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Recent Developments in Parity Progression Intensities in Norway, An Analysis Based on Population Register Data

by

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Abstract

This contribution summarizes research results from a project at the Central Bureau of Statistics analyzing the determinants of cohort fertility in Norway. The data consist of female birth histories derived from reported births recorded in the Central Population Register. Sufficient information exist to reconstruct the birth and marriage histories of all women—grouped in one year cohorts—born after 1935. The birth histories have been supplemented with individual socioeconomic information derived from the 1960, 1970 and 1980 Population Censuses. We first delineate the reproductive experience of the female cohorts born between 1935 and 1955. We then examine the sociodemographic fertility differentials of three selected cohorts: women born in 1935, 1945 and 1955. Finally, we concentrate on the determinants of parity-three progressions, as most of the recent fertility decline in Norway is accounted for by a sharp reduction in this parity transition. The analysis is for the most confined to marital fertility.

The demographic factors age at marriage, age at entry into parenthood, the occurrence of the first birth relative to marriage, the durations of previous birth intervals, and change of mate-partner dominate overwhelmingly fertility variation. Place of residence and religious denomination are also salient covariates. For a variety of models, socioeconomic variables like income and occupation (of each spouse) and the education of the woman's parents play only a marginal determinant role. The woman's attained education emerges as a somewhat more important variable. A positive effect of education on third-birth progressions is apparent for parity-two women having their second birth in the late seventies. The more common gross inverse relation between education and life-time fertility is corroborated.

More thorough results than the summary given here can be found in Brunborg and Kravdal (1986), Gomez de Leon *et al* (1987) and Kravdal (1989 and 1990); particularly in the latter.

1 Introduction

The fertility decline that has characterized most of the European countries after the mid sixties is clearly manifest in Norway by a drop in the total fertility rate between 1964 and 1984 from 2.98 to 1.66—that is, a decline of about 1.3 children per woman in ten years.[1] Most of this decline is the result of substantial changes in reproductive behavior as well as changes in marriage and cohabitation arrangements of the female cohorts born between 1935 and 1955. Particularly relevant to study the fertility decline is the behavior of the cohorts 1935–1945 as they experienced the 'second half' of their reproductive life (say, after age 25) during the seventies, a period that marks a sharp decline in the number of women that progressed from parity-two to parity-three, which accounts for most of the decline in the period total fertility rate.[2]

In the data at hand,[3] the only female cohorts observed until the effective end of their reproductive lives (about age 44) are the 1935-1940 cohorts. Their respective completed fertility ranges from 2.51 to 2.40 children per woman. A larger group of cohorts—women born from 1935 to 1945—can be compared in their *quantum* fertility using fertility up to age 39 as a rough proxy for completed fertility. Figure 1 shows, for the cohorts 1935 to 1945, the cumulated fertility to age 39 (CF_{39}) and the proportions of women that, by age 39, have had at least one child ($B \geq 1$), at least two children ($B \geq 2$) and at least three children ($B \geq 3$). Clearly noticeable is the fact that the proportion of women progressing to parity three decreases markedly for successive cohorts, while the proportions childless and the proportions progressing to parity two remain approximately constant. Also manifest is the fact that the decline in cumulated fertility CF_{39} follows to some extent the decline in $B \geq 3$.

A natural way to look for possible mediating factors in this development is to inspect for changes in marital status, as a conventional demographic control for 'exposure' to the materialization of fertility. Table 1 shows the distribution of the 1935 and 1945 cohort populations classified according to marital status at age 39 (living in stable unions, ever married and never married) as well as the proportion childless and the average number of children corresponding to each of these groups. Indeed some changes in marital arrangements are evident in the ten years separating these two cohorts. Divorce clearly gained prevalence during the decade as the proportion of married women living in stable unions fell 11 percent points while the proportion who experienced a marriage dissolution increased 10 percent points. In turn, the nearly doubling of fertility in the never married group (plus a tenuous increase in its relative size) strongly suggest a simultaneous increase in the prevalence of informal cohabitation. Altogether, however, these changes account but marginally for the decline in the average number of children from 2.54 to 2.22. As manifest in Table 1,

[1] By 1988 the total fertility rate has increased slightly to 1.84 children per woman. The provisional 1989 figure is 1.88 children per woman.

[2] Another contributing factor is the gradual increase in the postponement of having a first child for the cohorts born after 1955. This point is returned to later in Section 5.

[3] Details of the data are discussed in Section 2 below.

Figure 1: Cumulated fertility to age 39 ($CF_{39} - 2$) and proportions of women having at least one child ($B \geq 1$), at least two children ($B \geq 2$) and at least three children ($B \geq 3$)—by age 39—for the cohorts 1935 to 1945

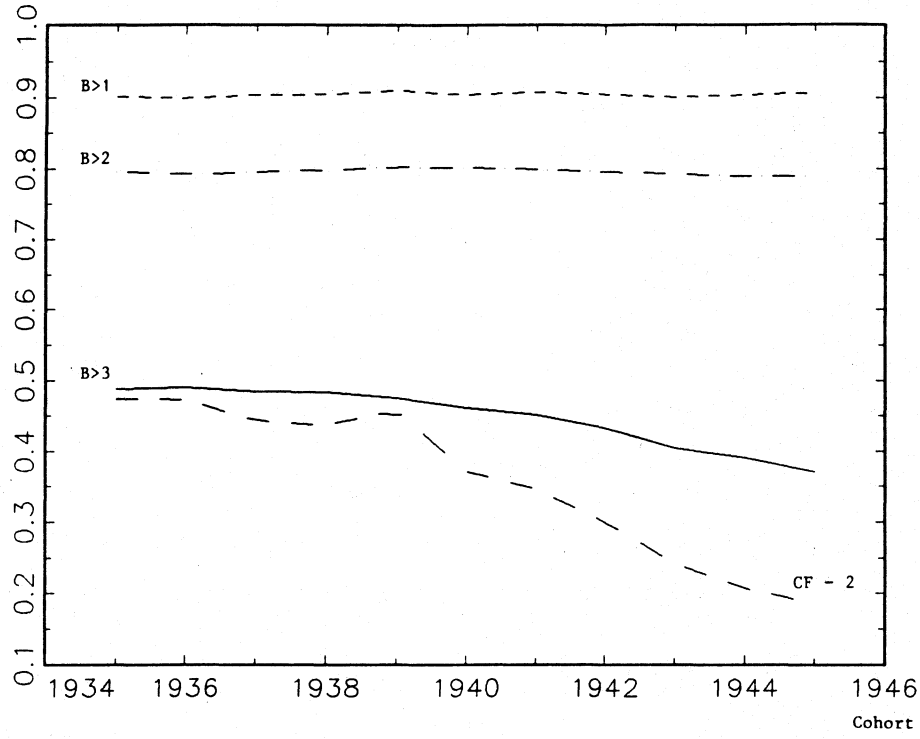


Table 1: Percent distribution of the 1935 and 1945 cohort populations according to marital status at age 39; proportion childless and average number of children for each of the status groups

	Number of women	Per cent	Average number of children	Proportion childless (per cent)
			1935 cohort	
Total population	17241	100.0	2.54	9.1
never married	936	5.4	0.17	86.5
still in first marriage	14820	86.0	2.71	4.2
experienced dissolution	1485	8.6	2.60	9.0
			1945 cohort	
Total population	27213	100.0	2.22	9.1
never married	1808	6.6	0.32	75.6
still in first marriage	20387	74.9	2.39	3.8
experienced dissolution	5018	18.4	2.23	6.4

the bulk of the *quantum* fertility of the two cohorts is contributed by the ever and presently married women, and fertility in these two groups declined in about the same order of magnitude each. Clearly, factors above and beyond marriage and cohabitation arrangements should be explored to put forth more plausible conjectures or hypotheses regarding explanations for the recent fertility decline in Norway.

The literature points out a wide range of factors that, under different theoretical arguments, are presumed as explanatory or interpretive concerning reproductive behavior. These range from predominantly economic arguments as the opportunity costs of children and relative income, to factors like psychological needs or changes in values and norms. Several theoretical considerations have in different degrees inspired the analysis reported here, but without obliging any particular view. Part of the somewhat eclectic approach of the enquiry derives from inescapable limitations in the data that impede to scrutinize more squarely the views propounded by some theoretical hypothesis. The available data derives entirely from administrative records: the Population Register and Population Censuses. Within the limitations of the data, some weight has been given to the available socioeconomic variables, notably to the woman and her husband's education and occupation. Religious denomination is also included as to try to bring into the analysis the importance of values and normative considerations. Finally, place of residence, a dimension hardly ever available in studies based on survey data except for very aggregate classes, is brought into the analysis to control for underlying variables distributed across geographic variation.

