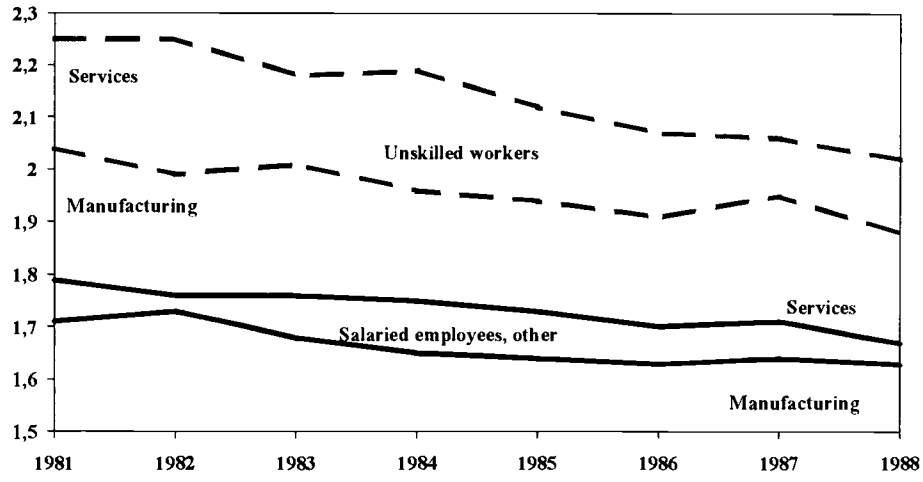
	1981	1984	1988
Farming/fishing			
Other salaried employees	1.93	1.89	1.98
Unskilled workers	2.12	2.38	2.00
Bank-finance sector			
Upper level	1.33	0.93	1.16
Other salaried employees	1.60	1.60	1.58
Unskilled workers	2.10	2.05	1.91
Services and repair services			
Upper level	1.47	1.46	1.36
Other salaried employees	1.79	1.75	1.67
Unskilled workers	2.25	2.19	2.02

Women in farming and fishing as a group had the highest number of children, and it can be seen from the table that this is true for each of the socio-economic groups included.

Likewise, senior-level salaried employees as a group had the lowest number of children and it can be seen from the table that this is true in each of the industries included and that the development in their fertility "follows" the pattern in the industry.

These features are even more obvious in figure 9.9.

Figure 9.9 **Average number of children of other salaried employees and unskilled workers according to industry. Women, aged 35 years**



Within each of the two socioeconomic groups considered, fertility according to industry follows the same pattern: a higher number of children for women aged 35 in services and a lower number for women aged 35 in manufacturing. The differences between the industries in each socio-economic group were, however, larger at the beginning of the 1980s, especially for unskilled workers. The type of industry has a more significant effect on fertility for women with low levels of vocational education.

Main trends

When socioeconomic status and industry are considered together, it is found that women in the same socioeconomic group have a differential fertility according to the pattern dominant in their industry.

10. Fertility among men

The present chapter describes the development in men's fertility in the 1980s. As far as possible, this chapter follows the contents of chapter 5 concerning women's fertility in the 1980s. The fertility of men is defined as the number of liveborn children with the man registered as father. Paternity in this study is based on the reference number from child to parents recorded in the Population Statistics Register (chapter 3).

The main features of fertility trends in Denmark have been discussed in chapter 5. Prior to the establishment of the Fertility Database register studies on fertility relied on the Medical Register on Vital Statistics for their data. Therefore, it was only possible, generally speaking, to analyse the trends in fertility among women, since the Medical Register on Vital Statistics, which constitutes the basis of the annual statistics, contains relatively detailed information about women who give birth, but only information about men in those cases where the parents of a new-born child are legally married.

The information available for that period did reveal, however, that men who become fathers are frequently somewhat older than the mother.

10.1. Men in families

Lack of data about men and children

Research on expectations of future family size and the number of children has been conducted to a much lesser degree for men than for women.

More recent interview surveys on fertility in Norway and Sweden have also included men, but in Denmark, there have been no such attempts to analyze men's fertility.

Danish research that does relate to men and children has concentrated mainly on the extent to which men help with domestic chores.

Paternity leave

Since July 1984, fathers in Denmark have had access to paternity leave comprising 2 weeks, within the first 14 weeks after birth of the child and up to 10 weeks from the child's 15th-24th week. Paternity leave is only avialable to men when both he and the mother are entitled to unemployment benefit (Nygaard Christoffersen 1990).

Only about 3% of the men eligible for paternity leave take advantage of the 10 weeks. Economic factors, labour market conditions and attitudes still make it difficult for fathers to take leave (Nygaard Christoffersen 1990).

The introduction of paternity (and parental) leave and the condition of leave can justifiably be seen as a result of men's desire to be with their child, and it is likely that a man who spends time with his new-born child will feel a greater responsibility as the child grows older. All in all, paternity leave should thus result in more and better contact between child and father and a more equal distribution of domestic chores between parents.

Typically, men have the longest vocational education and therefore the highest income in young families. Loss of earnings was stated as a reason for not sharing parental leave by about 25% of men becomming fathers in 1984-1989 (Nygaard Christoffersen 1990).

Help with domestic chores

The extent to which men help with domestic chores increased during the 1980s. More than half of the married or cohabiting men were responsible for 26% to 50% of all domestic chores in 1987 compared with 27% of the men in 1976 (Levevilkår i Denmark 1992).

If the woman is working outside the home, the man is more likely to help with domestic chores the longer the weekly working hours of the woman. For each younger 10-year age group, the proportion of families where the woman is responsible for the majority of domestic chores is declining (Hjorth Andersen 1991).

Consequently, in the younger families men are more likely to take part in the daily activities of the family, also with respect to the children.

Family versus occupational work

In spite of the fact that men now have a right to paternity leave, it is emphasized in a report on parental leave from 1990 that some fathers experienced negative reactions from their colleagues or employers if they wanted to go on paternity leave (Nygaard Christoffersen 1990).

Twentysix percent of all occupationally active men aged 16-74 years worked at least 39 hours a week in 1990 compared with only 10% of women. Of the couples in 1987 with children below school age, 50% were both working full-time. In 29% of the families, one of the partners - typically the man - worked full-time, and the other partner worked part-time (Levevilkår i Denmark 1992).

Men are attached to the labour market to a greater degree and the organizational framework of occupational employment has been laid down irrespective of family obligations (Ipsen 1992).

How many children?

As already mentioned, information about the number of children men have and the age of men when they become fathers has only been included in Danish surveys to a limited extent.

In a survey conducted in 1984, family conditions among members of the Danish Association of Masters and Ph.D.s were studied (Emerek 1986). The results of this survey revealed for each age group that on average men had more children than women. This is explained by the fact that there are fewer childless men and that those men with children had had more children than women.

This particular result should, however, be seen in relation to other results from the same survey which showed that 68% of the married or cohabiting male university graduates had a partner with a shorter education, while the women, to a greater extent (74%) had a partner with a similar education (Emerek 1986). The fact that female university graduates had fewer children

could be seen as a consequence of them living in a "two-career family" with all the practical demands that this entails.

Sex-specific differences in the relationship between level of education and fertility are aparent despite an increasing tendency towards a more equal division of domestic chores.

In a recent report on changing family conditions, Nygaard Christoffersen (1993), concludes that young men are less likely to establish a family if they are unable to support that family. At the same time, it is underlined that unemployed men have fewer dependent children (below the age of 18) than unemployed women. Fertility differences between employed and unemployed men had increased from 1974 to 1990.

In the present report, fertility is discussed exclusively in relation to each woman and man.

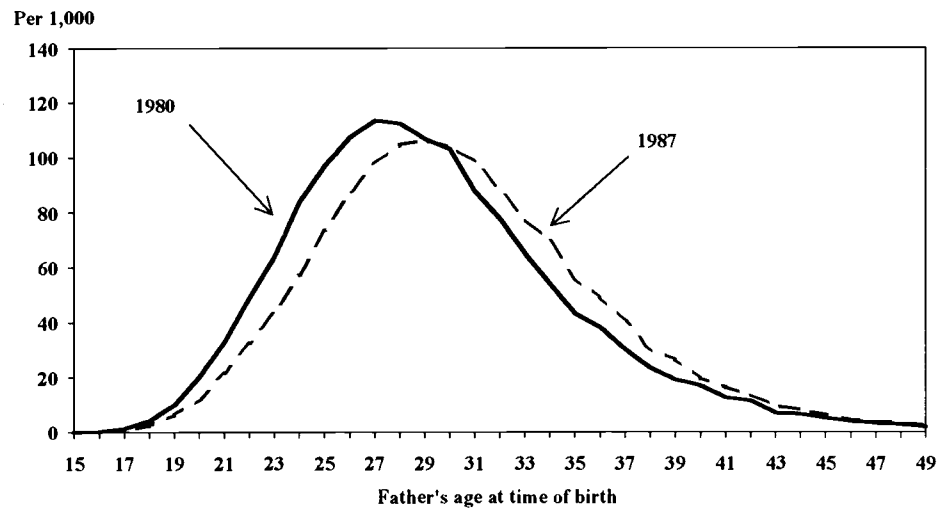
10.2. Fertility trends in the 1980s

Age-specific fertility rates

Figure 10.1 shows the age-specific fertility rates for Danish men in 1980 and 1987. The development is similar to that already described for women. The peak of the curve has moved to the right but is lower in 1987 than in 1980 whereas it continued to increase for women until 1992 (figure 5.7).

Figure 10.1

Age-specific fertility rates for men. 1980 and 1987



The curve peaked at age 29 in 1987 compared with at age 27 in 1980, and the fertility rates of men aged over 30 were higher at all ages in 1987. Furthermore, the figure also shows that men have children in a wider age interval than women. Referring again to figure 5.7, men have their first children later than women but continue to have children longer - men's fertility rates do not reach the same low level as women aged 42-43 years until they are aged 49.

Average age at 1st-5th child

At the birth of the first child, men are, on average, somewhat older than women. As can be seen from table 10.1, the average age of men at the birth of their first child in 1980 was almost 27 compared with 28 in 1988.

Table 10.1

Average age of men at time of birth of 1st-5th child. 1980, 1984 and 1988

	1980	1984	1988
1st child	26.9	27.5	28.0
2nd child	30.0	30.6	31.1
3rd child	33.3	34.2	34.5
4th child	35.8	37.0	37.3
5th child	37.9	38.7	39.6

In comparison, the average age of women at first birth was 24.2 in 1980 and 25.6 in 1988 (table 5.1).

Figure 10.2

Average age of men and women at birth of their 1st, 2nd and 3rd child

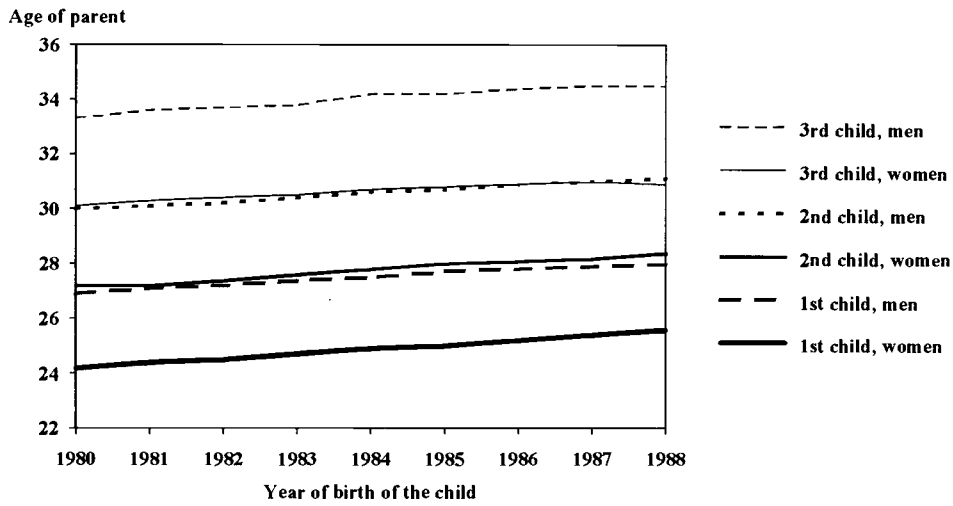


Figure 10.2 shows the development in the average age of men and women at the birth of their 1st, 2nd and 3rd child in the period 1980-1988. Firstly, it can be seen from the figure that men are older than women at each birth. Secondly, it appears that the age of men at the birth of their first respective second child is very similar to that of the women at the birth of their second respective third child.

Average number of liveborn children

In the above, it appeared that men's fertility rates peaked at higher age than women's, that they had children at higher age, and that the average age at birth of the first child was approximately 2.5 years higher for men.

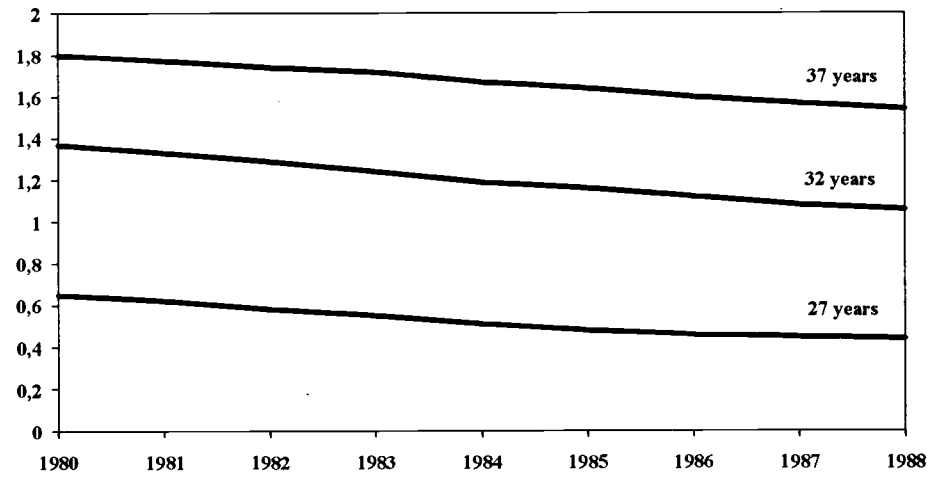
In the description of the general fertility trends, women's fertility levels were expressed through the number of liveborn children they had had at ages 25, 30 and 35.

In order to compare groups of men with comparable groups of women according to level of education, for example, it is relevant to consider the number of children men and women have at the same age. The effect of family obligations in labour market careers for each sex, for example, may be an area of interest for analysis. In order to evaluate the age distribution of men and women according to number of children, comparable age groups in terms of fertility should be selected. Therefore, men's fertility expressed as the number of liveborn children to whom they are fathers will be analysed mainly at age 27, 32 and 37.

Even with this age difference of two years, men had, on average, fewer children than women. Less than every second man aged 27 had a child (0.44 on average) in 1988. This should be compared with women aged 25 who had 0.54 children on average in 1988. On average, women aged 28 had one child, whereas this was not the case for men until they was 32.

Figure 10.3 shows the number of children of men at ages 27, 32 and 37. It can be seen that at each age the number declined throughout the period 1981-88.

Figure 10.3 **Average number of children. Men aged 27, 32 and 37. 1980-1988**



Number of children

Table 10.2 shows the percentage distribution of men aged 27 and 37 according to the number of children in 1980, 1984 and 1988, respectively.

Twothirds of the men aged 27 had (still) no children in 1988. Although, it is especially a characteristic feature among younger men that the proportion of men with children has declined (from just under 50% in 1980 to slightly more than 30% in 1988), it is notable that the proportion of men aged 37 with more than one child has fallen from 67% in 1980 to 56% in 1988.