In what follows we summarize the results obtained along different stages of the analysis drawing upon the more extensive reports that document each of these. In Section 3, after succinctly detailing the data and methods used (Section 2), we report results regarding the basic demographic characteristics of age, cohort, length of the previous interval, and change of mate-partner as determinants of parity-specific transition intensities.[4] In Section 4 we report the covariates of the number of children at age 39 for the female cohorts born in 1935 and 1945, and of the number of children at age 29 for the 1945 and 1955 cohorts. The analysis concentrates there on age at marriage and timing of first birth relative to marriage (for continuously married women), plus a number of individual socioeconomic factors derived from the 1960, 1970 and 1980 Population Censuses: education, occupation and place of residence, among others.[5] In Section 5 the dependent variable becomes third-birth transition probabilities, explored again in the light of socioeconomic variables issued from the 1970 and 1980 censuses. In order to bring into proper play the census period variables and subsequent fertility the sample is restricted there to married women who had a second birth in 1969 or in 1979.[6] Finally a brief concluding discussion ends the paper.

[4] Brunborg and Kravdal (1986) give a full account of these findings.

[5] Kravdal (1989) gives a comprehensive account of these results.

[6] Complete results of this analysis are reported in Kravdal (1990).

2 Data and methods used

2.1 The data

The bulk of the data comprises birth and marriage histories derived from the Central Population Register of Norway. The Register was created in October 1964 assigning individual identification (ID) numbers to all persons present in the 1960 Population Census. Ever since, every newborn and immigrant receives also an individual ID number.[7] The Register is updated every time a person changes residence, changes marital status, emigrates or dies, making note of the dates of these occurrences. Kravdal (1986) gives technical details of the birth and marriage histories, and their quality is assessed in Brunborg and Kravdal (1986) and Kravdal and Noack (1988).

The birth histories are derived linking children and mother's identification numbers (as reported in the birth certificates and then recorded in the Register)[8] for as far back in time as feasible (given the characteristics of the establishment of the Register) and up to 1984, the last year for which the linkage is presently available. In all, cohort fertility can be reconstructed starting with the women born in 1935. By 1984 these women attained 49 years of age and, therefore, their complete reproductive history is known. In practice, complete fertility is available up to the 1940 cohort as recorded fertility above age 44 is virtually nil. The reproductive life of subsequent cohorts is observed up to increasingly younger ages, limited by censoring in 1984. The youngest cohort reported here comprises women born in 1955, observed until attaining age 29 in 1984.

From the birth histories the following demographic variables are retained as covariates:

- *Birth cohort of the mother (or father)*
- *Age of the mother (or father) at the time of birth of the immediate previous child*
- *Change of mate-partner*
- *Length of the preceding birth interval*
- *Sex composition of siblings*

[7] The first six digits of the personal number identify the date of birth of the individual, and the ninth the sex. Every individual record in the Register contains, among other information, the ID number of the person, the ID number of his or her parents, place of residence, marital status, and, if applicable, the spouse's ID number.

[8] Each parent's ID number is requested in the birth certificates and both are recorded in the vast majority of cases. For nearly every birth, thus, the mother and the father's age at birth is available. For successive births this allows to inspect for features such as changes in parental partner and the sex composition of siblings. Births sorted by father's ID number are also available. In Section 3 a few male fertility results are reported.

The marital histories are derived in turn by sorting out for each woman her successive changes in marital status as recorded in the Register, including separation, divorce, and widowhood. The completeness of the marital histories requires some qualification, however, as we do not know the date of marriage for the women married prior to 1964 except if they remained married until the 1970 census. For the 1945 cohort (and subsequent cohorts) this poses no mayor problem as only save a few women in this cohort had married before 1964. The 1935 cohort is more vulnerable to this deficiency but, altogether, only a small number of women among those who married before 1964 had divorced or separated prior to the 1970 census. With these minor shortcomings the marital histories serve to produce the following controls:

- *Martial status*
- *Age at marriage*
- *Occurrence of first birth relative to marriage*
- *Age difference between spouses*

Needles to say, in a context of rapidly increasing cohabitation formal marriage has somewhat eroded informative value as an indicator of living arrangements. However, in the absence of supplementary information on cohabitation martial status still remains a useful variable.[9]

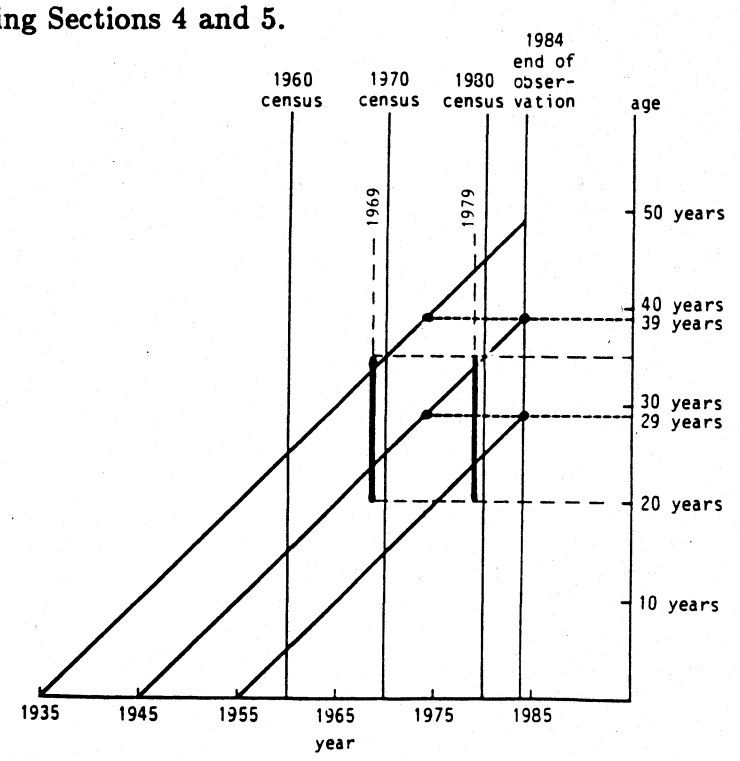
In addition to the birth and marriage histories, individual information is available from matched data from the 1960, 1970 and 1980 Population Censuses. This brings a rich of socioeconomic data to the exclusively demographic information available from the Register. Clearly, the nature of the two sources of information require to adjust in accordance the methodological perspective as the censuses refer to characteristics of the population at a single *point* in time while the histories constitute *flow* information. We return to this issue in short. First we list the variables retained from the censuses:[10]

- *Place of residence*
- *Woman's education*
- *Parent's education*
- *Husband's education*
- *Woman's labor force participation*

[9]It is worth noticing in this regard that, for the period under study, illegitimate fertility hardly exceeds 20 percent of all live births, with the highest percentage occurring towards the end of the observation in 1984.

[10]Their respective categories are made explicit below in Sections 3–5 where we show tables of parameter estimates. Details on making compatible the information in the three censuses as well as on deciding the particular categories used are given in Kravdal (1989 and 1990).

Figure 2: Lexis diagram displaying the observational plan for the two analytic perspectives comprising Sections 4 and 5.



- *Woman's occupation*
- *Husband's occupation*
- *Woman's income*
- *Husband's (absolute and relative) income*
- *Religious denomination*

In practice, as should become clear from our subsequent discussion, the information retained from the censuses is essentially that of 1970 and 1980. Figure 2 shows the Lexis diagram of the two analytic perspectives comprising Sections 4 and 5. In the first perspective the dependent variable is the total fertility attained at age 39—CF_{39}—by the cohorts 1935 and 1945. The 1970 and 1980 censuses provide thus information (say, place of residence, education attained, occupation, etc.) centered at age 35. A similar analysis is conducted for the cohorts 1945 and 1955 but limited to age 29—CF_{29}. Here the census variables apply at age 25. In the second perspective the dependent variable is the probability of having a third child within five years after the birth of the second child, the so called *quintum* Q_3. To bring into play the census information the analysis is confined in this case to the women who had a second child in 1969 or in 1979. The census information apply thus in practice to the age at birth of the second child.[11]

[11]The census information refers, on average, to one year after the birth of the second child. This

2.2 The methods

Essentially three different multivariate methods are used at each stage of the analysis: hazard, linear and logistic regression models. We presume the readers are well-versed in these now common procedures of demographic analysis.

The *hazard regression* approach used is the discrete analog of Cox's hazard regression where the underlying hazard and the covariates are modeled as categorical variables and fitted via log-linear models estimation methods. This approach allows to conduct hypothesis testing and model selection within the flexible apparatus of log-linear models.[12] The hazard models reported in Section 3 assume fixed covariates.

In Section 4 the analytic tool is *multivariate linear regression*. As mentioned above, the gist of the analysis there is to predict individual variation in *quantum* fertility—the number of children brought by age 39 by the women born in 1935 and 1945, and by age 29 by the women born in 1945 and 1955—by means of a number of demographic and socioeconomic variables. Two variables are treated as continuous with linear effects: age at marriage and educational level.[13] The rest are categorical. To accommodate bringing in some socioeconomic characteristics of the husband the results reported in Section 4 are restricted to continuously married women. In addition, two modalities are used: including and excluding childless women by age 39 (or 29)—for properly testing the effect of the timing of the first birth relative to marriage.[14] For simplicity, no interactions are considered. Appraisal of significance is determined by conventional inspection of the t-values.[15]

The third analytic approach resorts to *logistic regression* to estimate the probability of having a third child within five years from the birth of the second, conditioned on having the second in 1969 or 1979. All the independent variables are treated as categorical here. Some further inclusion criteria are the following. 1) The analysis is restricted to women living in Norway by the end of 1984 and who were present at the time of the censuses in 1960, 1970 and 1980. This is just a matter of convenience after verifying that excluding emigrants, immigrants and women who died does not bias the results. 2) Marital bind (of first marriage) is verified at the time

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conditioning was sought purposely to accommodate some hypothesis concerning the woman's labor force participation after birth. Results in this connection are shown in Section 5.

[12]Hypothesis testing was conducted by comparing the likelihood-ratio goodness-of-fit statistic G^2 of pairs of nested hierarchical models arranged in a forward selection manner.

[13]The linear term for educational level comprises six points from 2 to 7 according to the following number of years of school attendance: 2=(7–9); 3=(10); 4=(11–12); 5=(13–14); 6=(15–16); and 7=(17–18). The above refers to standard Norwegian educational nomenclature. In Section 5 educational level is treated as a categorical variable.

[14]Kravdal (1989) shows results for ever married women as well. No significant differences are noticed by restricting the analysis to married women. This also brings the results in Section 4 somewhat in line with those in Section 5.

[15]For categorical variables a t-value higher than 2 indicates a significant difference ($p < 0.05$) from an arbitrary baseline group. For continuous variables it tests the null hypothesis that the linear carrier is zero.

of the second birth and five years later. This implies that the estimated five-year probabilities depend on the fact that women remain in a stable marriage during the observation period. 3) Women who had a third birth one year after the second—that is, in 1970 or in 1980—do not enter the analysis. This is in order to cleanse the effect of 'commitment to labor force participation' from the effects of fertility itself, as the former is measured by active labor force engagement one year after the second birth, a condition most certainly determined in turn by having an infant child. Assessment of statistical significance is ascertained here (as customarily in logistic models) by means of the standard errors of the parameters.[16]

3 The demographic determinants of parity progressions

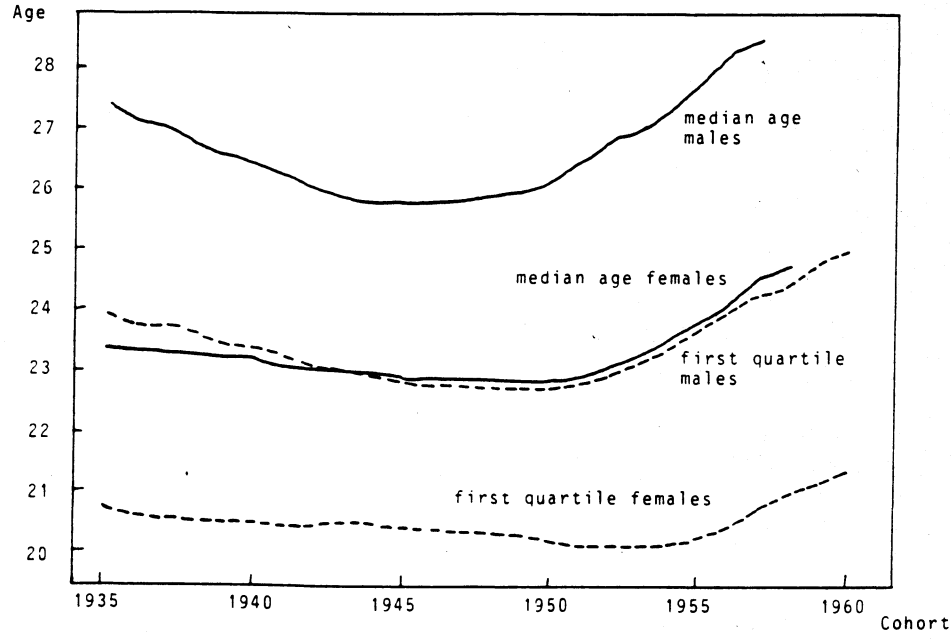
Cohort fertility unfolds necessarily sequentially along parity progression transitions, that is, as the proportion of women with at least $n \geq 0$ children who go on to have at least one more child. If observed for cohorts which have completed their childbearing, the weighted average of women who had $0, 1, 2, \ldots, n$ children provides an index of the mean number of children per woman—the cohort *quantum* analogue to the total fertility rate. The *tempo* of cohort fertility is usually characterized as the mean age at the occurrence of each successive parity transition, or, alternatively, as the mean duration time between sequential events. A few measures of completed fertility were referred to already in Section 1; we now turn to some indicators of timing.

We show in Figure 3 the median and quartile ages at first birth for the female and male cohorts born since 1935. The median trends show a clear *rejuvenation* of entry into parenthood for all the cohorts up to 1946 for males and 1949 for females. From thereon the opposite follows: a gradual *postponement* of entry into parenthood for subsequent cohorts (until the most recent cohorts for which the calculations are feasible). Closer inspection of Figure 3 suggest that the turning point in this behavior lies somewhere at the turn of the seventies decade. Particularly striking in the figure is the fact that the median age at motherhood coincides almost exactly with the quartile age at parenthood, a feature revealing the inveterate regularity in age-specific differences in fertility between females and males. We note in this connection that the sex difference in the median age at first birth went from 4.0 years in the 1935 cohort to 2.9 in the 1945 cohort, and then up again to 3.9 in the 1955 cohort—changes that mirror very closely the recorded differences in the median age at first marriage for males and females in the same cohorts (3.3, 2.4 and 3.8, respectively).

To sum up, changes in the timing of entry into parenthood are a distinct feature of the evolution of cohort fertility, notably the gradual postponement of family initiation from the cohort 1950 onward. Inspection of the quartile trends allows us to

[16]The conventional rule of thumb is to deem as significant ($p < 0.05$) any effect that is at least twice as large as its standard error.

Figure 3: Median and first quartile ages at birth of first child for female and male cohorts born 1935–1960.