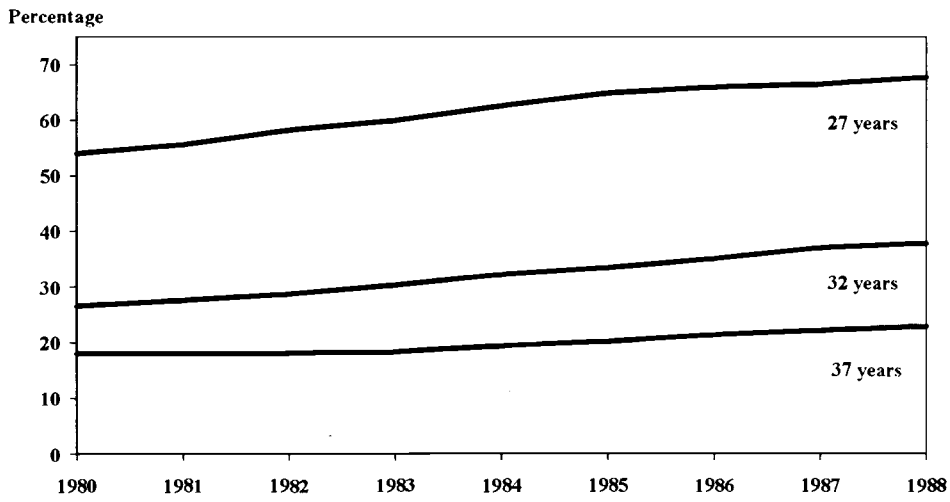
Table 10.2 **Distribution of men aged 27 and 37 according to the number of liveborn children. 1980, 1984 and 1988. Percentage**

	1980	1984	1988
27 years			
0 children	53.9	62.6	67.8
1 child	28.8	24.8	22.0
2 children	15.5	11.3	9.1
3 children	1.6	1.2	1.0
4+ children	0.2	0.1	0.2
37 years			
0 children	18.1	19.5	23.0
1 child	14.9	18.3	20.3
2 children	43.2	43.0	40.5
3 children	18.4	15.4	13.0
4+ children	5.3	3.8	3.2

As for women, the sharp increase in the proportion of childless men has an effect on the total distribution as shown in table 10.2. Consequently, the proportion of men with no children can be considered alone.

Figure 10.4 shows the development in the proportion of men with no children from 1980 to 1988. There was a sharp increase at each age, most pronounced at age 27. It is interesting that the proportion of men aged 37 with no children corresponds more or less to the proportion of women with no children at age 30.

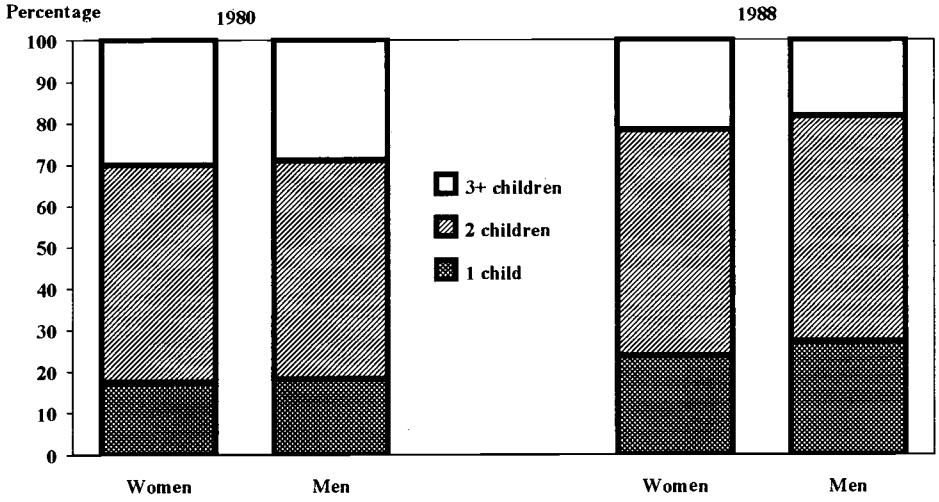
Figure 10.4 **Proportion of childless men at ages 27, 32 and 37 years. 1980-1988**



As was the case for women, an increasing proportion of the men with children had only one child in 1988. Figure 10.5 shows the percentage distribution of 37 year old men and 35 year old women with children in 1980 and 1988 according to the number of children. For both sexes, the

proportion in 1988 with more than 1 child is smaller than in 1980, and in both years there is a considerable difference in the distributions.

Figure 10.5 **Percentage distribution of men aged 37 and women aged 35 with children according to the number of children. 1980 and 1988**

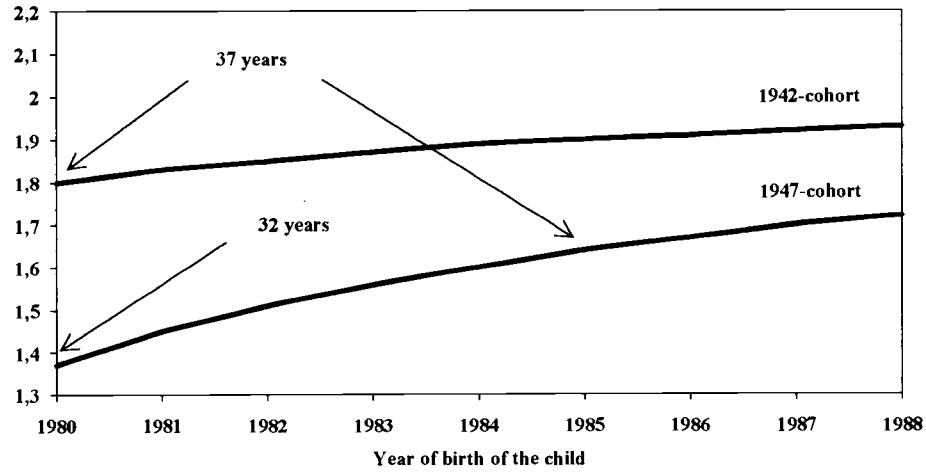


Fertility among men aged over 30 years

When discussing the fertility level of women, the number of children at age 35 was regarded more or less as the final number of children they would have. For men age 37 is taken as this upper age limit, although of course men do have children after this age (figure 10.1).

Figure 10.6 shows changes in the number of children for the two cohorts of men aged 32 and 37 years in 1980, respectively.

Figure 10.6 **Average number of children, 1980-1988, for men aged 32 and 37 in 1980**



10.3. Spacing

Age-specific birth rates for first births

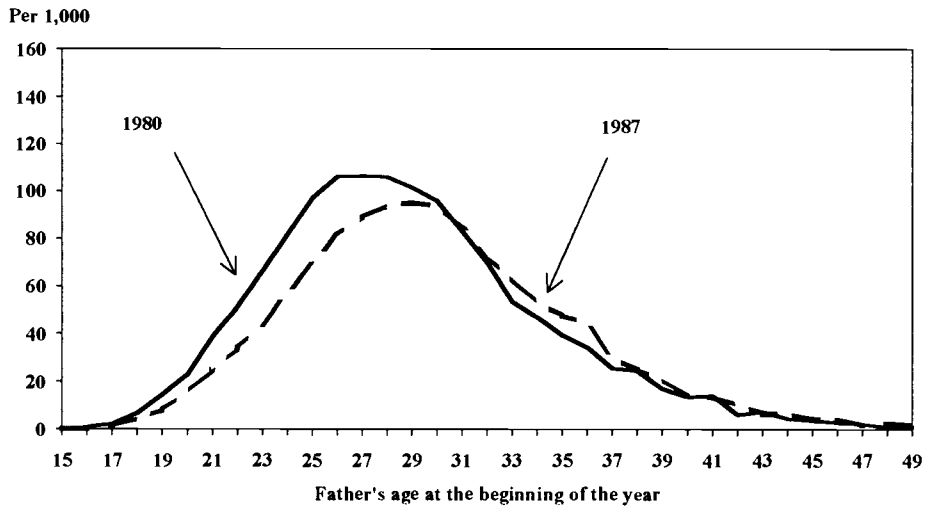
Figure 10.7 shows the age-specific birth rates for first births for men in 1980 and 1987. The peak of the curve has moved to the right and is lower in 1987 than in 1980, a consequence of the increasing age at first birth.

The birth rates for first births for men are lower than those for women at each age, as the proportion of men with no children is higher at each age (cf. figure 6.2).

The proportion of men with one child in 1988 is higher for men aged over 27. As already shown, men were older than women when they had their first child.

Figure 10.7

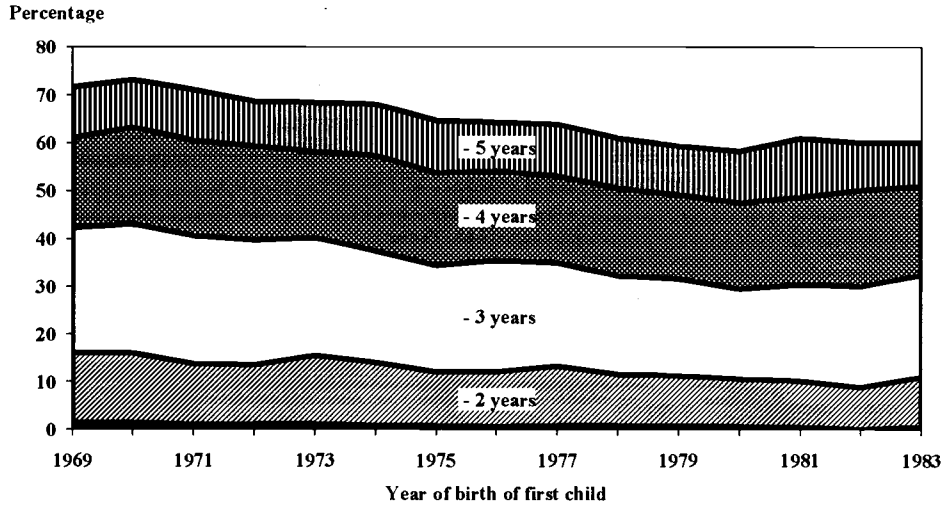
Age-specific birth rates for first birth for men. 1980 and 1987



In order to be able to make comparisons with women, the spacing between first and second child is considered for men who had their first child aged 24 after 1968. As was the case for women, a smaller proportion of men had their second child within 5 years in the 1970s, and this proportion was declining up until the early 1980s.

Figure 10.8

Percentage of men aged 24 at time of birth of first child who have their second child within specific time intervals



10.4. Educational status

Average age at 1st-3rd child

Table 10.3 shows the average age of men at the birth of their 1st-3rd child in 1981, 1984 and 1988, respectively.

Table 10.3

Average age at birth of 1st-3rd child. Men by level of general education. 1981, 1984 and 1988

	1981	1984	1988
9th class			
1st child	25.6	25.9	26.3
2nd child	28.4	29.0	29.7
3rd child	31.7	32.1	32.6
Total	**27.4**	**27.9**	**28.5**
Upper secondary examination			
1st child	28.3	29.1	29.8
2nd child	30.9	31.8	32.5
3rd child	34.3	34.8	35.6
Total	**30.2**	**31.1**	**31.8**

The average age of men at the birth of their first child has increased from 1981 to 1988 as was seen for women. However, while the fertility pattern of women with 9 years of schooling has not changed to any considerable degree, the age of men with this same level of general education has increased at the birth of the first child by approximately 1 year.

Average number of children

Men with a higher level of general education had fewer children than women with a similar education. Men aged 37 in 1988 had 1.54 children, on average, with relatively smaller educational-specific differences than women (cf. table 8.3).

Table 10.4 **Average number of children to men according to level of general education at ages 27, 32 and 37 years. 1981, 1984 and 1988**

	1981	1984	1988
27 years			
8th class	0.82	0.74	0.66
9th class	0.72	0.63	0.67
10th-11th class	0.58	0.49	0.48
Upper secondary school examination	0.36	0.26	0.28
32 years			
8th class	1.50	1.34	1.26
9th class	1.38	1.26	1.23
10th-11th class	1.28	1.15	1.10
Upper secondary school examination	1.06	0.95	0.94
37 years			
8th class	1.88	1.80	1.67
9th class	1.80	1.67	1.57
10th-11th class	1.77	1.65	1.51
Upper secondary school examination	1.64	1.50	1.46

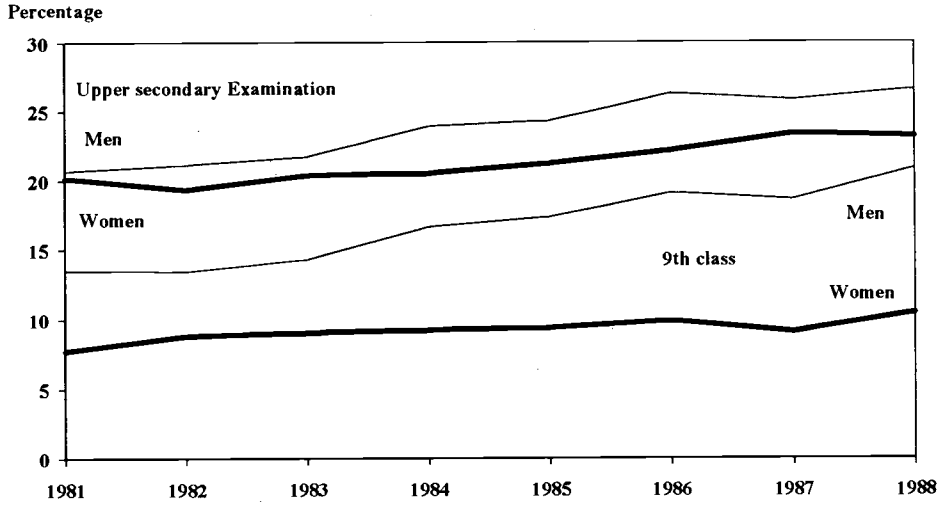
Proportion of men with no children

At all ages, there was a greater proportion of men than women with no children. The proportion of men aged 37 with no children increases sharply in the 1980s for all educational status groups, but especially for men with a short general education (9th class).

Compared with women aged 35 this observed increase is more pronounced. Consequently, the differences in the proportion of men and women with no children also increased in the 1980s.

Figure 10.9

Proportion of childless men aged 37 and women aged 35 respectively, according to level of education. 1981-1988



10.5. Socioeconomic status

In 1988, 30% of men were employed as workers, with an equal proportion of unskilled and skilled workers. Almost the same percentage were salaried employees (28%).

Table 10.5 shows the number of children of men aged 37 in each socio-economic group in 1981, 1984 and 1988.

Table 10.5

Average number of children of men aged 37 in selected socioeconomic groups. 1981, 1984 and 1988

	1981	1984	1988
Self-employed in farming and fishing	2.00	1.86	1.81
Other self-employed persons	2.08	1.90	1.76
Managers with 20 and more employees	2.04	1.86	1.73
Salaried employees, in senior levels	1.75	1.64	1.52
Salaried employees, in managerial levels	1.83	1.73	1.61
Other salaried employees	1.70	1.57	1.48
Skilled workers	1.79	1.71	1.61
Unskilled workers	1.79	1.73	1.57
Employees, not further specified	1.23	1.30	1.17
Students	1.14	1.08	1.13
Disability pensioners	0.62	0.65	0.67
Persons, not economically active	1.13	1.24	1.17
Total	**1.77**	**1.67**	**1.54**

Self-employed persons and managers with at least 20 employees had, on average, most children, although the number declined in each group from 1981 to 1988.

Apart from the small group of students at this age (149 in 1988), the groups of "employees, not further specified" and economically inactive men have the lowest number of children.

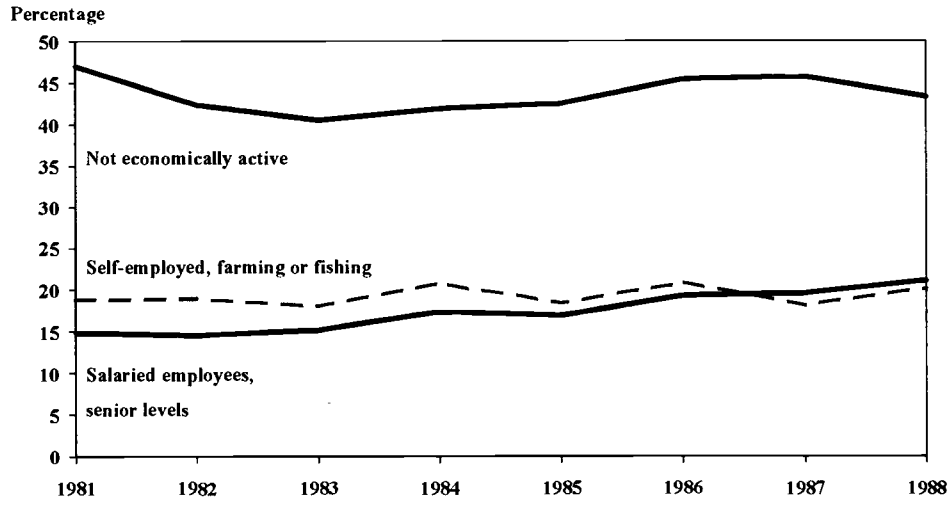
It is worth nothing that male salaried employees and workers have more or less the same number of children whereas female senior level, salaried employees had considerably fewer children, on average, than lower level salaried employees who, in turn, had fewer children than unskilled women (cf. table 9.3).

The groups of economically inactive persons are also quite different. Economically inactive men had, on average, just over 1 child each, while women in this socioeconomic group had 2 children. These women are typically full-time housewives.

Proportion of childless men

The proportion of men aged 37 with no children in selected socioeconomic groups appears from figure 10.10.

Figure 10.10 **Proportion of childless men aged 37. Selected socio-economic groups. 1981-1988**



Main features of men's fertility in the 1980s

In the 1980s, the fertility rates of men aged over 30 increased as did the average age at birth of a child inespective of parity. On average, men were a few years older than women at the birth of a child, so that men had their 1st child at an age when women had their 2nd child.

At all ages considered in the study, there are relatively more men than women without children.

It is characteristic that the proportion of men with no children had also increased in the study period for men with a short school education and that fertility patterns are more similar for economically active men in selected socioeconomic groups than is the case for women.

Fertility trends in Denmark in the 1980s

Litterature

Andersen, Otto (1981). Nogle resultater fra omnibusundersøgelsernes fertilitetsspørgsmål. Copenhagen: Danmarks Statistik, internt notat. (Results from fertility questions in the Omnibus Surveys).

Befolkningsudvikling og sundhedsforhold 1901-60 (1966). Statistiske Undersøgelser nr. 19. Copenhagen: Det Statistiske Departement. (Population Development and Health Conditions 1901-60).

Bernhardt, Eva (1989). The incompatibility between education and early childbearing: The experience of the 1953 Stockholm Metropolitan birth cohort. Scand Pop Stud 1989;9:85-123.

Bertelsen, Ole (1981). Det faldende fødselstal. Copenhagen: Danish National Institute of Social Research (The Falling Birth Rate. Illustrated by the Relationship of Family Size to Woman's Education and Employment).

Bertelsen, Ole & Ussing, Jytte (1974). Familiestørrelse og livsstil. Copenhagen: Danish National Institute of Social Research. (Family Size and Style of Life).

Bjerkedal, Tor (1980). Occupation and outcome of Pregnancy. Oslo: Central Bureau of Statistics of Norway.

Blossfeld, Hans-Peter and Huinick, Johannes (1991). Human Capital Investments or Norms of Role Transition? How Women's Schooling and Career Affect the Process of Family Formation. Am J Soc 1991;97:143-68.

Cliquet, R.L. (1991). The second demographic transition: fact or fiction? Population Studies no 23. Strassbourg: Council of Europe.

Danmarks Statistiks Erhvervsgrupperingskode af 1. april 1977. Copenhagen: Danmarks Statistik (Standard Industrial Classification).

Dansk Fagkode (1979). Copenhagen: Arbejdsdirektoratet. (Danish Occupational Code).

Emerek, Ruth (1986). Uddannelse - vejen til lighed? Ålborg: Ålborg Universitetscenter. (Education - the road to equality?).

Ericsson, Anders et al (1984). Pregnancy Outcome and Social Indicators in Sweden. Acta Paediatr Scand 1984;73:69-74.

Federkeil, Gero (1992). Changes of Family Life in the 1980s - The Case of the Federal Republic of Germany. University of Bielefeld, Unpublished Paper.

Gundelach, Peter and Riis, Ole (1991). Genopstår familien? Dansk Sociologi 1991;2:72-77. (Will the family rise again?).

Gundelach, Peter and Riis, Ole (1993). Danskernes værdier. Copenhagen: Forlaget Sociologi (The values of the Danes).

Haslebo, Gitte (1982). Fordeling af tid og arbejde i velfærdsstaten. Landsplanlægning 1983-2000. Copenhagen: Planstyrelsen. (Distribution of time and work in the welfare state).

Hjort Andersen, Bjarne (1991). Børnefamiliernes dagligdag. Copenhagen: Danish National Institute of Social Research. (The daily life of families with children).

Hoem, Britta (1979). Fertiliteten efter kvinnans ålder och paritet hos danska kvinnor födda sedan 1945. Copenhagen: Danmarks Statistik. (Fertility by woman's age and parity among Danish Women born since 1945).

Hoem, Britta and Hoem, Jan (1987). The impact of women's employment on second and third births in modern Sweden. Population Studies 1989;43:47-67.

Holm Petersen, Jørgen (1992). The Fertility Project - Fertility 1961-88. Internal Report III. Copenhagen: Statistical Research Unit.

Ipsen, Sanne (1992). Fleksibel arbejdstid. Dansk Sociologi 1992;3:45-59. (Flexible Working Hours).

Kaysen Petersen, Ole (1985). Register-Based Family and Household Statistics. Scand Pop Stud 1985;7:74-87.

Knudsen, Lisbeth B. (1988). Fødsler og sociale forhold 1982-1983. Copenhagen: Danish Institute of Clinical Epidemiology and National Board of Health. (Social Risk Factors for Low Birthweight and Infant Mortality in Denmark 1982-1983).

Knudsen, Lisbeth B. (1993): Paritetsoplysningen i Sundhedsstyrelsens medicinske fødselsregister. Validering ved hjælp af ny fertilitetsdatabase i Danmarks Statistik. Ugesk Laeger - accepted for publication. (Registration of parity in Denmark).

Knudsen, Lisbeth B. (1992). Recent trends in childbearing and family-structure in Denmark. Plenary lecture, 10th Nordic Demographic Symposion, Lund, August 1992.

Knudsen, Lisbeth B. and Børlum Kristensen, Finn (1986). Monitoring perinatal mortality and perinatal care with a national register: Content and Usage of the Danish Medical Birth Register. Community Medicine 1986;8:29-36

Kravdal, Øystein (1989). Sociodemographic differentials in the number of children. A Study of Women born 1935, 1945 and 1955. Oslo: Central Bureau of Statistics of Norway.

Kravdal, Øystein (1992). The weak impact of female labour force participation on Norwegian third-birth rates. European Journal of Population 1992;8:247-63.

Landstabelværk. Folke- og boligtællingen 1981. Copenhagen: Danmarks Statistik. (Population and Housing Census 1981).

de Leon, José Gomez (1990). Recent developments in parity progression intensities in Norway. Paper presented at the Workshop on Applications of the Life Course Approach to Household Dynamics in Contenporary Europe. European Science Foundation. Ghent, June 1990.

Lesthaeghe, Ron (1991). The Second Demographic Transition in Western Countries: An interpretation. IPD-Working paper 1991-2. Brussels: Interuniversity Programme in Demography.

Lesthaeghe, Ron and Meekers, Dominique (1986). Value changes and the dimension of Familism in the European Community. European Journal of Population 1986; 2: 225-268

Levevilkår i Danmark (1992). Statistisk oversigt 1992. Copenhagen: Danmarks Statistik & Socialforskningsinstituttet. (Living Conditions in Denmark. Compendium of Statistics 1992).

Martinelle, Sten (1990). New Fertility Trends in Sweden. Stockholm: SCB

Matthiessen Poul Chr. (1970). Some Aspects of the demographic transition in Denmark. Copenhagen: Københavns Universitets fond til tilvejebringelse af undervisningsmidler.

Matthiessen, Poul Chr. (1984). Befolkningens vækst - årsager og konsekvenser. Copenhagen: Berlingske Forlag. (Population Growth - causes and consequenses).

Matthiessen, Poul Chr. (1990). Befolkning og samfund. Copenhagen: Handelshøjskolens Forlag. (Population and Society).

Mørkeberg, Henrik (1976). Fødslers placering i familiens livsforløb. København: Socialforskningsinstituttet. (Timing of Births).

Nygaard Christoffersen, Mogens (1990). Barselsorlov - mænds og kvinders erhvervsmæssige baggrund for at tage orlov. Copenhagen: Danish National Institute of Social Research. (Maternity and paternity leave - the role of socio-economic status).

Nygaard Christoffersen, Mogens (1993). Famliens ændring - en statistisk belysning af familieforholdene. Copenhagen: Danish National Institute of Social Research. (The Changing Family).

Rasmussen, Niels Kr. (1983). Abort - et valg? Fødsler, fødselsbegrænsning og svangerskabsafbrydelse. København: Institut for Social Medicin. (Induced abortion - a choice?).

Rubin, Marcus and Westergaard, Harald (1890). Ægteskabsstatistik, på grundlag af den sociale lagdeling. Copenhagen: Philipsen (Statistics on marriages related to social grouping).

Skotte, Lene (1989). Concepts and definitions used in the Danish family and household Statistics. Scand Pop Stud 1989;9:237-42.

Smith, Nina (1989). Kan økonomiske teorier forklare kvinders placering på arbejdsmarkedet? Nationaløkonomisk Tidsskrift 1989. p. 321-38. (Can economic theories explain women's position in the labour market?).

Smith, Nina (1990). Uddannelse, karriere og børn. Paper. Økonomisk Institut, Århus Universitet. (Education, carreer and children).

Statistik om prævention og aborter 1990 (1992). Copenhagen: National Board of Health (Statistics on Induced Abortions).

Statistisk tiårsoversigt (1992). Copenhagen: Danmarks Statistik. (Statistical ten-year review 1992)

Thygesen, Lars and Jensen, Poul (1985). Linkage of records on objects of different kinds, methodological problems and practical experience. Bulletin of the International Statistical Institute, Vol LI, Amsterdam 1985.

Van de Kaa, Dirk (1987). Europe's Second Demographic Transition. Washington: Population Bulletin 1987; 42, no 1.

Vital Statistics 1989 (1991). Copenhagen: Danmarks Statistik

Appendix I. List of studies in Danmarks Statistik on Fertility trends

Fertilitetsnedgangen i Danmark. Statistiske Efterretninger. Befolkning og valg (1985:13). Copenhagen 1985: Danmarks Statistik. (Fertility decline in Denmark).

Hoem, Britta: Fertiliteten efter kvinnans ålder och paritet hos danska kvinnor födda sedan 1945. Copenhagen 1979: Danmarks Statistik. (Fertility by woman's age and parity among Danish Women born since 1945).

Kvindegenerationerne efter 1945 fordelt efter alder og antal levendefødte. Statistiske Efterretninger. Copenhagen 1980: Danmarks Statistik. (Generations of women born after 1945 by age and number of livebirths).

Matthiessen, Poul Chr.: Fertilitetsforskelle i Danmark. Statistiske Undersøgelser no 14. Copenhagen 1965: Det Statistiske Departement. (Differential Fertility in Denmark).

Matthiessen, Poul Chr.: Fertiliteten uden for ægteskab. Statistiske Undersøgelser. Copenhagen 1968: Det Statistiske Departement. (The Fertility rate out of wedlock).

Nedgangen i fødselstallet. Statistiske Efterretninger. Copenhagen 1969: Danmarks Statistik. (The declining birthrate).

Pedersen, Lars: Regionale fertilitetsforskelle 1981-1985. Arbejdsnotat no 22. Copenhagen 1988: Danmarks Statistik.

Regionale fertilitetsforskelle 1971-1976. Statistiske Undersøgelser no 35. Copenhagen 1977: Danmarks Statistik. (Regional differencies in fertility).

In Vital Statistics:

1975 Consensual unions
1976 The declining birthrate
1977 Formation and dissolution of families since 1965
1980 Statistics on families and households
1981 The declining birthrate
1984 Divorces and children in divorces 1964
1985 Children born outside wedlock
1987 Trends in fertility in Denmark
1988 Formation and dissolution of families since 1960
1990 Development of population 1990

Appendix II. Data Material for the Figures

Chapter 5

	1981	1982	1983	1984	1985	1986	1987	1988
Figure 5.5								
Average age at								
1st child	24.8	25.0	25.2	25.4	25.5	25.7	25.9	26.1
2nd child	27.7	27.9	28.1	28.3	28.5	28.6	28.7	28.9
3rd child	30.9	31.0	31.0	31.3	31.3	31.5	31.5	31.5
4th child	32.7	33.0	33.4	33.2	33.5	33.5	33.4	33.4
Figure 5.6								
Liveborn per 1,000 women	**(1970)**							**(1990)**
Parity 1	26.1		23.4					29.8
Parity 2	24.1		18.9					22.5
Parity 3	12.1		6.3					8.3
Parity 4	4.9		1.5					2.0
Figure 5.8								
Average no. of live births								
25 years	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.5
30 years	1.5	1.5	1.4	1.4	1.4	1.3	1.3	1.3
35 years	1.9	1.9	1.9	1.9	1.8	1.8	1.8	1.7
Figure 5.9								
Percentage childless women								
25 years	46.7	48.8	50.7	54.1	56.3	57.9	60.0	61.8
30 years	18.7	19.6	21.5	22.6	23.9	25.7	26.4	27.0
35 years	10.7	11.1	11.3	11.9	12.5	13.5	13.8	15.0
Figure 5.10								
Average no. of live births, cohorts 1944 and 1949								
1944	2.0	2.0	2.0	2.0	2.1	2.0	2.0	2.1
1949	1.6	1.7	1.7	1.8	1.8	1.8	1.9	1.9

Chapter 6

	Rate per 1,000						Proportion with one child	
	First child		Second child		Third child			
	1980	**1987**	**1980**	**1987**	**1980**	**1987**	**1980**	**1988**
Age of women	Figure 6.2		Figure 6.4		Figure 6.8		Figure 6.3	
14	0.41	0.30	-	-	-	-	-	-
15	1.74	1.46	40.40	49.38	-	-	-	-
16	6.24	3.15	17.47	52.36	-	-	0.3	0.2
17	17.04	8.09	47.62	89.74	40.82	-	1.0	0.4
18	31.12	17.46	62.80	81.15	50.00	110.09	2.6	1.3
19	52.52	27.03	87.08	90.36	44.37	66.44	6.1	2.9
20	71.66	40.69	116.32	99.82	55.24	42.93	10.8	5.0
21	85.14	53.13	138.95	123.98	54.48	68.88	16.5	8.5
22	107.50	69.05	139.82	128.53	48.88	63.02	22.2	12.4
23	120.17	86.40	158.59	154.06	58.04	62.54	26.9	17.0
24	135.02	102.71	164.31	163.70	52.27	64.32	30.5	21.5
25	144.52	118.92	174.65	166.43	51.59	64.95	32.7	24.8
26	143.00	125.40	179.73	177.75	49.81	54.75	33.1	28.5
27	137.61	131.23	183.27	175.06	47.96	58.49	31.5	30.1
28	127.04	122.79	175.12	184.40	47.82	53.46	29.9	30.9
29	110.73	114.84	162.33	181.88	40.48	50.74	27.6	29.1
30	90.74	100.38	140.44	155.06	39.35	48.66	24.2	27.5
31	81.55	88.36	123.35	142.10	36.60	46.18	21.6	25.7
32	64.13	72.99	103.83	113.82	29.71	38.07	19.7	23.8
33	52.97	60.45	76.26	94.16	26.13	31.72	17.9	22.8
34	38.23	48.19	58.24	74.34	20.34	25.45	16.7	21.2
35	32.92	38.00	41.03	54.66	17.49	21.44	15.6	20.2
36	23.68	30.71	33.93	39.81	12.17	17.40	-	-
37	18.10	24.80	24.16	28.80	7.70	11.75	-	-
38	10.44	17.17	18.42	20.60	6.21	7.66	-	-
39	8.85	11.25	9.03	12.88	5.56	4.67	-	-
40	6.37	4.45	7.74	7.45	2.50	3.62	-	-
41	3.73	3.26	2.80	3.47	1.23	2.11	-	-
42	0.99	3.13	1.58	2.39	1.03	1.28	-	-
43	0.31	0.57	0.66	1.32	0.55	0.76	-	-
44	0.86	0.91	0.42	0.20	0.38	0.45	-	-
45	-	-	0.19	0.23	0.10	0.07	-	-
46	-	-	-	-	0.11	0.08	-	-
47	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-