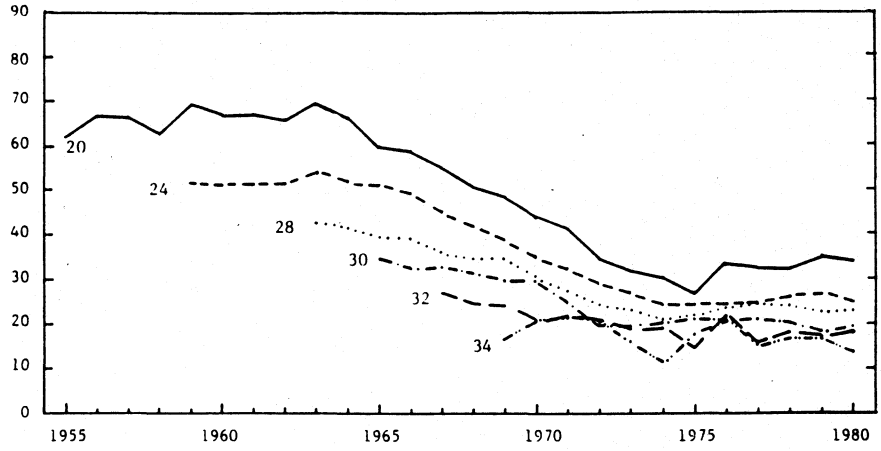
presume that the postponement trend will continue for some years. Clearly, behind the 'postponement' some may never make the transition, that is, some will remain childless. With the data at hand no complete treatment of this question can be adequately undertaken. However, as far as the inspection allows, one can expect moderate increases in the proportions of women remaining childless. A judicious estimate of the proportion of women childless by age 39 for the 1955 cohort yields 16.4 percent. It results from increases in the proportions childless among the married and ever married (5.3 and 8.8 percent, respectively) not compensated by reductions in the proportion childless among the never married (64.6 percent).

We now skip any reference to the timing of second births[17] and move to inspect the demographic determinants of third-birth transitions, as changes in this transition, together with changes in the timing of entry into parenthood, are one of the most salient features responsible for the recent decline of fertility in Norway.

In Figure 4 we show the probability of having a third birth within five years after the birth of the second child—the *quintum* Q_3—for successive cohorts between 1935 and 1960. The plots are arranged by calendar year (instead of by cohort) to enhance period effects. The decline in third-birth progression intensities is clearly manifest. For instance, the probability of having a third birth for women who had their second birth at age 20 was close to 70 percent for the cohorts 1935–1943 (that is, along the period 1955–1964). In less than a decade (9 cohorts later) the same probability has reduced to about 35 percent, that is, a fifty percent reduction. For women who

[17]Brunborg and Kravdal (1986) give further details of this parity transition.

Figure 4: Quintum Q_3 subsequent to having a second birth at ages 20, 24, 28, 30, 32 and 34 for the cohorts 1935–1960 (plotted by calendar year).



had their second child at age 24 the reduction is just as large. Now for women who delayed their second birth until after age 30 the quintum is altogether very low, as one may expect if only from physiological reasons.

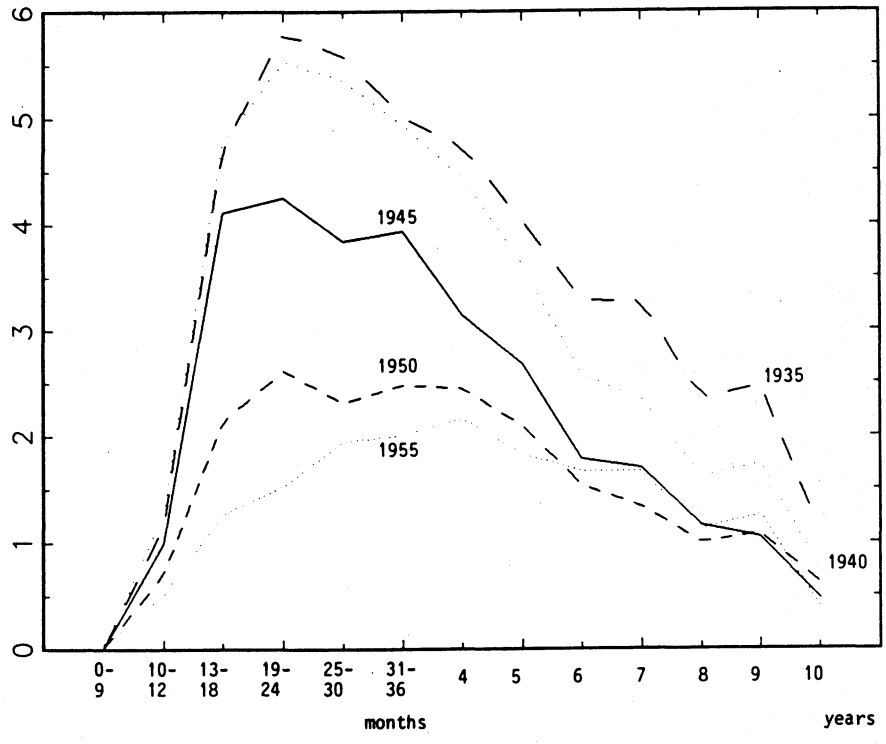
Most remarkable in Figure 4 is the rapid convergence of the quintum over successive cohorts, dampening in some degree the effect of the timing of the second birth. As subsequent cohorts entered into the second half of the sixties, every cohort experienced a marked decline of the quintum, irrespectively of the age at the second birth. After, say, 1973, the process has manifestly stabilized, with a consequent narrowing of the effect of the timing of the second birth. Thus, for recent cohorts the quintum of women who 'hurry' to have their second birth at age 20 is not so different from those who 'delay' their second birth until age 34.[18] Altogether, this evidence seems to bear out the adoption of the two-child family norm spreading progressively to larger segments of the population during the second half of the sixties and the early seventies. Once the norm is established the period effect vanishes and only a parity effect is left (low third-birth probabilities altogether).

From our foregoing discussion it is evident that age at birth and birth cohort 'interact' with each other to produce the quintum changes shown in Figure 4. We now have recourse to hazard regression to more formally explore—via multivariate analysis—the relative importance of different demographic factors (and interactions between these factors) in determining the observed individual variation in third-birth transition intensities. The demographic variables retained are listed in Section 1 but are repeated here only to introduce a mnemonic character to facilitate reference to them:[19] 1. Cohort (C); 2. Age at second birth (A); 3. Interval between first and second birth (I); 4. Change of father-mate (F); and 6. Sex composition of siblings (S). To these we should add the time domain of the third-birth hazard intensities:

[18] Admittedly, an age effect still remains after convergence.

[19] The categories of the respective variables will become clear in short in the tables and figures reporting parameter estimates

Figure 5: Relative third-birth intensities. Nonproportional effects of birth cohort.



duration after the second birth (D). We proceed directly to report the results of the preferred model without providing details of the tests that conducted to this choice.[20]

The generating class of the chosen model is: S CA CD AD IF. That is, joint effects of cohort and age at second birth (CA) and length of second birth interval and change of father-mate (IF); nonproportional effects of cohort (CD) and age at second birth (AD); and single effects of sex composition of siblings (S). A ranking of the relative importance of the main and joint effects is as follows:

$$D > A \simeq C > F \simeq I > S,$$

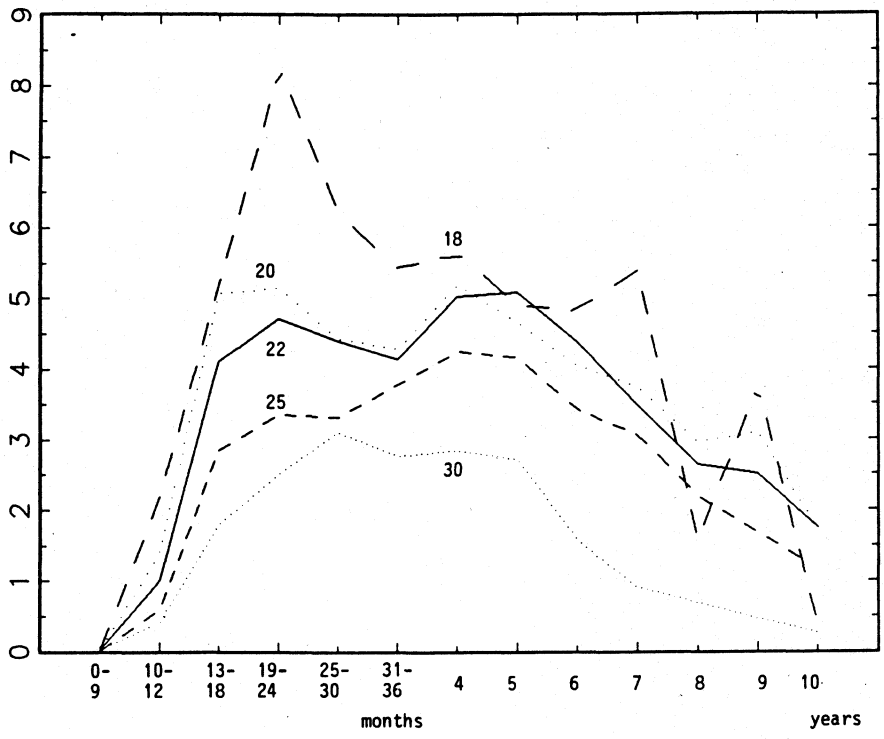
and

$$CD \simeq AD > CA > IF.$$

We now turn to review the parameters of the model, displayed in Figures 5 to 7. These are reported as *relative intensities* from an arbitrarily selected baseline group for which the relative intensities are set to one. We review first—in Figures 5 and 6—the nonproportional effects of cohort and age at second birth, respectively. These constitute covariates whose effects vary over the different duration intervals of the hazard. Not surprisingly, thus, the duration- specific shape of the hazards change across the different categories of the covariates in both cases.