Chapter 6

	< 1 year	-2 years	-3 years	-4 years	-5 years
Figure 6.5					
Year of birth of first child					
1968	1.2	13.5	23.8	21.0	11.9
1969	1.3	14.7	27.4	19.3	9.7
1970	0.9	14.6	26.7	20.1	11.1
1971	1.0	12.9	26.0	20.3	10.1
1972	0.7	13.6	26.5	19.7	10.4
1973	1.1	12.5	26.1	19.4	10.3
1974	0.8	13.2	22.7	19.6	10.6
1975	0.7	11.9	24.0	19.7	11.2
1976	0.9	11.8	23.2	19.1	10.0
1977	0.8	12.2	22.4	18.5	11.7
1978	0.6	11.6	21.4	18.8	10.8
1979	0.7	10.3	21.1	18.8	11.5
1980	0.7	10.8	20.4	18.9	11.3
1981	0.7	9.6	18.7	20.5	12.3
1982	0.6	9.2	21.3	20.2	10.6
1983	0.7	10.1	22.5	18.8	10.3
Figure 6.6					
25 years					
1980	0.3	10.4	19.8	17.1	10.7
1984	0.5	12.0	22.2	19.6	11.7
30 years					
1980	0.3	10.8	17.5	10.9	8.0
1984	-	10.7	18.0	15.4	8.5
Figure 6.7					
20 years					
1st-2nd child	0.4	11.2	19.7	17.8	*
2nd-3rd child	1.4	6.2	11.1	8.6	*
24 years					
1st-2nd child	0.5	13.0	22.6	19.3	*
2nd-3rd child	0.7	12.1	20.6	21.6	*

Chapter 8

	Rate per 1,000				Age distribution		
	9th class		Up.Sec.Exa.		1987		
	1981	1987	1981	1987	9th cl	10th-11th cl.	Up.Sec.Ex.
	Figure 8.1				**Figure 8.2**		
Age of women							
15	0.43	0.00	0.00	0.00	0.03	-	-
16	1.30	1.01	0.00	0.00	0.97	0.01	-
17	18.59	11.47	0.00	0.00	2.25	0.33	-
18	52.77	31.04	1.41	0.00	4.44	1.45	0.01
19	114.14	55.20	4.19	3.25	7.,50	3.75	0.42
20	138.98	69.98	10.83	7.12	9.84	6.15	1.46
21	163.64	93.69	18.62	12.75	13.37	7.80	2.70
22	165.55	108.78	29.77	21.35	14.71	9.38	4.17
23	166.03	128.28	47.24	33.10	13.28	10.32	5.93
24	191.90	127.97	70.12	54.00	8.50	10.79	8.69
25	161.29	146.84	89.92	76.72	6.09	10.69	10.41
26	156.65	132.09	111.84	109.27	3.97	9.83	12.27
27	137.83	125.94	127.17	119.75	3.16	7.80	11.13
28	106.24	84.55	127.34	131.53	1.9	5.97	10.07
29	106.67	89.92	111.76	131.62	1.94	4.91	8.38
30	86.57	72.01	125.00	130.43	1.37	3.09	7.00
31	73.81	76.58	95.97	117.34	1.59	2.34	5.35
32	83.52	55.06	80.63	110.56	1.16	1.69	4.07
33	41.24	57.14	82.49	91.62	1.12	1.29	2.72
34	40.98	41.34	64.03	69.08	0.81	0.89	1.75
35	18.48	30.18	46.80	56.21	0.56	0.56	1.21
36	32.00	19.43	46.51	42.17	0.37	0.29	0.76
37	8.62	21.10	21.02	38.11	0.41	0.20	0.56
38	19.23	16.84	28.63	38.60	0.28	0.19	0.46
39	3.60	14.58	14.73	17.28	0.22	0.11	0.18
40	4.08	2.27	10.54	15.19	0.03	0.08	0.18
41	4.35	0.00	15.87	2.94	0.03	0.04	0.03
42	4.55	0.00	4.15	5.05	0.03	0.02	0.04
43	4.49	0.00	8.66	0.00	0.00	0.02	0.01
44	4.15	4.93	0.00	0.03	0.01	0.00	-
45	3.96	5.12	0.00	0.03	0.00	0.00	-
46	-	-	0.00	0.00	-	-	-
47	-	-	0.00	0.00	-	-	-
48	-	-	0.00	0.00	-	-	-
49	-	-	0.00	0.00	-	-	-

Chapter 8

	1981	1982	1983	1984	1985	1986	1987	1988
Figure 8.3								
Average no. of live births at age 25 as percent of age 35 years (same year)								
8th class	59.3	55.7	52.4	46.9	48.1	45.8	42.8	41.9
9th class	56.8	59.7	59.5	61.1	60.3	56.8	54.0	53.0
10th-11th class	42.6	41.8	41.3	39.5	38.5	37.4	36.5	35.1
Upper sec. exam.	20.4	19.1	18.3	15.8	14.8	14.2	13.6	13.6
Figure 8.4								
Percentage childless								
9th class								
25 years	29.4	27.5	28.5	28.0	29.1	32.6	33.6	37.8
35 years	7.7	8.8	9.0	9.2	9.4	9.9	9.1	10.5
Upper sec.exam.								
25 years	73.3	74.7	76.7	79.4	80.9	81.8	83.0	83.4
35 years	20.1	19.3	20.4	20.5	21.2	22.1	23.4	23.2
Figure 8.5								
Distribution by no. of live births 35 years (%)								
9th class								
1 child	19.3	21.0	20.0	20.3	20.9	20.3	20.7	20.3
2 children	57.6	57.7	59.4	58.9	58.4	58.0	57.0	58.9
3+ children	23.2	21.3	20.6	20.8	20.7	21.7	22.3	20.8
Upper sec.exam.								
1 child	26.7	28.1	28.5	29.1	29.9	29.5	28.6	29.1
2 children	53.5	52.2	54.2	52.8	53.5	52.8	53.7	52.8
3+ children	19.8	19.7	17.3	18.0	16.6	17.7	17.6	18.0
Figure 8.6								
Average age at birth								
Long further educ.	30.7	31.0	31.3	31.4	31.6	31.8	31.8	31.9
Short further educ.	28.3	28.6	28.9	29.1	29.4	29.6	29.9	30.0
Clerical educ.	28.0	27.6	27.5	27.3	27.2	27.1	27.1	27.2
Commercial educ.	26.9	26.9	26.6	26.5	26.5	26.5	26.6	26.6
Figure 8.7								
Proportion childless 35 years								
Long further education	23.8	24.7	25.7	24.8	27.0	26.7	28.6	31.8
Medium further education	14.9	15.8	15.2	16.4	17.0	19.0	20.2	19.7
Short further education	12.9	11.9	13.9	13.6	14.2	14.4	15.9	16.4
Clerical education	10.0	10.5	10.4	11.9	11.2	12.2	12.1	14.0
Skilled worker, other	7.6	8.1	7.8	7.4	9.6	10.6	9.8	12.1
Commercial education	7.7	8.1	7.2	8.2	8.0	9.6	8.4	9.4

Chapter 9

	1981	1982	1983	1984	1985	1986	1987	1988
Figure 9.1								
Average no. of children, 35 years								
Employee, upper level	1.43	1.39	1.42	1.40	1.38	1.35	1.31	1.31
Skilled	1.71	1.70	1.66	1.61	1.62	1.61	1.59	1.62
Unskilled	2.17	2.16	2.12	2.12	2.05	2.02	2.02	1.97
Pensionaries	1.28	1.22	1.27	1.18	1.22	1.25	1.30	1.27
Other, not ec. active	2.29	2.26	2.24	2.21	2.21	2.12	2.10	2.13
Figure 9.2								
Average no of children at age 25 as percentage of 35 years								
Salaried employees, upper level	14.7	12.9	11.3	10.7	10.1	10.4	8.4	8.4
Salaried employees, other	39.3	38.6	37.1	32.4	31.5	30.7	28.3	27.0
Unskilled workers	49.3	48.1	46.7	45.3	44.4	43.6	43.1	42.6
Figure 9.3								
Proportion childless among women aged 35								
Salaried employees, upper level	22.7	23.4	22.2	23.7	23.9	25.8	26.0	26.5
Salaried employees, other	12.3	12.2	12.0	12.2	12.3	13.8	13.0	14.5
Unskilled workers	7.1	7.2	7.2	6.9	7.8	7.9	8.0	9.4
Figure 9.4								
Distribution by no of children, 35 years								
Salaried empl. upper level								
1 child	32.5	34.9	34.0	33.9	35.0	33.6	36.6	35.0
2 children	51.4	50.1	51.2	51.1	50.4	52.8	51.0	53.4
3 children	14.2	13.2	12.9	13.2	13.2	11.9	11.0	9.9
4+ children	1.9	1.8	1.9	1.8	1.5	1.7	1.4	1.8
Salaried empl., other								
1 child	23.7	24.1	24.1	24.8	25.1	25.3	25.8	26.0
2 children	58.1	59.5	60.5	59.2	59.8	59.4	59.2	58.8
3 children	15.8	14.5	13.9	14.1	13.4	13.4	13.3	13.5
4+ children	2.4	2.0	1.6	1.9	1.7	1.8	1.7	1.8
Unskilled workers								
1 child	13.5	13.2	13.3	14.4	15.5	17.3	16.8	18.0
2 children	49.9	50.4	46.0	52.2	53.6	54.1	54.4	54.0
3 children	27.9	28.6	21.3	26.4	24.8	23.1	22.8	22.2
4+ children	8.6	7.8	7.3	7.0	6.0	5.4	6.0	5.8
Figure 9.5								
Average no of children, 35 years								
Farming	2.60	2.46	2.47	2.50	2.45	2.44	2.29	2.16
Manufacturing	1.92	1.89	1.88	1.84	1.80	1.78	1.79	1.74
Retail trade	1.89	1.86	1.85	1.82	1.79	1.74	1.77	1.75
Banking	1.63	1.63	1.58	1.58	1.60	1.58	1.56	1.52
Services, repair serv.	1.92	1.88	1.85	1.84	1.79	1.76	1.75	1.71

Chapter 9

	1981	1982	1983	1984	1985	1986	1987	1988
Figure 9.6								
Average no children at age 25 as percentage of age 35								
Farming	46.5	40.2	40.5	36.4	34.7	35.2	27.5	32.4
Retail trade	37.7	37.4	33.7	31.5	30.5	31.6	27.3	24.2
Banking/finance	36.2	33.1	31.6	26.6	24.4	24.1	22.4	21.7
Services, repair services	37.0	36.7	35.7	33.7	32.4	30.7	29.7	28.7
Figure 9.7								
Proportion childless women aged 35								
Farming	3.1	4.7	4.7	4.7	3.7	3.4	6.6	10.2
Banking	14.9	14.8	15.4	15.4	14.3	17.0	16.2	17.3
Repair services, other serv.	10.5	11.7	10.9	11.2	11.8	12.5	13.1	14.1
All women								
Figure 9.8								
Distribution by no of live births. 35 years								
Farming								
1 child	7.7	7.8	8.2	8.1	10.1	8.1	11.8	13.7
2 children	35.6	41.7	41.0	39.2	40.7	44.5	44.4	43.5
3 children	39.6	37.2	37.3	38.8	35.9	35.7	32.5	33.2
4+ children	17.1	13.3	13.4	14.0	13.2	11.7	11.2	9.6
Banking, finance								
1 child	26.0	25.6	27.8	27.3	27.2	25.8	28.1	28.9
2 children	58.9	59.5	59.2	59.7	60.1	60.6	59.3	59.2
3 children	13.1	13.3	11.8	11.7	11.6	12.0	11.4	11.0
4+ children	2.0	1.6	1.2	1.3	1.0	1.6	1.2	0.9
Services, repair services								
1 child	18.1	19.1	19.9	20.6	22.0	24.5	23.1	24.1
2 children	55.3	55.4	56.7	56.1	56.3	56.8	56.4	55.7
3 children	22.0	21.3	19.7	19.7	18.7	16.0	17.1	17.0
4+ children	4.7	4.2	3.7	3.6	3.0	2.7	3.3	3.1
Figur 9.9								
Average no of children, 35 years								
Unskilled worker								
Manufacturing	2.04	1.99	2.01	1.96	1.94	1.91	1.95	1.88
Repair serv.	2.25	2.25	2.18	2.19	2.12	2.07	2.06	2.02
All	2.17	2.16	2.12	2.12	2.05	2.02	2.02	1.97
Other salaried employees								
Manufacturing	1.71	1.73	12.68	1.65	1.64	1.63	1.64	1.63
Services, repair services	1.79	1.76	1.76	1.75	1.73	1.70	1.71	1.67
All	1.73	1.71	1.7	1.7	1.68	1.66	1.66	1.63

Chapter 10

	Rate pr. 1,000								
	1980	1981	1982	1983	1984	1985	1986	1987	1988
Figure 10.1									
Fathers age									
15	-	0.2	0.1	-	0.1	0.1	0.1	0.1	
16	0.5	0.5	0.4	0.1	0.2	0.2	0.1	0.3	
17	1.7	1.0	1.0	0.9	1.0	0.9	1.0	0.8	
18	4.4	3.3	3.2	2.8	2.9	2.7	2.5	2.6	
19	10.4	8.3	8.7	74.0	6.9	6.8	6.2	6.5	
20	20.6	18.9	15.6	14.8	13.7	13.1	13.1	12.1	
21	33.1	30.5	29.3	25.6	21.7	21.1	22.6	21.8	
22	49.3	43.2	39.8	37.2	35.1	33.9	32.7	32.6	
23	64.3	56.3	55.8	50.7	48.9	47.3	44.1	44.0	
24	84.0	72.7	70.2	64.2	65.3	62.2	60.3	57.3	
25	97.2	88.7	82.2	79.0	79.8	79.2	75.7	73.8	
26	107.7	97.6	95.3	91.3	88.0	87.7	91.6	87.0	
27	113.7	102.9	103.7	97.9	97.8	102.0	97.0	97.9	
28	112.5	107.2	104.7	100.7	101.6	106.3	104.8	104.6	
29	106.9	103.6	106.4	99.4	101.8	106.8	104.6	106.5	
30	103.2	96.4	97.8	96.3	95.2	98.5	103.0	104.1	
31	87.8	84.5	87.4	87.8	90.2	92.7	97.1	98.8	
32	78.0	72.0	75.5	76.7	78.9	83.9	87.2	88.7	
33	65.4	63.9	63.9	63.8	66.1	70.7	78.6	77.4	
34	54.5	51.7	54.3	56.0	58.5	63.7	64.3	70.1	
35	43.4	44.0	45.2	45.1	48.0	51.8	56.2	55.9	
36	38.2	34.7	35.6	37.7	39.5	41.5	45.8	49.2	
37	30.4	28.0	29.7	29.3	30.9	32.7	37.0	40.7	
38	23.7	26.1	24.1	23.2	28.4	28.6	29.9	30.4	
39	19.4	19.0	20.2	20.1	20.9	23.6	25.5	26.5	
40	17.0	14.3	15.1	15.0	16.9	17.5	20.4	19.7	
41	12.8	13.6	12.2	11.4	12.6	14.5	14.0	16.4	
42	11.6	10.1	10.4	10.4	10.4	11.9	11.9	13.6	
43	7.2	7.6	7.6	8.3	8.8	9.0	9.7	9.8	
44	6.9	7.1	6.8	6.4	7.6	7.0	8.0	8.2	
45	5.3	5.1	4.7	4.8	5.7	5.4	6.4	6.5	
46	4.3	4.2	4.2	4.2	4.6	4.4	5.6	4.6	
47	3.6	3.7	2.6	3.2	3.6	4.2	3.9	4.0	
48	3.1	2.7	2.4	2.2	2.7	3.0	3.3	3.4	
49	2.1	2.1	2.4	1.9	2.0	2.4	2.0	2.8	
Figure 10.2									
Men:									
1st child	26.9	27.1	27.2	27.4	27.5	27.7	27.8	27.9	28.0
2nd child	30.0	30.1	30.2	30.4	30.6	30.7	30.9	31.0	31.1
3rd child	33.3	33.6	33.7	33.8	34.2	34.2	34.4	34.5	34.5
Women, cf figure 5.5									

Chapter 10

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Figure 10.3									
Average no of live births									
27 years	0.65	0.62	0.58	0.55	0.51	0.48	0.46	0.45	0.44
32 years	1.37	1.33	1.29	1.24	1.19	1.16	1.12	1.08	1.06
37 years	1.80	1.77	1.74	1.72	1.67	1.64	1.60	1.57	1.54
Figure 10.4									
Proportion childless men									
27 years	53.9	55.6	58.3	60.0	62.6	64.9	65.9	66.5	67.8
32 year	26.6	27.6	28.8	30.3	32.2	33.5	35.1	37.0	37.8
37 years	18.1	18.0	18.2	18.4	19.5	20.3	21.4	22.2	23.0
Figure 10.5									
Distribution by no of live births									
Men, 37 years									
1 child	18.2	19.4	20.5	21.3	22.7	23.3	24.2	25.0	26.3
2 children	52.8	53.0	53.0	53.7	53.4	53.7	53.8	53.4	52.6
3+ children	29.0	27.6	26.4	25.0	23.9	22.9	22.0	21.6	21.1
Women, 35 years									
1 child	17.5	18.1	18.8	19.8	20.6	21.6	22.5	22.9	23.8
2 children	52.5	53.3	54.2	55.0	54.5	54.9	55.3	54.9	54.5
3+ children	30.0	28.6	27.0	25.1	24.9	23.6	22.3	22.2	21.7
Figure 10.6									
Average no of live births cohorts 1942 and 1947									
1942	1.80	1.83	1.85	1.87	1.89	1.90	1.91	1.92	1.93
1947	1.37	1.45	1.51	1.56	1.60	1.64	1.67	1.70	1.72

Chapter 10

	Rate of first birth per 1,000	
	1980	1987
Figure 10.7		
Age		
14	-	-
15	0.14	0.18
16	1.17	0.52
17	2.62	1.58
18	7.09	4.45
19	14.72	8.10
20	23.33	15.49
21	39.10	24.92
22	51.66	33.84
23	66.61	43.90
24	82.19	57.12
25	97.26	69.14
26	106.45	81.57
27	106.80	89.09
28	106.19	94.09
29	101.70	95.24
30	96.03	93.78
31	83.14	84.63
32	70.17	72.42
33	53.49	63.17
34	47.18	52.83
35	39.65	47.90
36	34.60	44.27
37	25.75	30.04
38	24.77	25.05
39	17.16	21.01
40	13.74	14.10
41	14.16	13.86
42	6.14	10.39
43	7.46	6.67
44	4.74	6.46
45	3.91	4.29
46	3.11	4.58
47	2.37	1.93
48	1.12	2.64
49	1.41	2.01

Chapter 10

	< 1 year	-2 years	-3 years	-4 years	-5 years
Figure 10.8					
Year of birth of first child					
1968	1.7	14.7	25.3	20.0	11.2
1969	1.5	14.6	26.1	18.8	10.7
1970	1.5	14.5	27.0	20.2	9.9
1971	1.1	12.7	26.8	19.8	10.7
1972	1.2	12.3	26.2	19.6	9.4
1973	1.3	14.2	24.8	17.8	10.3
1974	0.9	13.2	23.4	19.9	10.6
1975	0.8	11.3	22.2	19.4	11.0
1976	0.6	11.4	23.5	18.6	10.2
1977	0.8	12.5	21.6	18.2	10.8
1978	0.8	10.7	20.8	18.2	10.5
1979	0.7	10.6	20.2	17.6	10.3
1980	0.7	9.9	18.8	18.1	10.8
1981	0.6	9.6	20.1	18.3	12.4
1982	0.1	8.8	21.1	20.1	9.9
1983	0.6	10.4	21.4	18.5	9.3

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Figure 10.9									
Proportion childless									
Men, 37 years									
9th class	*	13.5	13.4	14.3	16.7	17.4	19.1	18.7	20.9
Upper Second exam	*	20.7	21.1	21.7	24.0	24.3	26.3	25.8	26.6
Women, 35 years									
9th class	*	7.7	8.8	9.0	9.2	9.4	9.9	9.1	10.5
Upper Second exam	*	20.1	19.4	20.4	20.5	21.2	22.1	23.4	23.2

Appendix III. Variables in the Fertility Database

The variables included in the Fertility Database have been retrieved from various annually updated registers in Danmarks Statistik. The main characteristics of the registers were mentioned in Chapter 3.

This appendix contains a list of variables available in the Fertility Database and the registers from which they have been retrieved. Not all of the listed variables have been analysed in this report.

Further details about the registers can be found in Landstabelværk (1984) and Knudsen & Børlum Kristensen (1986).

III.1. Person Number

All of the registers mentioned below except The Register on Building and Dwelling Statistics have nationwide coverage and contain personal identification of the individuals.

The personal identification in the registers is the Person Number, a 10-digit number given to each individual with a permanent address in Denmark. The Person Number consists of the six digit date of birth (day, month, year) followed by a four digit number. The last digit indicates the sex of the individual (even for females, odd for males).

This Person Number is used as a mean of identification and registration in almost all conceivable areas of public (and private) administration for example with regard to income tax, employment, health insurance and treatment for illness. Bank accounts are identified by the same number and no social benefits can be received without this number.

The use of the Person Number is generally accepted in Denmark and is stored in the registers which form the basis for the routine statistics.

The Person Number allows various registers to be linked - as was done to establish the Fertility Database - but the linking of registers is subject to strict and specific legislation regarding security.

III.2. Register on Population Statistics

From the Register on Population Statistics the status of the resident population in Denmark as of 1 January each year since January 1979 has been extracted. Special files comprise data on migration and adoption.

The references to (i.e. Person Numbers of) mother and father identify the actual parent(s). If a child is adopted the reference will be changed to the Person Number(s) of the new parent(s). In the Fertility Database both references are kept.

Variables used:

Women and men
Actual place of residence (municipality)
Previous place of residence
Address
Country of birth
Citizenship (actual and previous)
Marital status (actual and previous)
Date of marriage
Date of immigration
Date of emigration
Person Number of spouse (actual and previous)
Status in the family (head, spouse etc.)
Type of family
Type of household

Children
Person Number of mother (actual and previous)
Person Number of father (actual and previous)
Country of birth
Date of immigration
Calendar year of adoption

III.3. Medical Register on Vital Statistics

This register comprises data on all live births and stillbirths in Denmark since 1 January 1973 by women with a permanent address in Denmark.

Variables used:

Mother
Previous number of live births
Previous number of stillbirths
Previous number of spontaneous abortions
Previous number of induced abortions
Duration of marriage at time of delivery

Child
Person Number of mother
Sex
Single or multiple birth
Birthweight
Gestational age
Date of death
Age at death in hours or days
Causes of death

III.4. Education Classification Module

The Education Classification Module comprises information on all individuals over the age of 14.

In the Fertility Database, educational status registered as of 1 January 1984 for example is based on information as of 1 October 1983.

Variables used:

Women and men
Type of general education
Completed vocational education
Type of ongoing education
Point in time of completed education
If receiving wage during education
Amount of time spent during the year on the education in question

When education is analysed in the study, the 8-digit education identifiation codes have been grouped in the following way:

General education:

9th class	9th class in lower secondary education or any education at same level.
10th-11th class	10th class and any other school education at these levels.
Upper secondary school examination	This particular examination or any examination at the same level.

Vocational education
Clerical education
Commercial education
Skilled workers (in various groups of industries)
Short, medium and long courses of further education.

III.5. Employment Classification Module

This comprises data on the resident population in Denmark.

Variables used:

Women and men
Rate of unemployment
Insurance categories
Type of occupation
Type of industry
Socioeconomic position

III.6. Register on Income Statistics

Data on income are primarily based on tax information.

Variables used:

Women and men
Type and amount of annual income
Type and amount of benefits

III.7. Register on Buildings and Dwellings

Each dwelling can be identified by the detailed address in the Register on Buildings and Dwellings. The register is produced annually and by use of the address for each individual in the Register on Population Statistics data on the resident population in Denmark can be linked to characteristics of the individual's dwelling.

Variables used:

Women and men
Type and size of dwelling
Number of rooms
Number of persons in the household
Facilities, e.g., bathing, heating and toilet facilities
Ownership and tenure

III.8. Register on Income Compensation Benefits

From this register, data can be retrieved from 1984 onwards. The register comprises information on the amount of specific social benefits received by residents in Denmark.

Variables used:

Women and men
Amount, type and duration of social benefits
- unemployment
- sickness
- birth
- social support
- disability pension

Appendix IV. Calculation and evaluation of parity

In this appendix the determination of parity and the validity of the calculated measure of parity is described in more detail than in chapter 3.

IV.1. Reference(s) from child to parent(s)

The basis for the determination of parity is the reference to (=Person Number of) the mother in the child's record in the Register on Population Statistics and the Person Number of the mother included in the Medical Register on Vital Statistics. As a first step, a Children's File was constructed.

Register on Population Statistics

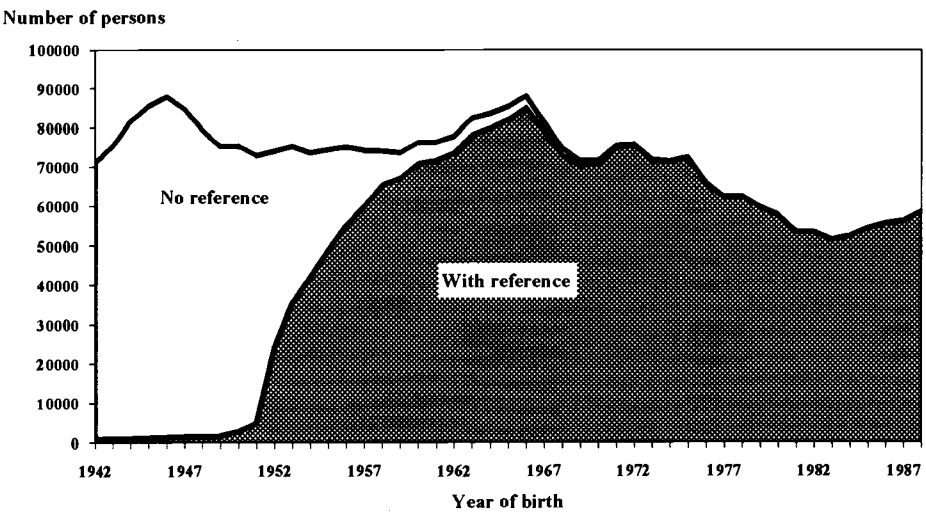
From the most recent file in the Register on Population Statistics relating to the resident population as of 1 January 1989, data on all individuals born in the period 1 January 1942 to 1 January 1989 were extracted.

The women in the study population were born in the period 1 January 1930 to 1 January 1977 and 1942 was considered the first year they could give birth. The initial population of "children" resident in 1989 was extended to include members of the same birth cohorts who could only be identified in previous annual files back to 1979.

In determining the parity of the adult population, much emphasis was placed on ensuring that the most valid reference from the child to both mother and father was kept in the Fertility Database.

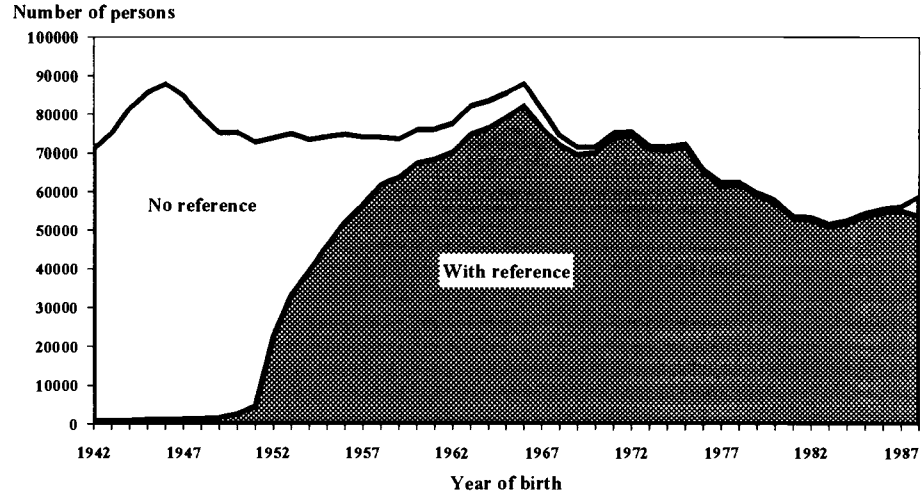
Figure IV.1

Number of records with and without reference to a mother. Generations born 1942-1988



The most recent information available from the Register on Population Statistics was considered most valid and kept in the child's record. This is of particular importance with regard to changes in the child's own Person Number which may occur in some cases as discussed later.

Figure IV.2 **Number of records with and without reference to a father. Generations born 1942-1988**



The calculated parity in this report is the so-called biological parity where only liveborn children are considered. This is the case both for the mother and the registered father.

Register on Vital Statistics

The data from the Register on Population Statistics have been supplemented with data from the Register on Vital Statistics, which comprises information on all live and stillborn infants in Denmark born from 1 January 1973. All liveborn infants born in Denmark from 1973 onwards who emigrated or died before 1 January 1979 were not present in any of the resident populations for the period 1979-1989 and could therefore only be identified in this way.

Another advantage is that the Register on Vital Staistics includes the Person Number of both the newborn infant (if liveborn, for stillbirths only date of birth) and the mother. This information concerning births is based partly on birth notification forms and partly on the Central Population Register and comprises, in addition to demographic information, medical variables describing the condition of the child after delivery, e.g. birthweight and, when appropriate, date of death within the 1st year of life.

Subsequently, linking with data from the annual populations has only included children with a reference to the mother, to the father or to both, and whose parents are in the study population.

Reference to mother

The Person Number of the mother retrieved from the Medical Register on Vital Statistics was retained as a reference to the biological mother.

Changes in Person Number may occur over time, but when establishing the Fertility Database, Person Numbers in the files were only corrected for the children.

The Person Numbers of mothers and fathers have not been changed as the record linkage between annual population files and annual files on

educational status, occupation etc. require the Person Number at a given point of time to remain unchanged.

If a child had changed Person Number, it would be listed with two (or more) separate records in the Children's File. The way in which changes in children's Person Numbers were handled is described below.

The Children's File was sorted according to the mother's Person Number. This file was matched with a unified file of all women present in at least one of the annual populations.

This linkage created a new file called the parity file. In the parity file, a woman can appear more than once - either with a single record stating that no child has been identified or with several records, one for each child identified in the registers.

Each case where the same woman had two singleborn children born within five months of one another was listed. The structure of the records and the information on the source and the year of the original record made it possible to make corrections and create a combined record with the corrected data of the child.

Typical corrections related to the dates of birth of newborns or of children born abroad whose date of birth had been incorrectly registered at the time of immigration to Denmark. In both cases, the most recent Person Number was retained.

In a few cases it was necessary to contact the Central Population Register directly to check which Person Number was the most recent.

IV.2. Calculation of parity

After making the corrections mentioned above, the number of live births to each woman in the study population was counted and this number was used as a measure of parity.

Table 3.1 in chapter 3 illustrates the coverage af references from child to parent. For children born from 1960 onwards, almost 100% have a reference to the mother.

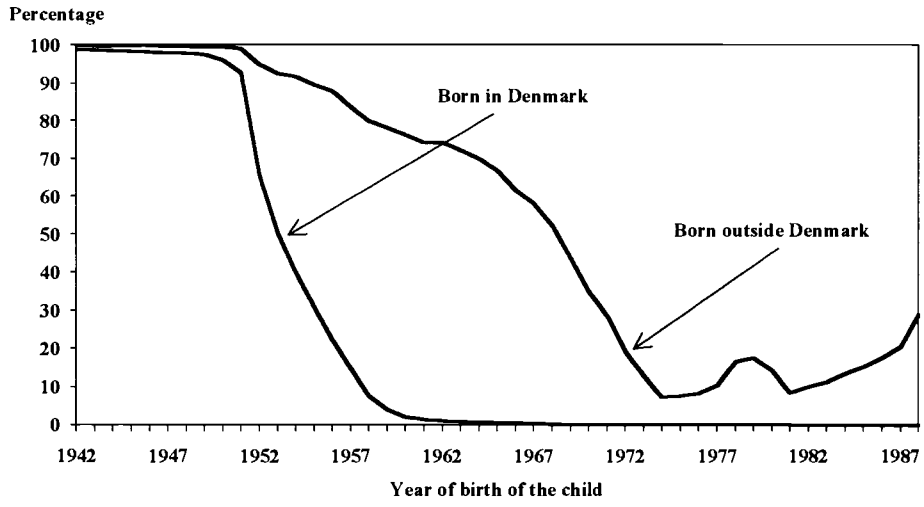
On the basis of these figures the coverage of reference from child to parent in this study is considered complete for children born in Denmark from 1960 onwards. The calculation of parity, therefore, is considered valid for all cohorts of women born from 1945 onwards giving birth in Denmark. There is not total accordance between the coverage from child to parent and the validity of the calculated parity.

Most of the missing references in the mentioned cohorts are found for children born outside Denmark. If the cohorts are specified according to country of birth, only a very small proportion of the children born in Denmark are without a reference, while the proportion of immigrants

without a reference varies from approximately 70% in the generations from the mid-1960s to between 5% and 20% in the generation from the mid-1970s onwards.