[20]Gomes de Leon *et al* (1987) show sequential tests leading to a very similar model but modelling *paternal* parity transitions.

Figure 6: Relative third-birth intensities. Nonproportional effects of age at second birth.

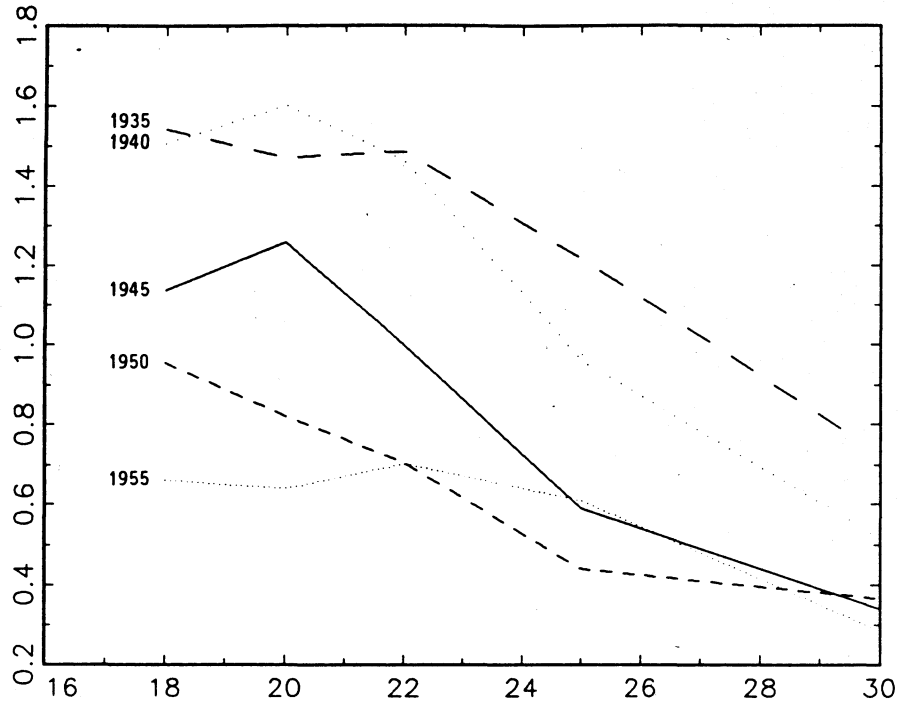


In Figure 5 it is manifest that a change in the tempo of third-birth intensities has occurred over successive cohorts. The earlier cohorts show a rapid increase in the transition intensities after one year from the birth of the second child; they reach a peak at two years of duration and then decrease gradually afterwards. Subsequent cohorts show increasingly flatter intensities as the result of dwindling signs of a jump after one year plus the intensities remaining at a much lower level altogether.

Figure 6 shows the effects of age at second birth. Except for the faltering behavior of age 18 (due to the relative few cases in this class) the other ages show effects as expected. The manifest bimodality of the hazards for ages 20 to 22 compels attention. It probably indicates some degree of heterogeneity in the cohorts as for instance heterogeneity induced by divorce and remarriage of some women while others remain continuously married.[21] For those having a second child at age 30 the prominent and sharp reduction patent after five years of duration may constitute a sign of reaching physiological impairments to further advance one extra parity. Clearly, this result can be just as well behavioral. In any event, we make note that five years of observation after the birth of the previous child seems a rather convenient 'window' to capture subsequent fertility for two-child mothers: about 75 percent of the third births occur

[21]Women who marry early and start family formation immediately or even before marriage—say as to have a second child at age 20 or 22—are more prone to divorce than women who marry late and somewhat delay having children (Kravdal, 1988). Assuming for the divorced a waiting time of 2 to 3 years for forming a new union and having a third-birth may well explain the bimodality of the hazard for these ages at second birth.

Figure 7: Relative third-birth intensities. Joint effects of cohort and age at second birth.



within this lapse.

In Figure 7 we show the relative intensities equivalent to the 'interaction' between cohort and age at second birth discussed in connection with the quintum probabilities of Figure 4. We corroborate here again that large segments of the 1935–1940 cohorts were subject to some sort of fertility inertia (inbuilt momentum) as the highest transition intensities pertain to women who already had their second child in their twenties. Then the inertia gradually erodes over successive cohorts.

Two other effects still remain to be discussed from the model: the sex composition of siblings (S), and the interaction between length of second-birth interval and change of father-mate (IF). The former confirms that norwegian couples with two children have no marked preferences for the sex composition of siblings, although the relative intensities of couples with two girls or two boys are slightly higher (about 18 percent in both cases) than the intensities of couples with one boy and one girl. The relationship implied by IF is somewhat more complex and is depicted in Table 2. Reading across the interval categories it becomes patent that parity-two women who have their second child with a father-mate different from the first tend to have, on average, about twice as high third-birth intensities than those who had their children with the same mate. Now this effect changes across the different interval categories, notably for the women who do not change mate-partner. This result can be interpreted as the outcome of some form of selection, where couples selected for their propensity to remain stable and for sharing relatively high fertility aspirations complete their

Table 2: Joint effects of birth interval and change of mate-partner on third-birth progression intensities

	Father-partner	
Birth interval	same	different
0- 2	1,50	1,64
3- 4	1,00	1,71
5- 7	0,65	1,60
8-10	0,54	1,43
11-15	0,86	1,76

third-birth transitions rapidly, within an interval of at most four years. In contrast, women who do change father-mate show nearly constant intensities and at a much higher level altogether. This feature can mean for this group the materialization of desired fertility in the new couple, allowing for random time in the process of separation and then consolidation (as to have children) of a relationship with a new partner.[22] We caution, however, that the results derived from Table 2 (as well as the interactions in Figures 5–7) should be interpreted as *controlling for all else*. They do not imply, for instance, that women in stable unions end up with fewer children than women who experienced a marital dissolution, as Table 1 promptly disclaims.

To sum up, age at second birth, birth cohort and length of the interval between the first two births all exert marked effects in the shape and level of third-birth transitions. Women having their second child at age 18 have third-birth relative intensities almost three times as high as women delaying their second child to age 30. Women in the 1935 cohort have third-birth intensities about twice as high as women born in 1955. Two-child mothers with a short interval between their births (at most 2 years) have third-birth intensities about three times higher than women with a long interval (8 to 10 years). Change of mate and the sex composition of siblings determine also (by the orders of magnitude referred to in the paragraph above) the level of third-birth transitions. In general, the results presented above constitute largely confirmed 'stylized facts' of fertility dynamics. They are for instance remarkable concordant with similar results obtained by Hoem and Hoem (1989) for a sample of Swedish women.

[22]Interestingly enough, similar results derived for males indicate that change of mate has slightly more important effects for males than for females. On average, men who have changed mother-mate have third-birth intensities 46 percent higher than the corresponding intensities for women, relative to the analogous intensities of not having changed partner in both cases. A likely conjecture is that divorced or separated men do not bring with them previous children into a new relationship. Thus, what ostensibly seems as higher third-birth intensities, can in fact be the materialization of the two-child norm in the new couple.

4 Sociodemographic differentials of *quantum* fertility

In this section the emphasis lies in exploring the relative importance of some socioeconomic variables (education and occupation of the women and her husband, and her parent's education) in conjunction with sociodemographic variables (age at marriage and the timing of the first birth with respect to marriage) plus a regional control (place of residence) and religious denomination. Instead of focusing on transition intensities as in the section before the emphasis lies here on *quantum* fertility: the total number of children born by age 39 for women in the cohorts 1935 and 1945—hereon referred to as CF_{39}^{1935} and CF_{39}^{1945}, respectively—and the cumulated fertility to age 29 for women born in 1945 and 1955—CF_{29}^{1945} and CF_{29}^{1955}. As described before, ordinary linear regression is the multivariate setting to conduct the analysis. The results reported here are restricted to continuously married women.