Figure IV.3

Percentage of each birth cohort without reference to mother in the Children's File. Children born in and outside Denmark



There are a number of reasons why there may be missing references. Some of the older generations of children might have been over 18 when they immigrated to Denmark, and in this case they would have been considered as adults so that no parents are registered in the Central Population Register.

The reference used in this study is, as mentioned, reference to the biological parent. Children born outside Denmark and adopted by Danish parents will not have any reference to the biological mother (or father).

Comparison with previous live births

The calculated parity of each woman can be compared with the number of previous live births stated in the Medical Register on Vital Statistics.

Due to the design of the basic notification form for this register it was not possible to distinguish between the number of live births and stillbirths prior to 1 January 1978.

An evaluation of parity has therefore been performed separately for two groups of women - those who were too young to give birth prior to 1978 and the remaining group of women who could have given birth both before and after 1978. Errors may occur of course on the notification forms as well as in the Fertility Database.

The first group of *young* women comprises a total of 430,832 women in the Fertility Database. They were born in the period 1965-1975 and thus aged 13-23 in the study period and gave birth to 39,612 liveborn singletons in Denmark in the period 1978-1989.

Table IV.1 shows the parity distribution of these women calculated either from the stated number of previous live births (MRVS) or from the number of infants identified (FTDB).

About 32,000 of the 39,612 children were firstborn, and 7,000 second born, corresponding to 81% and 17% respectively. As mentioned above, these women are still rather young at the end of the study period and 23,309 of their children (58.8%) were born in 1988 or 1989. Just over 70% of the second born children are from these two years, all of which illustrates the very low rate of fertility among Danish teenagers (less than 10 per 1,000 in the late 1980s).

Table VI.1

Number of live born singletons in Denmark from 1978 onwards for women born in the period 1965-75, by maternal parity at the index-birth, calculated from two sources

Number of previous live births retrieved from MRVS	Demographic Parity, calculated from FTDB				
	First child	Second child	Third child	Fourth+ child	Total
0 or not stated	31,972 80.7%	80	1	2	32,055 80.9%
1 prev. liveb	96	6,697 16.9%	13	1	6,807 17.2%
2 prev. liveb.	16	35	603 1.5%	6	660 1.7%
3+ prev. liveb.	0	3	8	57 0.1%	68 0.2%
No information	17	5	0	0	22 0.1%
Total	**32,101 81.0%**	**6,820 17.2%**	**625 1.6%**	**66 0.2%**	**39,612 100.0%**

The marginal distributions differ only slightly from one another. The figures on the diagonal show that a total of 39,329 births (99.2%) are given the same parity in both sources.

Table IV.2 illustrates the results of this same comparison for births from 1978 onwards for the second group of older women born before 1965 who could have given birth before and after 1978.

These women gave birth to a total of 617,636 liveborn singletons in the period 1978-89. Less than half of these children (44%) were firstborn, while more than one third (38%) were second born. As expected, this distribution varies from the one seen for the younger women, but it is perhaps surprising to note the same high degree of correspondance between the two sources as

for the younger group, despite the fact that births before the establisment of MRVS will have been experienced by the older group.

The sum of the percentages in the diagonal in the table gives 97.7% having total correspondance between the two sources, compared with 99.2% for the younger group. A higher proportion of the older women have four or more children and if the parity 4+ group is specified as parities 4,5,6,7,8 and 9+, only 0.2% of these are not in accordance.

Table IV.2 **Number of live born singletons in Denmark from 1978 onwards for women born before 1965, by maternal parity at the index-birth, calculated from two sources**

Number of previous live births retrieved from MRVS	Demographic Parity, calculated from FTDB				
	First child	Second child	Third child	Fourth+ child	Total
0 or not stated	267,960 43.4%	2,722	611	151	271,444 43.9%
1 prev. liveb	2,031	233,063 37.7%	1,202	117	236,413 38.3%
2 prev. liveb.	313	2,144	78,717 12.7%	614	81,788 13.2%
3+ prev. liveb.	119	275	1,596	25,537 3.9%	27,527 4.4%
No information	199	166	58	41	464
Total	**270,622 43.8%**	**238,370 38.6%**	**82,184 13.3%**	**26,460 4.2%**	**617,636 100.0%**

IV.3. Occurrence rates for birth of the first child

Previously, the parity distribution of all Danish women was not known. For a given calendar year, only the parity distribution of women giving birth that year was known.

On the basis of these cross-sectional compilations Hoem (1979) estimated the parity distributions of cohorts of women up to a given age, and these distributions have since been updated annually and included in the current statistics.

These calculations begin with the number of women in the given cohort at the beginning of their reproductive age. The size of the cohort is reduced each year by the number of women giving birth to their first child that year.

By summing the rates of the different age groups, the number of women at a given age with at least one child is calculated (Vital Statistics 1990).

Similarly, still on the basis of the parity distribution of women giving birth, the number of women at a given age in a cohort with any number of children can be estimated.

In the Fertility Database, each woman has been assigned a parity value at the beginning of each calendar year (and time of each birth). Consequently, occurence rates for the birth of the first child can be calculated by dividing the number of first births by the number of women with no children at a given time or age. Similarly, occurence rates for the birth of any child number can be calculated.

Table IV.3 shows the difference between the previously calculated parity distribution and the parity distribution calculated using the Fertility Database. The figures refer to the two groups of women aged 30 at the beginning and at the end of the period i.e. from cohorts 1950 and 1957, respectively.

Table IV.3 **Parity distribution at age 30 (B-group) for woman. 1950- and 1957-cohort, from the Fertility Database and Vital Statistics**

	1950-cohort		1957-cohort	
	FTDB	VS	FTDB	VS
	pct.			
O children	18.7	17.6	27.0	26.5
1 child	25.5	26.0	27.5	28.2
2 children	43.6	44.0	36.3	36.7
3+ children	12.2	12.3	9.2	8.7

In Vital Statistics, these calculations are based on the same year - same cohort principle (chapter 4). This implies that "women aged 30 in 1980" comprises women aged 30 at the end of 1980, i.e. born in 1950. The calculated parity distribution for these women (Vital Statistics) is then compared with the parity distribution (Fertility Database) as of 1 January 1981 for women from the same cohort.

There is almost complete accordance between the distributions, based on these two measures.

Table IV.4 shows the average number of live births among women aged 25 and 30 each year in the study period.

The average numbers of livebirths are almost identical when based on the two different sources.

Age-specific first birth rates for the first child's birth are calculated for the 1965-cohort of women. This cohort is selected because all women who have given birth have done so in the study period. Consequently, the difference between the two methods of calculation is immediately apparent.

Table IV.4 **Average number of live births. Women 25 and 30 years from the Fertility Database and Vital Statistics**

	25 years		30 years	
	FTDB	VS	FTDB	VS
1980	0.77	0.78	1.52	1.51
1981	0.74	0.74	1.48	1.48
1982	0.70	0.70	1.44	1.42
1983	0.65	0.65	1.40	1.39
1984	0.61	0.61	1.36	1.35
1985	0.59	0.59	1.33	1.31
1986	0.56	0.56	1.31	1.27
1987	0.54	0.55	1.29	1.26

In age groups where there are very few births the method of calculation is generally of no importance but in age groups with relatively high fertility the calculated first birth rates depend to a greater extent on the method used.

By summing the first birth rates for the 1965-cohort, the original method estimates that 6.5% will have had at least one child by the end of the year in which they reach age 20 (Vital Statistics 1990), whereas the use of the Fertility Database gives a figure of 6.4%.

IV.4. Childless women

The proportion of women with no children according to the Fertility Database has been compared with previous calculations based on cross-sectional annual statistics (Hoem 1979 and Vital Statistics).

The calculated proportions of women in the 1965-cohort with no children at a given age are almost identical irrespective of method of calculation.

It should be born in mind that the calculated measures for cohort fertility with both methods of calculations are not true cohort figures as changes in the population, i.e. migrations and deaths, are not taken into account. Fertility in both cases is calculated on the basis of information relating to that part of the cohort present in Denmark at the given time.

It appeared from the tables in chapter 3 that the large majority of the population is stationary, and that mortality before age 50 is still so low that it does not significantly change the population.

V. Concepts from statistical modelling of fertility data, with an illustration on the association between education and fertility of primiparous women.

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This appendix contains a brief introduction to some standard tools in statistical demography with particular attention to fertility measures. The models are used to elucidate the intrinsic consistency between various measures of cumulative fertility. We also illustrate their use for simultaneously studying associations between fertility and several explanatory variables ('multivariate analysis') through an example showing how fertility of primiparous varies with level of general education.

1. Statistical models.

The basic statistical model considers one sex at a time and assumes that births to a parent occur according to a Poisson process with some age–dependent intensity $\varphi(a)$, often called the force of fertility. That is, the probability that a parent gives birth to a child in the infinitesimally small age interval $[a, a+da)$ is $\varphi(a)da$, disregarding terms of higher order of magnitude in da; formally

$$P(\text{birth in } [a, a + da)) = \varphi(a)da + o(da) \ .$$

The force of fertility $\varphi(a)$ is (obviously) assumed to equal zero outside of the fertile age interval, and $\varphi(a)$ may in addition depend on parity, calendar time, marital and/or social status, education etc. and last but not least the sex of the parent. For each sex different parents are assumed to produce children independently.

In demography the intensities are usually assumed piecewise constant, e.g. in one–year age groups, so that

$$\varphi(a) = \varphi_k \ , \qquad k \leq a < k+1, \qquad k = 0, 1, 2, \ldots$$

where $\varphi_k=0$ for k less that the lowest fertile age (e.g. 12 years) and $\varphi_k=0$ for k greater than the highest fertile age (e.g. 50 years for women). It is well known and easily shown that given a set of parents of the same sex, the standard (so–called maximum likelihood) estimator of the force of fertility φ_k is given by

$$\hat{\varphi}_k = \frac{b_k}{t_k}$$

where b_k is the number of births observed to parents of integer age k and t_k the aggregate life–time (or exposure) of parents of these ages. Thus, the statistical estimator of the force of fertility is the same as the age–specific fertility rate. The discussion in Chapter 4 based on the Lexis diagram on how to approximate the exposure under various observational schemes is also relevant here.

The above exposition includes the possibility of death or migration of a parent only rather indirectly. Indeed, a necessary assumption is that entrance to and exit from the exposure set of parents prone to give birth happen independently of the fertility. In particular, for each parent, independence is assumed between the events of death (or migration) and giving birth in the next small time interval.

When necessary, mortality may be included in the model through an intensity function (force of mortality) $\mu(a)$.

2. Concepts of cumulative fertility.

Based on the formal framework developed above, this section briefly describes three measures of cumulative fertility: The Total Fertility Rate, the Net Reproduction Rate and the Average Number of Live Births (for the latter, see Sections 2.2 and 4.2 in the main text).

2.1. Total Fertility Rate (TFR).

The average number of children born by a parent, provided there is no mortality, is called Total Fertility Rate (TFR). By the definition of the force of fertility, the expected number of children born in an infinitesimal age interval [a, a+da) is $\varphi(a)da$, so that

$$TFR = \int_0^\infty \varphi(a)da$$

where the interval $[0,\infty)$ over which the force of fertility is integrated, may be reduced to the fertile period $[\omega_1, \omega_2)$. More formally, this follows from the Poisson process assumption specified in Section 1 above. According to this the number of births born to a parent over an age interval (a_1, a_2) is Poisson distributed with expectation

$$\int_{a_1}^{a_2} \varphi(a)da \ ,$$

which may sometimes be useful as a 'partial' measure of fertility.

A (maximum likelihood) estimate of TFR or any of the partial measures, is found by replacing the force of fertility by its estimate. For piecewise constant intensities, one finds

$$TFR = \sum_{k=\omega_1}^{\omega_2-1} \hat{\varphi}_k = \sum_{k=\omega_1}^{\omega_2-1} \frac{b_k}{t_k} \ .$$

Note that TFR is estimated by what is called the Completed Fertility in demography, which turns out to be a maximum likelihood estimate in the previously defined statistical model.

2.2. Net Reproduction Rate (NRR).

Another measure of the reproduction rate, the Net Reproduction Rate (NRR), is defined as the average number of children that will

be born to a parent, evaluated at the birth of the parent, taking into account mortality.

The above assumptions are now extended to include independence of mortality and fertility. By a similar reasoning, the expected number of children born in [a, a+da) taking into account the possibility of parental mortality (with rate $\mu(a)$) is then ${}_ap_0\,\varphi(a)da$ where

$$ {}_ap_0 = \exp\{-\int_0^a \mu(t)dt\} $$

is the probability that the parent survives from birth to age a. Accordingly, the Net Reproduction Rate is

$$ NRR = \int_0^\infty {}_ap_0\,\varphi(a)da \ . \qquad (2.1) $$

Again a formalization of the argument is possible within the stochastic process framework, which will highlight the assumption of independence of mortality and fertility.

Note that by setting ${}_ap_0=1$, i.e. by not including mortality, (2.1) becomes TFR. The following connects an approximate ML–estimate of NRR to demographers' use of the term Net Reproduction Rate. Rewriting (2.1) yields

$$ NRR = \sum_{a=\omega_1}^{\omega_2-1} {}_ap_0 \int_0^1 {}_\tau p_a\ \varphi(a+\tau)d\tau \ . $$

Assuming piecewise constant forces of fertility and mortality, one obtains

$$ NRR = \sum_{a=\omega_1}^{\omega_2-1} {}_ap_0\,\varphi_a \int_0^1 {}_\tau p_a\,d\tau \ , $$

where

$$\int_0^1 {}_{\tau}p_a \, d\tau = \frac{1-e^{-\mu_a}}{\mu_a} \simeq 1 - \tfrac{1}{2}\mu_a \, , \; \mu_a << 1 \qquad (2.2)$$

and the probability ${}_ap_0$ is estimated by

$${}_ap_0 = \frac{\ell_a}{\ell_0}$$

where ℓ_a is the number of women of age a.

Setting μ_a in (2.2) to zero yields an approximate ML–estimate of NRR

$$\hat{NRR} = \sum_{a=\omega_1}^{\omega_2 - 1} {}_a\hat{p}_0 \, \hat{\varphi}_a = \sum_{a=\omega_1}^{\omega_2 - 1} \frac{\ell_a}{\ell_0} \hat{\varphi}_a \; . \qquad (2.3)$$

This is exactly how demographers define the Net Reproduction Rate, and thus turns out to correspond to an ML–estimate of a reproduction rate construct in a statistical model.

Note that NRR is slightly overestimated by (2.3) since μ_a in (2.2) is set equal to zero. This was discussed in further detail by Hoem (1969, p. 48).

2.3. Average Number of Births (ANB).

In Sections 2.2 and 4.2 of the main text a third measure of cumulative fertility was defined, viz. the average total number of (live) children born by a woman at a given time. It is calculated for an actual cohort as the total number of live births to parents of a given age (and sex) divided by the total number of parents (of that sex) still alive at that age.

The natural theoretical counterpart to this empirical measure is the expected number of (live) births to a parent in the age interval [0, a] given that she or he survives to age a.

Employing once again the infinitesimal argument the expected number of children born in [a, a+da) to a parent who is known to survive a_1 where $a_1 > a+da$ is

$$ {}_{a}p_0 \, \varphi(a)da \, {}_{a_1}p_a / {}_{a_1}p_0 = \varphi(a)da \ , $$

since ${}_{a}p_0 \, {}_{a_1}p_a = {}_{a_1}p_0$ for $a_1 > a$. Therefore the average number of births to parents known to survive a is

$$ ANB(a) = \int_0^a \varphi(t)dt $$

and in particular $ANB(\infty)=TFR$. We define $ANB=ANB(\infty)$ as the expected number of children born to a parent who is known to have survived the fertile period. For further discussion and a stochastic process framework, see Hoem (1969).

We conclude that the Average Number of Births, given survival past the fertile age range, estimates the same theoretical measure as the Total Fertility Rate. It therefore becomes of interest to compare the properties of the empirical measures $\hat{ANB}$ and $\hat{TFR}$ considered as estimators of ANB=TFR.

Formal calculations show that the asymptotic variance of the empirical TFR, calculated on the basis of the intensity estimates, is

$$ Var\{\hat{TFR}\} = Var\{ \sum_{k=\omega_1}^{\omega_2-1} \hat{\varphi}_k \} = \sum_{k=\omega_1}^{\omega_2-1} \frac{\varphi_k}{E\{t_k\}} $$

Recall that t_k is the aggregate lifetime in the age interval [k,k+1). The asymptotic variance of the empirical $ANB(\infty)$ may be shown to be

$$ Var\{\hat{ANB}\} = \frac{\sum_{k=\omega_1}^{\omega_2-1} \varphi_k}{E\left\{ t_{\omega_2-1} \right\}} \ . $$

Now

$$E\left\{t_{\omega_2-1}\right\} \leq E\{t_k\} \quad \text{for} \quad k = \omega_1, \ldots, \omega_2-1$$

since there are fewer women of age ω_2-1 in the (closed) cohort than women of any other age. The following inequality is therefore asymptotically valid

$$\text{Var}\{\hat{\text{ANB}}\} \geq \text{Var}\{\hat{\text{TFR}}\}$$

and $\hat{\text{TFR}}$ is thus the better (more efficient) estimator. It is noted however, that for a population with a small force of mortality, the difference between the variances of the two estimators becomes small and one may use either of the two.

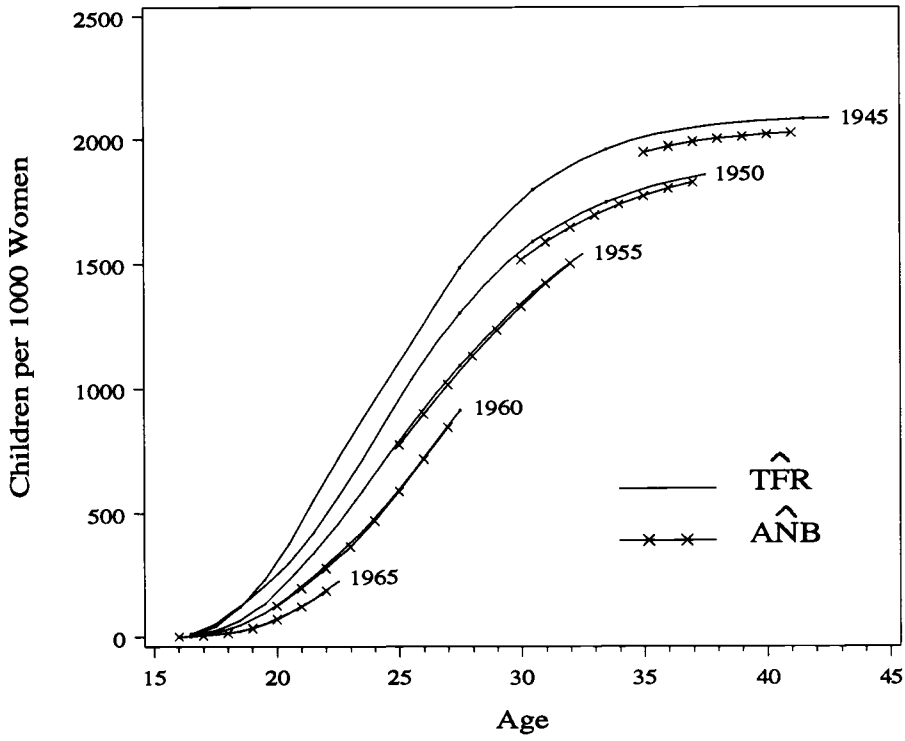
3. Empirical comparison of $\hat{\text{TFR}}$ and $\hat{\text{ANB}}$.

It was shown in the last section that $\hat{\text{TFR}}$ and $\hat{\text{ANB}}$ are two estimates of the same measure of fertility. It is important to bear in mind that this result is derived assuming a closed population and with certain simplifying assumptions (independence) about the forces of fertility and mortality. Since the Danish population is not closed and the independence assumption may not be quite accurate, it is worthwhile comparing the two measures using actual data.

Figure V.1 shows the two estimates as a function of the expected age at the birth of the children, for cohorts 1945, 1950, 1955, 1960 and 1965.

The solid lines are $\hat{\text{TFR}}$ for the different cohorts based on "Befolkningens Bevægelser" (Vital Statistics). The lines marked with crosses are $\hat{\text{ANB}}$ for the different cohorts, calculated from the Fertility Database and based on the whole Danish population.

Figure V.1 **Comparison of Fertility Measures $\hat{TFR}$ and $\hat{ANB}$ Cohorts 1945 to 1965**



Note that $\hat{TFR}$ is based on "same age, same year" groups, whereas $\hat{ANB}$ is based on "same age, same cohort" groups. The difference in the expected number of children given survival, due to the different time–age groups, has to some degree been eliminated by plotting the two estimates as functions of the expected age at the birth of the children. This adjustment amounts to subtracting 6 months from the age in the "same age, same cohort" group. Thus the age indicated on the abscissa is the expected age ("average" age) of the women when they give birth.

It is seen that $\hat{ANB}$ is systematically slightly smaller than $\hat{TFR}$ for the early cohorts (1945–1950). For the later cohorts i.e. the 1955, 1960 and 1965 cohorts, the two estimates are almost identical.

Explanations of the differences between the two measures could be many. One of the most important is that the $\hat{ANB}$ is based on a partially incomplete register. The register does not include information about children who died before 1972. For the same reason no registration of the mothers to these children is available. This means that the parity of women from the early cohorts, here 1945 and 1950, is systematically underestimated.

Also, as mentioned initially, the two measures are shown to estimate the same, only in a closed population. The differences may thus also in part be accounted for by the migration. Another doubtful assumption is that the force of mortality is parity independent. Hoem (1970) showed that increased parity–specific mortality with increasing parity implies that the expected number of children to a woman given survival becomes smaller.

Figure V.2 **Comparison of $\hat{TFR}$ and $\hat{ANB}$**
Cohort 1966

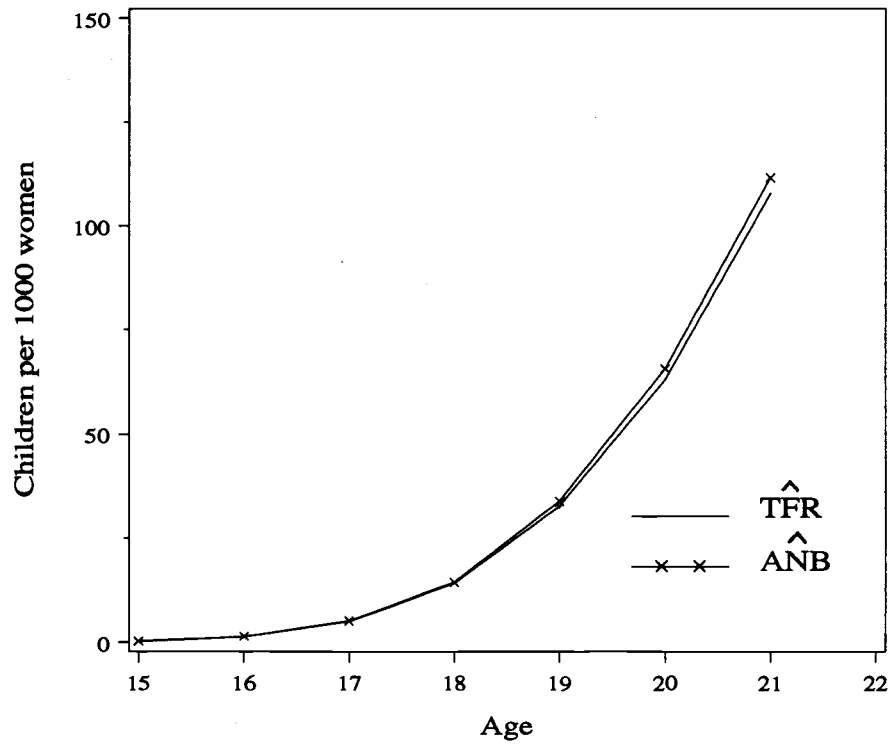


Figure V.2 shows $\hat{TFR}$ and $\hat{ANB}$ for the 66–cohort. The estimates are calculated using data from the Fertility Database and the age groups are thus the same and the data is complete. Furthermore, only data up to age 21 is available for this cohort which means that parity–specific mortality is likely to be negligible.

In this plot the agreement is almost complete. However, $\hat{ANB}$ is slightly larger than $\hat{TFR}$. An indication of the cause of this deviation is obtained from the following table

Year	Age	No. of births (Cum)	Cum no.of births (Retro)	No. of women
81	15	9 (9)	12	42756
82	16	51 (60)	64	42896
83	17	153 (213)	222	43088
84	18	397 (610)	627	43288
85	19	795 (1405)	1466	43468
86	20	1323 (2728)	2861	43694
87	21	1957 (4685)	4864	43667

The third column is the number of children born in Denmark by women with age at the end of the year given in the age column. The numbers in parenthesis are the cumulated sums of births. The fourth column is the number of children registered as born to women who survived the calendar year given in "the year" column. The fifth column is the number of women at the end of the year in which they had their birthday given in the age column.

Note that the number of children in column 4 is larger than that in column 3 indicating that some women have immigrated to Denmark after having given birth to children. This is confirmed by the fifth column where it is seen that the cohort has increased in size over the six year period, by 43667–42756 = 911.

The main conclusion from this comparison of the two measures is:

$\hat{TFR}$ and $\hat{ANB}$ are equivalent in a closed population with parity independent mortality. Comparing them using actual data shows differences between the two estimates which to a large extent is believed to be accounted for by a known partially incomplete register and by migration.

4. Multiplicative Poisson models, illustrated by the dependence of the fertility of primiparous women on age, calendar year, and general education.

In epidemiology the modern statistical counterpart of the classical concept of indirect standardization is the multiplicative intensity model, cf. Keiding (1987), Hoem (1987), Breslow & Day (1987) and Clayton & Kaldor (1987 a,b).

In this section we illustrate this methodology by studying the dependence of the fertility of primiparous women on age, calendar year and level of general education. The forces of fertility are assumed piecewise constant over 1–year age and calendar time periods. As in Section 8 of the main text, general education is scored in the three categories low: 8–9 years of school, medium: 10–11 years of school, and high: high school. The example is chosen partly because the statistical model fits unusually well. Often it is necessary to introduce extra parameters to describe additional random variation not explained by the primary parameters (for a published example based on other Danish demographic data see Keiding et al. (1990)). However, these issues are beyond the scope of this appendix.

Consider then the force of fertility φ_{ayg} for a primiparous woman of age $a=13,...,45$, calendar year $y=1981,...,1987$ and general education g=low, medium, or high. We are interested in obtaining a simpler description of φ_{ayg} in terms of a multiplicative decomposi-

tion – in a particularly simple situation $\varphi_{ayg}=e^{\xi_a} e^{\eta_y} e^{\zeta_g}$ – or equivalently an additive decomposition of the (natural) logarithm of φ_{ayg}, in the simple example above

$$\log(\varphi_{ayg}) = \xi_a + \eta_y + \zeta_g \ .$$

Based on the Poisson distribution, a likelihood function may be derived allowing estimation of the parameters by maximum likelihood and hypothesis testing by likelihood ratio tests. We use the term deviance in the standard generalized linear model (GLIM) sense, to mean minus twice the log (likelihood) ratio for the current hypothesis as tested against the full model where the φ_{ayg} vary freely. The deviance is approximately χ^2—distributed with a certain number of degrees of freedom (df).

Initially, it is tested whether φ_{ayg} can be parameterized as

$$\log \varphi_{ayg} = \alpha_{ay} + \beta_{ag} + \gamma_{yg}$$

The hypothesis is accepted with deviance=321, df=315, P=0.40.

Further reduction of the model is possible since a test of the hypothesis $\gamma_{yg}=0$, i.e. no calendar year – education interaction effect, is accepted with $\chi^2=13.5$, df=12, P=0.33.

The two remaining interaction effects may not be removed from the model without loss of information. This is illustrated in the following table

Effect	χ^2	df	P
age*year ($\alpha_{ay}=0$)	552	171	<0.0001
age*geduc ($\beta_{ag}=0$)	5230	54	<0.0001

The final model is thus in the form

$$\log \varphi_{ayg} = \alpha_{ay} + \beta_{ag} \qquad (4.1)$$

This result is interesting for two reasons. Firstly, it is surprising that it is possible to fit such a simple model to data from the entire Danish population. Secondly, the parameterisation is such that for each age, the model is a multiplicative Poisson model with only main effects: calendar year and education.

This means, first, that the age–specific fertility differs between the three groups defined by education. This is well–known. However, the model implies that, in a certain sense, these differences are constant over the seven calendar years included in this study. Formally, this is seen by the following equations

$$\log \varphi_{ayg_1} - \log \varphi_{ayg_2} = \alpha_{ay} + \beta_{ag_1} - \alpha_{ay} - \beta_{ag_2} = \beta_{ag_1} - \beta_{ag_2} \; ;$$

the difference, for fixed age and calendar year, of the logarithm of the intensities for two different educations, depends only on the age and the educations, but not on the calendar year.

Figure V.3 shows the relative age–specific intensities for the women with 10–11 years of school and High School. The intensities are shown relative to the women with 8–9 years of school.

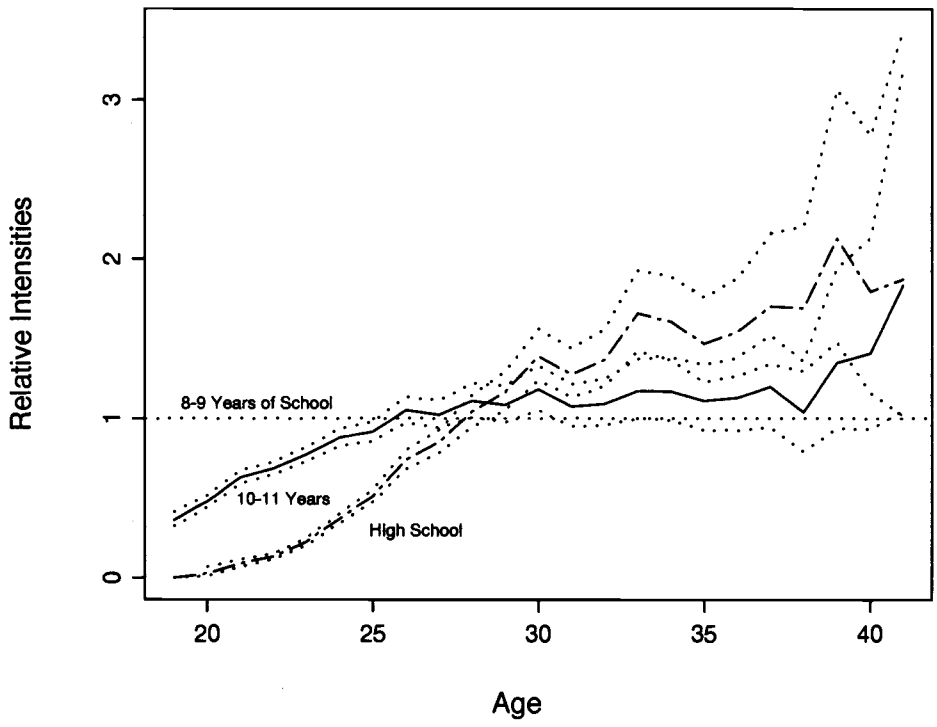
On each side of the curves of the estimates, upper and lower 95% pointwise confidence limits are plotted.

For primiparous women below about age 26 years, the fertility of the women with 10–11 years of school is lower than that of the women with 8–9 years of school. After age 26 years the fertility of "10–11 years" is almost constant and 10–20% higher than that of "8–9 years".

The fertility of the primiparous women with High School starts at an even lower level than that of "10–11 years". It reaches the level of the other two groups at about 27 to 28 years of age. For the older women (age over 28) the fertility increases more and more relative to the other two groups.