Tables 3 and 4 show the regression coefficients for all the retained variables fitted to CF_{39}^{1935} and CF_{39}^{1945}, and Tables 5 and 6 show equivalent figures of fits to CF_{29}^{1945} and CF_{29}^{1955}. Each variable shows (when relevant [23]) the categories of the breakdown groups, with an asterisk indicating an arbitrary baseline group. Gross and net effects are shown side by side to gauge the extent of intercorrelation between the variables. As mentioned before, women childless by age 39 (or 29) are excluded when testing the effect of the timing of the first birth relative to marriage.

Altogether, the demographic variables have the largest effects, a fact that remains valid for the three cohorts studied and the two limiting ages. Quite saliently, the coefficient of age at marriage remains almost unchanged for the four cases and does not vary significantly with or without controls. On average, women who delay ten years their entry into marriage end up—by age 39- –with one fewer child than women of the same age who married ten years early. This rather perfunctory feature of marital fertility is the largest covariate of all.[24] Next in importance is the timing of the first birth relative to the date of marriage. In the four cases, strong positive effects evince the importance of sociodemographic factors hinging on age: the younger the age at entry into parenthood, the higher the level of subsequent fertility. This effect erodes somewhat over time—that is, over successive cohorts–but only slightly, and without receding its overall importance.

The third most important covariate is place of residence. To a large extent this variable is independent of other controls included in the models, notably for the rural areas. It thus measures regional characteristics above and beyond the socioeconomic and demographic variables.[25] Clearly, fertility is systematically higher in rural ar-

[23]Educational level and age at marriage are treated as continuous variables.

[24]Clearly, age at marriage is a potential demographic confounder of other variables as it manifestly affects fertility directly and, at the same time, is likely to be correlated with other 'risk factors'. Educational level is a case in question, to which we return in brief.

[25]The norwegian names designating the different regions in Tables 3–6 translate as follows:

Table 3: Regression models of number of children at age 39 among women living in stable unions. Women born in 1935.

	Number of women incl. 617 child-less at age 39	Univariate models: incl. 617 childless at age 39	Multivariate models: incl. 617 childless at age 39		Multivariate models: excl. 617 childless at age 39	
		effect estimate	effect estimate	t-value	effect estimate	t-value
Educational level [1] (linear)		-0.094	0.092	(6.3)	0.091	
Place of residence [1]						
Østlandet non-rural	5457	-0.36	-0.20	(- 5.9)	-0.19	
*Østlandet rural	1833	0.00	0.00		0.00	
Sørlandet non-rural	1333	0.17	0.23	(5.2)	0.24	
Sørlandet rural	523	0.50	0.44	(7.6)	0.49	
Vestlandet non-rural	1588	0.09	0.24	(5.8)	0.24	
Vestlandet rural	1017	0.61	0.65	(14.0)	0.66	
Trøndelag non-rural	768	-0.09	0.06	(1.1)	0.03	
Trøndelag rural	538	0.50	0.46	(7.9)	0.39	
Nord-Norge non-rural	1018	0.18	0.29	(6.1)	0.23	
Nord-Norge rural	684	0.59	0.57	(10.7)	0.49	
Age at marriage (linear)		-0.107	-0.100	(-27.0)	-0.093	
Timing of first birth						
1+ year before marriage	796				0.77	(18.2)
same year as marriage	3650				0.31	(14.0)
*1+ year after marriage	9696				0.00	
Occupation [1]						
not employed	9175	0.75	0.76	(14.2)	0.63	
technical, scientific, juridical work	86	-0.15	-0.04	(- 0.3)	0.01	
artistic, literary work	25	0.24	0.42	(1.7)	0.35	
medical work	500	0.15	0.38	(4.9)	0.34	
pedagogical work	460	0.25	0.29	(3.4)	0.27	
administration	31	-0.13	0.22	(1.0)	0.43	
clerical work	969	-0.22	0.01	(0.2)	0.06	
sales work, commerce	819	-0.01	0.02	(0.3)	0.02	
agriculture, fishing	923	1.01	0.68	(9.5)	0.60	
graphic work	21	-0.21	0.11	(0.4)	-0.07	
*industry, craft (excl. graphic work)	523	0.00	0.00		0.00	
hotel, restaurant	383	0.12	0.24	(3.0)	0.21	
house porter, charwork	562	0.53	0.50	(6.9)	0.35	
other occupations	282	0.09	0.16	(1.9)	0.10	
Husband's education [1]						
unknown [3]	173	-1.64	-0.14	(- 0.9)	-0.14	
low (2)	8026	0.20	0.02	(0.9)	0.02	
* medium (3-5)	5509	0.00	0.00		0.00	
high (6-7)	1051	0.07	0.06	(1.3)	0.08	
Husband's occupation [1]						
not employed, unknown [3]	291	-1.04	0.04	(0.4)	0.12	
technical, scientific, juridical work	1134	-0.22	-0.01	(- 0.2)	0.01	
artistic, literary work	87	-0.27	0.06	(0.5)	0.06	
medical work	157	0.25	0.29	(2.8)	0.31	
pedagogical work	612	0.01	0.05	(0.8)	0.07	
religious work	26	0.34	0.24	(1.0)	0.27	
administration	865	-0.10	0.01	(0.3)	0.02	
clerical work	727	-0.31	-0.14	(- 2.9)	-0.10	
sales work, commerce	1127	-0.22	-0.07	(- 1.9)	-0.05	
agriculture, fishing	1422	0.41	0.17	(3.9)	0.20	
transport	1648	0.02	0.02	(0.6)	0.01	
wood work	1075	0.11	0.02	(0.4)	0.04	
graphic work	135	-0.34	-0.13	(- 1.3)	-0.10	
*industry, craft (excl. wood, graphic work)	4604	0.00	0.00		0.00	
hotel, restaurant	105	-0.20	-0.09	(- 0.7)	-0.07	
house porter, charwork	132	-0.09	-0.04	(- 0.4)	-0.04	
other occupations	612	-0.06	-0.04	(- 0.7)	-0.04	
Couple's religion [1]						
both members of						
* Norwegian Church	13443	0.00	0.00		0.00	
other rel. society	301	0.60	0.65	(9.4)	0.66	
none member of rel. soc.	49	0.33	0.44	(2.6)	0.42	
restgroup [3]	966	-0.45	0.01	(0.2)	0.02	
Parents' education [4]						
unknown, not living with parents at age 25	12759	0.72	0.11	(3.1)	0.03	
*low education (2)	1731	0.00	0.00		0.00	
medium education (3-5)	182	0.00	-0.04	(- 0.4)	0.05	
high education (6-7)	87	0.11	0.16	(1.2)	0.15	
R^2 statistics for the model			0.21		0.19	

[1] when the women were 35 years old
[3] including women who had not yet married at age 35
[4] when the women were 25 years old

Table 4: Regression models of number of children at age 39 among women living in stable unions. Women born in 1945.

	Number of women incl. 770 childless at age 39	Univariate models: incl. 770 childless at age 39 effect estimate	Multivariate models: incl. 770 childless at age 39 effect estimate	t-value	Multivariate models: excl. 770 childless at age 39 effect estimate	t-value
Educational level [1]						
(linear)		-0.090	0.014	(1.8)	0.022	
Place of residence [1]						
Østlandet non-rural	7599	-0.33	-0.20	(- 8.5)	-0.17	
*Østlandet rural	2283	0.00	0.00		0.00	
Sørlandet non-rural	1970	0.09	0.12	(4.1)	0.14	
Sørlandet rural	668	0.50	0.43	(10.5)	0.48	
Vestlandet non-rural	2320	-0.03	0.10	(3.5)	0.10	
Vestlandet rural	1319	0.41	0.43	(13.2)	0.42	
Trøndelag non-rural	1288	-0.13	-0.04	(- 1.1)	-0.05	
Trøndelag rural	669	0.21	0.20	(4.8)	0.17	
Nord-Norge non-rural	1446	0.00	0.11	(3.3)	0.06	
Nord-Norge rural	784	0.48	0.47	(12.3)	0.39	
Age at marriage (linear)		-0.094	-0.094	(-45.5)	-0.081	
Timing of first birth						
1+ year before marriage	1077				0.51	(17.7)
same year as marriage	4983				0.20	(13.5)
*1+ year after marriage	13516				0.00	
Occupation [1]						
not employed	6529	0.29	0.41	(11.5)	0.32	
technical, scientific, juridical work	429	-0.31	-0.03	(- 0.5)	-0.07	
artistic, literary work	68	-0.32	0.10	(0.9)	0.21	
medical work	2012	0.00	0.17	(4.2)	0.10	
pedagogical work	1522	-0.08	0.10	(2.2)	0.05	
administration	275	-0.53	-0.23	(- 3.5)	-0.22	
clerical work	2774	-0.33	-0.15	(- 3.8)	-0.17	
sales work, commerce	1640	-0.08	-0.04	(- 1.0)	-0.06	
agriculture, fishing	673	0.58	0.31	(5.8)	0.25	
graphic work	42	-0.37	-0.16	(- 1.1)	-0.13	
*industry, craft (excl. graphic work)	762	0.00	0.00		0.00	
hotel, restaurant	1147	0.09	0.15	(3.3)	0.09	
house porter, charwork	1203	0.32	0.34	(7.9)	0.23	
other occupations	1270	0.10	0.11	(2.6)	0.05	
Husband's education [1]						
unknown [2]	306	-1.13	-0.21	(- 3.3)	-0.13	
low (2)	8352	0.16	-0.03	(- 1.6)	-0.01	
* medium (3-5)	9235	0.00	0.00		0.00	
high (6-7)	2453	0.00	0.12	(4.7)	0.12	
Husband's occupation [1]						
not employed, unknown [2]	849	-0.30	0.01	(0.3)	0.04	
technical, scientific, juridical work	2229	-0.15	0.02	(0.8)	0.01	
artistic, literary work	157	-0.25	0.00		0.01	
medical work	337	0.10	0.16	(2.9)	0.13	
pedagogical work	1348	-0.08	-0.02	(- 0.6)	-0.01	
religious work	63	0.41	0.40	(3.3)	0.46	
administration	1944	-0.14	0.02	(0.9)	0.02	
clerical work	774	-0.31	-0.10	(- 2.7)	-0.10	
sales work, commerce	1563	-0.15	-0.01	(- 0.3)	-0.02	
agriculture, fishing	1424	0.41	0.27	(8.3)	0.27	
transport	2074	0.00	-0.01	(- 0.6)	-0.02	
wood work	929	0.16	0.11	(3.1)	0.10	
graphic work	206	-0.26	-0.05	(- 0.7)	-0.03	
*industry, craft (excl. wood, graphic work)	5031	0.00	0.00		0.00	
hotel, restaurant	160	-0.14	-0.04	(- 0.6)	0.00	
house porter, charwork	196	-0.15	-0.09	(- 1.4)	-0.02	
other occupations	1062	0.01	0.03	(1.1)	0.03	
Couple's religion [1]						
both members of						
* Norwegian Church	17550	0.00	0.00		0.00	
other rel. society	420	0.58	0.58	(12.5)	0.64	
none member of rel. soc.	243	-0.19	-0.04	(- 0.7)	0.00	
restgroup [3]	2133	-0.21	0.00		0.01	
Parents' education [4]						
unknown, not living with parents at age 15	171	0.17	0.10	(1.4)	0.06	
*low education (2)	18116	0.00	0.00		0.00	
medium education (3-5)	1455	-0.09	-0.02	(- 0.6)	0.00	
high education (6-7)	604	-0.06	0.16	(3.9)	0.16	
R^2 statistics for the model			0.21		0.20	

[1] when the women were 35 years old
[2] including women who had not yet married at age 35
[4] when the women were 15 years old

Table 5: Regression models of number of children at age 29 among women living in stable unions. Women born in 1945.

	Number of women incl. 1736 childless at age 29	Univariate models	Multivariate models			
		incl. 1736 childless at age 29	incl. 1736 childless at age 29		excl. 1736 childless at age 29	
		effect estimate	effect estimate	t-value	effect estimate	t-va
Educational level [1] (linear)		-0.214	- 0.023	(- 3.2)	0.000	
Place of residence [1]						
Østlandet non-rural	8789	-0.38	-0.11	(- 5.7)	-0.10	
*Østlandet rural	2414	0.00	0.00		0.00	
Sørlandet non-rural	1879	-0.02	0.09	(3.4)	0.09	
Sørlandet rural	663	0.25	0.21	(5.8)	0.24	
Vestlandet non-rural	2523	-0.17	0.05	(2.0)	0.04	
Vestlandet rural	1295	0.28	0.26	(9.2)	0.25	
Trøndelag non-rural	1375	-0.15	0.01	(0.3)	-0.03	
Trøndelag rural	722	0.20	0.16	(4.7)	0.12	
Nord-Norge non-rural	1655	-0.01	0.10	(3.9)	0.03	
Nord-Norge rural	827	0.37	0.34	(10.4)	0.23	
Age at marriage (linear)		-0.200	-0 ..	.6)	-0.134	
Timing of first birth						
1+ year before marriage	1118				0.62	(25.5
same year as marriage	5693				0.22	(18.9
*1+ year after marriage	13595				0.00	
Occupation [1]						
not employed	11496	0.80	0.48	(15.2)	0.27	
technical, scientific, juridical work	351	-0.22	0.06	(1.2)	0.02	
artistic, literary work	72	-0.14	0.09	(0.9)	0.08	
medical work	1611	0.01	0.25	(6.6)	0.13	
pedagogical work	1263	0.02	0.20	(4.7)	0.07	
administration	28	-0.07	0.10	(0.6)	0.07	
clerical work	3306	-0.19	-0.02	(- 0.6)	-0.08	
sales work, commerce	1067	-0.10	-0.07	(- 1.7)	-0.08	
agriculture, fishing	472	0.96	0.46	(3.7)	0.31	
graphic work	46	-0.16	-0.07	(- 0.6)	-0.16	
*industry, craft (excl. graphic work)	722	0.00	0 ..		0.00	
hotel, restaurant	617	-0.18	-0.01	- 0.3)	0.02	
house porter, charwork	407	0.37	0.18	(3.6)	0.08	
other occupations	684	-0.06	0.01	(0.3)	-0.05	
Husband's education [1]						
unknown [3]	3013	-1.01	-0.05	(- 1.0)	0.01	
low (2)	9089	0.26	-0.01	(- 1.0)	0.01	
* medium (3-5)	8787	0.00	0.00		0.00	
high (6-7)	1253	-0.16	0.02	(0.8)	0.01	
Husband's occupation [1]						
not employed, unknown [3]	3431	-1.10	-0.05	(- 1.3)	-0.06	
technical, scientific, juridical work	1656	-0.27	0.02	(0.8)	0.03	
artistic, literary work	165	-0.39	-0.07	(- 1.1)	-0.03	
medical work	234	-0.14	0.12	(2.1)	0.11	
pedagogical work	925	-0.27	-0.03	(- 0.8)	0.00	
religious work	29	0.01	0.22	(1.5)	0.48	
administration	527	-0.18	0.03	(0.7)	0.04	
clerical work	1169	-0.29	-0.03	(- 1.4)	-0.02	
sales work, commerce	1468	-0.15	0.01	(0.3)	0.01	
agriculture, fishing	1187	0.32	0.18	(6.1)	0.18	
transport	2430	0.01	0.00		-0.01	
wood work	1058	0.16	0.10	(3.7)	0.10	
graphic work	227	-0.27	-0.12	(- 2.2)	-0.07	
*industry, craft (excl. wood, graphic work)	6415	0.00	0.00		0.00	
hotel, restaurant	242	-0.22	-0.10	(- 1.8)	-0.09	
house porter, charwork	90	0.11	0.10	(1.1)	0.08	
other occupations	889	-0.18	-0.01	(- 0.3)	-0.02	
Couple's religion [1]						
both members of * Norwegian Church	17459	0.00	0.00		0.00	
other rel. society	339	0.25	0.23	(5.2)	0.33	
none member of rel. soc.	110	-0.21	-0.01	(- 0.1)	-0.01	
restgroup [3]	4234	-0.84	-0.01	(- 0.5)	0.00	
Parents' education [4]						
unknown, not living with parents at age 15	197	0.29	0.14	(2.4)	0.09	
*low education (2)	19734	0.00	0.00		0.00	
medium education (3-5)	1556	-0.21	-0.04	(- 1.6)	-0.02	
high education (6-7)	655	-0.36	0.02	(0.7)	0.07	
R^2 statistics for the model			0.36		0.33	

[1] when the women were 25 years old
[3] including women who had not yet married at age 29
[4] when the women were 15 years old

Table 6: Regression models of number of children at age 29 among women living in stable unions. Women born in 1955.