Figure V.3

Relative Fertility Associated with Education
Estimates are Relative to '8–9 Years of School'
Additional Lines are 95% Confidence intervals
Female Fertility 1981–87 – Parity = 0



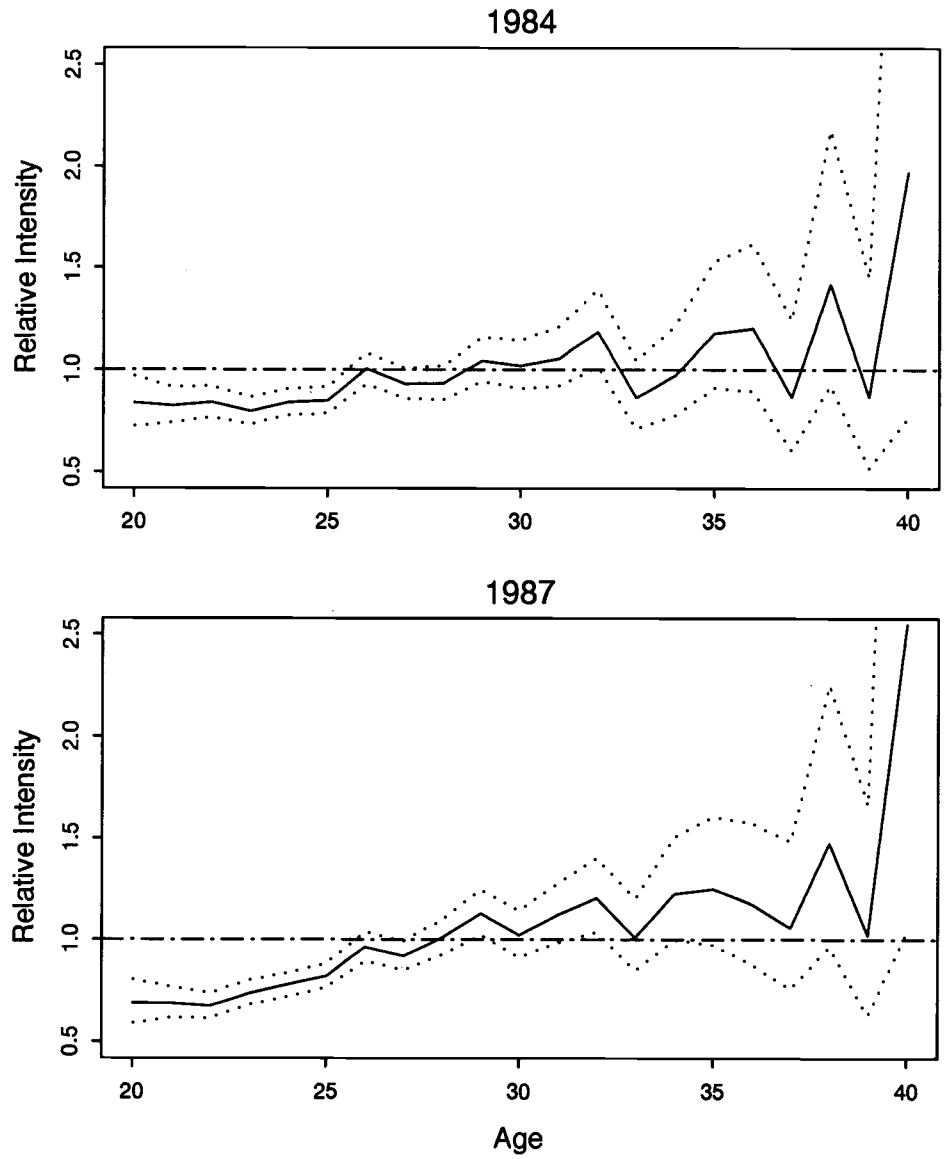
It is important to note that these age–specific fertilities for the three groups are controlled for the calendar year effect, i.e. for the differences in fertility over time (1981–87). The fertility changes from one year to the next but the relative fertility remains the same.

Figure V.4 shows the calendar year effect controlled for education as a function of age. Effects are shown relative to the fertility level in 1981.

Note that the fertility for the (primiparous) women under 27–28 is much lower in 1984 than in 1981 and even lower in 1987. The plot illustrates the very dramatic change in fertility experienced in the eighties. For the older primiparous women (age over 28) there is a clear tendency towards higher fertility up through the eighties.

Figure V.4

Fertility in 1984 and 1987 Relative to 1981
Additional Lines are 95% Confidence Intervals



The above analysis deliberately excluded the year 1988, primarily because early analyses had shown that the simple model (4.1) could not fit the whole period 1981-88 (deviance=429, df=361, P=0.008). Formally, we start from a model

$$\log \varphi_{ayg} = \alpha_{ag} + \beta_{ag} + \eta_{a,88,High}$$

With deviance=390, df=352 and P=0.08, this model is accepted. Further reduction of the model is not possible without loss of information. A test of the hypothesis: no age effect in $\eta_{a,88,High}$, i.e.

$\eta_{a,88,High}=\eta_{88,High}$ is rejected with $\chi^2=52.0$, df=22 and P=0.003. Unsurprisingly, it is still impossible to remove either of the two interaction terms α_{ay} and β_{ag}:

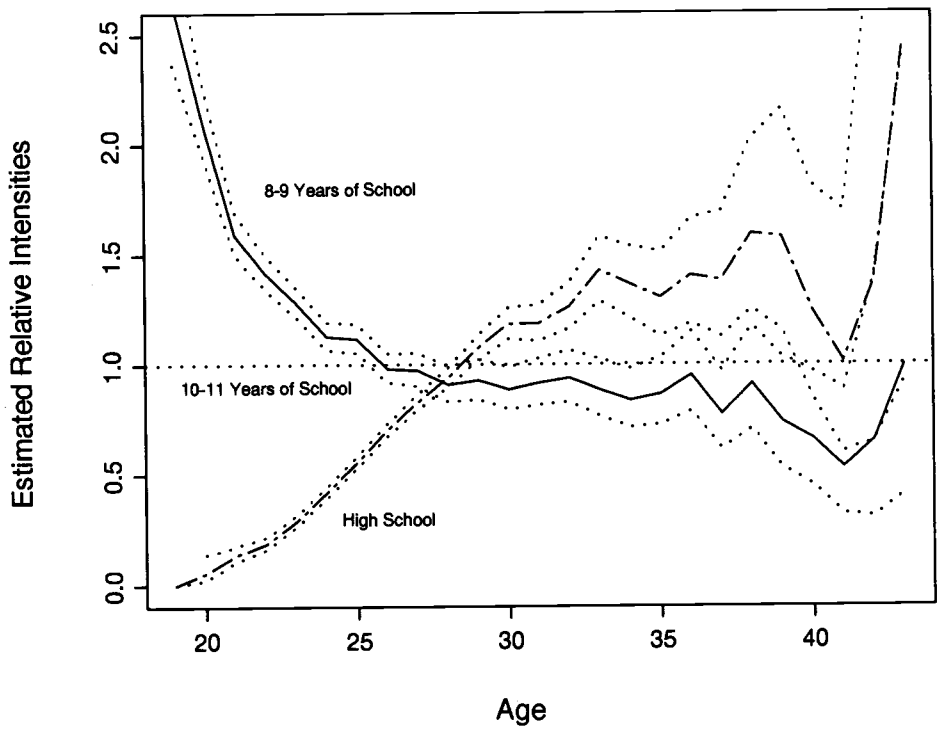
Effect	χ^2	df	P
age*year ($\alpha_{ay}=0$)	700	195	<0.0001
age*geduc ($\beta_{ag}=0$)	5260	54	<0.0001

The following plot shows the relative age–specific intensities for the women with 8–9 years of school and High School. The intensities are shown relative to the women with 10–11 years of school.

On each side of the curves of the estimates, upper and lower 95% pointwise confidence limits are plotted.

Figure V.5

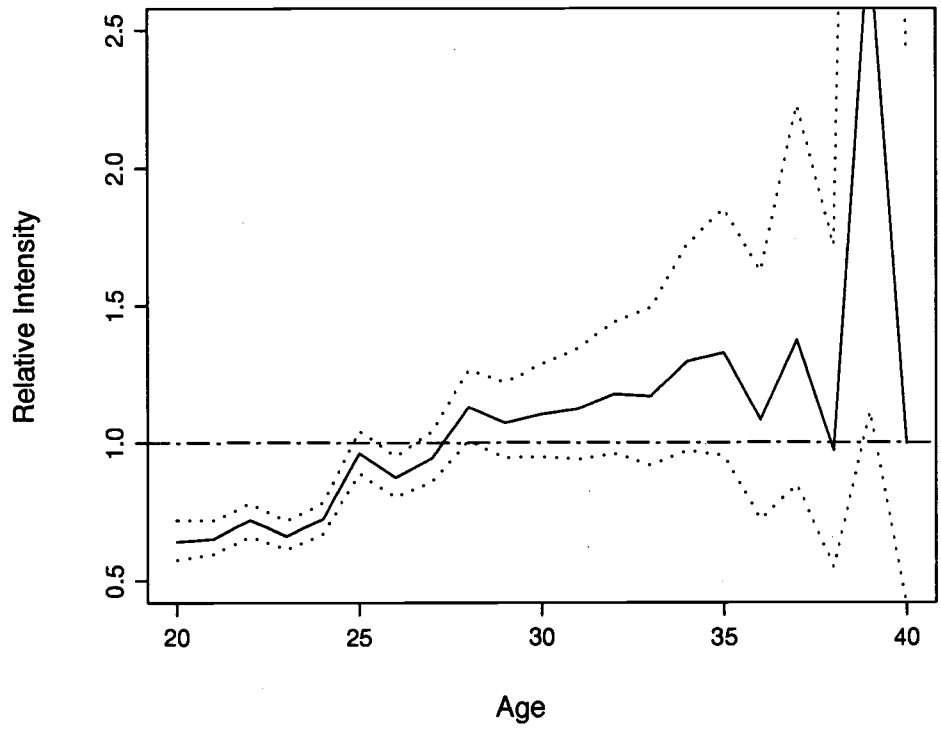
Relative Fertility Associated with Education
Estimates are Relative to '10–11 Years of School'
Additional Lines are 95% Confidence Intervals
Female Fertility 1981–88 – Parity = 0



Although this plot may not be compared directly with the plot of the relative intensities in above, it shows basically the same pattern in the fertility.

Figure V.6 shows the calendar year effect controlled for education as a function of age.

Figure V.6 **Fertility in 1988 Relative to 1981 with 95% Pointwise Confidence Bounds**



Note that the fertility for the youngest (primiparous) women (age under 25) is very much lower than in 1981. For the women of age over 25, there is now a clear rise in fertility. This rise in fertility was less noticeable in 1987, see above.

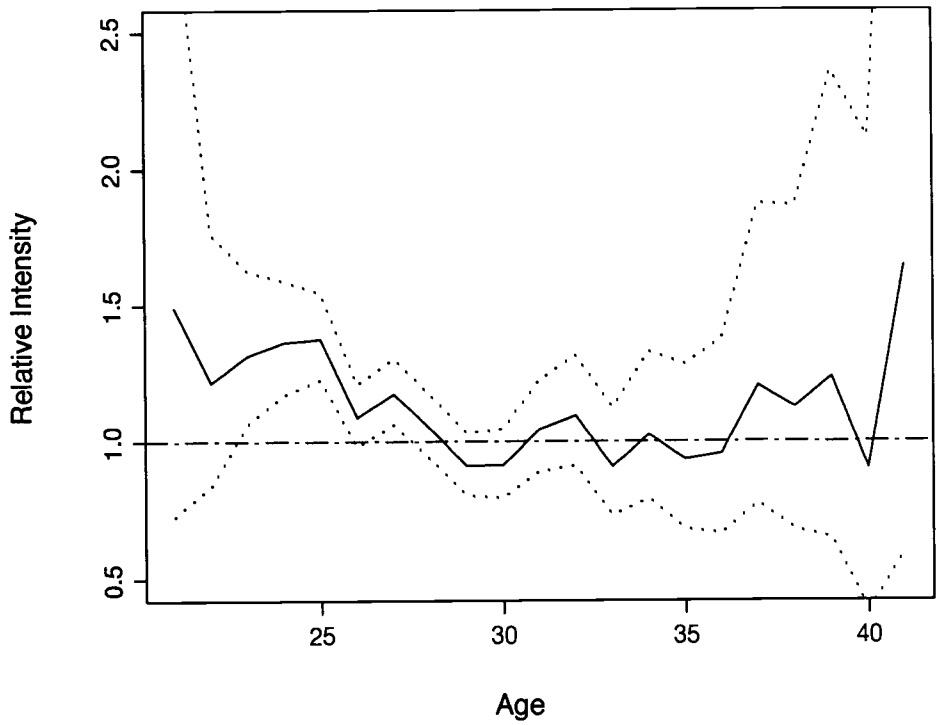
Strictly speaking, this plot only shows the fertility of the women with 8–9 and 10–11 years of school. It can however be regarded as a general fertility level in 1988 against which to compare women with a High School education.

Figure V.7 shows the fertility of the women with a High School education relative to this general fertility level shown in the previous plot.

Note that it is primarily the (primiparous) women in their mid twenties who deviate from the general fertility level i.e. the fertility level of the other two groups (8–9 and 10–11 years of school).

Figure V.7

Relative Fertility in 1988 for Women with High School with 95% Pointwise Confidence Bounds



References.

Breslow, N.E. and Day, N.E. (1987). Statistical methods in cancer research, II. The design and analysis of cohort studies. *WHO, International Agency for Research on Cancer*, Lyon.

Clayton, D. and Schifflers, E. (1987a). Models for temporal variation in cancer rates I: Age-period and age-cohort models. *Statist. Medicine* **6**, 449–467.

Clayton, D. and Schifflers, E. (1987b). Models for temporal variation in cancer rates II: Age-period-cohort models. *Statist. Medicine* **6**, 469–481.

Hoem, J.M. (1969). Fertility rates and reproduction rates in a probabilistic setting. *Biometrie–Praximetrie* **10**, 38–66.

Hoem, J.M. (1970). Probabilistic fertility models of the life table type. *Theor. Population Biol.*, **1**, 12–38.

Hoem, J.M. (1987). Statistical analysis of a multiplicative model and its application to the standardization of vital rates: A review. *Int. Statist. Rev.* 55, 119–152.

Keiding, N. (1987). The method of expected number of deaths 1786-1886-1986. *Int. Statist. Rev.* 55, 1–20.

Keiding, N., Andersen, P.K. and Frederiksen, K. (1990). Modelling excess mortality of the unemployed: Choice of scale and extra-Poisson variability. *Appl. Statist.* **39**, 63–74.

Vital Statistics. Various years. Danmarks Statistik, Copenhagen

Appendix VI. Researchers' access to the Fertility Database

The Fertility Database is established in order to provide basic data for fertility research in Denmark.This report present the first study based on the database and other studies are planned to take place in Danmarks Statistik. Furthermore, the primary results from the studies will be incorporated in the annual publication on vital statistics.

The philosophy of the database is that the primary statistical data are processed into a kind of semi-manufactures, so that a number of basic problems are solved. This applies for example to the linking of children to the parents.

The great advantage of the database is that the individual researcher - in his own project - does not have to start from scratch, and considerable amounts of time and money are thus saved.

The general design of the database means that many studies are within the scope of the database, although many decisions are, of course, made as regards the establishing of data combinations etc. However, the use of the Person Number and Address as a mean of identification means that problems that cannot be covered directly by the database alone can be dealt with by linking registers.

Researchers working outside Danmarks Statistik have access to the database provided that conditions of confidentiality are met.

It must be emphasized that the database is organized as a Register, and as such is subject to special rules approved by the Danish Register Authority. The register contains detailed information on each individual with the unique Person Number as key. In accordance with the register rules, Danmarks Statistik is not allowed to pass on data about individuals from registers but in addition to this Danmarks Statistik has drawn up its own rules in order to prevent a violation of confidentiality. This is because the data can be so detailed that a person can be identified so that confidentiality is not guaranteed by simply erasing the Person Number from the datafile.

Danmarks Statistik offers researchers the following arrangements:

1. Tabulations according to specifications set up by the researcher.

2. In-house work. A closely defined data material is available which is too detailed to be removed from Danmarks Statistik. In such situations, a researcher can analyse this material in-house at Danmarks Statistik. Material from such analyses may only be removed for Danmarks Statistik if it does not violate the rules of statistical confidentiality.

A contract is drawn up for each arrangement.

3. Computer programmes can be sent to Danmarks Statistik via an "electronic mail box". The connection to Danmarks Statistik is established

via a BBS (Bulletin Board System). This link does not give on-line connection with the dataset. At present, output is released twice a day.

4. In special cases, Danmarks Statistik can deliver "model data" to a researcher. The number of records and the size of each record is dependent on the sensitivity of the data. If many records are needed, the size of each record must be small.

The "model data" is only meant for use in the first programming phase of the project, and as a primary step before using other arrangements, such as the "electronic mail box".

5. Danmarks Statistik charges fees for CPU-time, consultancy and a fee for in-house work.