	Number of women incl. 1798 childless at age 29	Univariate models: incl.1798 childless at age 29 effect estimate	Multivariate models: incl.1798 childless at age 29 effect estimate	t-value	Multivariate models: excl.1798 childless at age 29 effect estimate	t-value
Educational level [1] (linear)		-0.200	-0.043	(- 6.9)	-0.011	
Place of residence [1]						
Østlandet non-rural	6904	-0.28	-0.08	(- 4.2)	-0.05	
*Østlandet rural	1798	0.00	0.00		0.00	
Sørlandet non-rural	2023	0.03	0.06	(2.4)	0.12	
Sørlandet rural	673	0.29	0.17	(5.1)	0.22	
Vestlandet non-rural	2342	-0.06	0.05	(2.2)	0.07	
Vestlandet rural	1227	0.30	0.23	(8.6)	0.23	
Trøndelag non-rural	1253	-0.08	0.04	(1.5)	-0.01	
Trøndelag rural	507	0.20	0.18	(4.9)	0.10	
Nord-Norge non-rural	1384	-0.04	0.14	(5.1)	0.03	
Nord-Norge rural	641	0.18	0.19	(5.5)	0.08	
Age at marriage (linear)		-0.153	-0.110	(-42.8)	-0.094	
Timing of first birth						
1+ year before marriage	1920				0.43	(25.3)
same year as marriage	4365				0.12	(10.5)
*1+ year after marriage	10669				0.00	
Occupation [1]						
not employed	6517	0.53	0.37	(12.6)	0.27	
technical, scientific, juridical work	643	-0.31	-0.05	(- 1.2)	-0.04	
artistic, literary work	54	-0.71	-0.30	(- 2.9)	-0.14	
medical work	2837	-0.09	0.11	(1.5)	0.09	
pedagogical work	1050	-0.18	0.11	(2.7)	0.06	
administration	152	-0.39	-0.13	(- 1.9)	-0.08	
clerical work	2858	-0.18	-0.05	(- 1.5)	-0.01	
sales work, commerce	1081	-0.07	-0.06	(- 1.8)	-0.04	
agriculture, fishing	326	0.58	0.30	(5.7)	0.26	
graphic work	49	-0.17	-0.12	(- 1.1)	-0.05	
*industry, craft (excl. graphic work)	696	0.00	0.00		0.00	
hotel, restaurant	891	-0.08	0.02	(0.6)	0.03	
house porter, charwork	603	0.41	0.23	(5.7)	0.14	
other occupations	995	-0.05	0.04	(1.1)	0.04	
Husband's education [1]						
unknown [2]	2933	-0.83	-0.03	(- 1.0)	-0.03	
low (2)	5478	0.17	-0.03	(- 1.8)	-0.03	
* medium (3-5)	8878	0.00	0.00		0.00	
high (6-7)	1463	-0.17	0.01	(0.6)	0.02	
Husband's occupation [1]						
not employed, unknown [2]	3399	-0.84	-0.16	(- 5.6)	-0.09	
technical, scientific, juridical work	1654	-0.24	-0.01	(- 0.3)	0.00	
artistic, literary work	134	-0.34	-0.08	(- 1.3)	-0.03	
medical work	347	-0.23	0.06	(1.3)	0.10	
pedagogical work	708	-0.19	0.00		0.00	
religious work	44	0.01	0.12	(1.0)	0.19	
administration	644	-0.18	-0.02	(- 0.5)	-0.02	
clerical work	755	-0.18	0.03	(1.1)	0.01	
sales work, commerce	1100	-0.12	-0.01	(- 0.3)	0.00	
agriculture, fishing	840	0.25	0.17	(5.7)	0.18	
transport	1664	-0.01	-0.01	(- 0.6)	-0.02	
wood work	977	0.08	0.03	(1.3)	0.05	
graphic work	163	-0.12	0.00		-0.02	
*industry, craft (excl. wood, graphic work)	5021	0.00	0.00		0.00	
hotel, restaurant	165	-0.18	-0.08	(- 1.3)	-0.05	
house porter, charwork	109	0.02	0.08	(1.1)	0.06	
other occupations	1028	-0.08	0.02	(0.8)	0.02	
Couple's religion [1]						
both members of * Norwegian Church	13326	0.00	0.00		0.00	
other rel. society	291	0.47	0.38	(8.7)	0.46	
none member of rel. soc.	437	-0.36	-0.13	(- 3.5)	-0.08	
restgroup [2]	4698	-0.60	-0.01	(- 0.4)	0.01	
Parents' education [4]						
unknown, not living with parents at age 5	32	-0.23	-0.12	(- 0.9)	-0.14	
*low education (2)	16170	0.00	0.00		0.00	
medium education (3-5)	1856	-0.15	0.02	(1.2)	0.04	
high education (6-7)	694	-0.40	0.01	(0.4)	0.06	
R^2 statistics for the model			0.33		0.29	

[1] when the women were 25 years old
[2] including women who had not yet married at age 25
[4] when the women were 5 years old

eas than in non-rural areas. Vestlandet and Nord-Norge seem to have, altogether, slightly higher fertility than the other regions and Østlandet markedly less. No clear pattern is discernable in changes over time but, in general, wherever there were large rural/non-rural differences these seem to have receded with time (mostly through fertility reductions in the rural areas).

The woman's occupation comes next in importance. As explained before, occupation refers to employment at age 35 for CF_{39}^{1935} and CF_{39}^{1945} and at age 25 for CF_{29}^{1945} and CF_{29}^{1955}. Inspecting the gross and net effects it becomes evident that woman's occupation is associated with other variables, as the two sets substantially differ. In all likelihood the woman's occupation is associated with her educational level and with related assortative husband's characteristics. The net effects indicate relative high fertility for housewives (which can obviously be housewives *because* their fertility), women working in agriculture/fishing, in medical-related work, in pedagogic work, and in cleaning and paid house keeping. These positive effects are systematic for the four models. Instances of lower relative fertility are women working in administrative tasks (for CF_{39}^{1945}) and women working in artistic and literary work (for CF_{29}^{1955}). We underline that the negative effects are not significant in all cases. The husband's occupation[26] shows a few parallels. Women married to men working in agriculture/fishing and in the medical sector have higher relative fertility. In contrast, women married to men working in clerical jobs tend to have lower relative fertility (although this effect vanishes over time). Priests seem to have substantially higher relative fertility but their coefficients do not reach statistical significance except for CF_{39}^{1945}.

We now turn to the couple's religion. Couples not members of the official Norwegian Church and members of other religious denominations are taken here as engaged in somewhat less apathetic credence and practice of religious and meaning-giving ideas or values. Religious denomination is certainly a rather crude surrogate for religious practice or other indicators of ideational effects. At any rate, crude an indicator as it is, the couple's religious denomination proves to be an effective discriminator for couple's heterogeneity in this respect: members of religious denominations other than the Norwegian Church tend to have substantially higher fertility than members of this church.[27]

The effect of attained educational level on fertility is one of the variables that has received most attention in the literature, stirred by theoretical considerations. Here again our variable refers to a fixed point observation in time: attained education at

Østlandet–Eastern Norway, Sørlandet–Southern Norway, Vestlandet–Western Norway, Trøndelag–Middle Norway and Nord-Norge–Northern Norway.

[26]Three extra occupations are included for men: religious work (priest), transport and wood work. Very few women are engaged in these activities.

[27]For couples where none of the spouses are members of a religious society, their relative fertility goes from high values when fitting CF_{39}^{1935} to moderately low relative fertility when fitting CF_{29}^{1955}. This cannot be taken properly, however, as a trend for this group.

age 35 when fitting CF_{39}^{1935} and CF_{39}^{1945}, and attained education at age 25 when fitting CF_{29}^{1945} and CF_{29}^{1955}. In the first two cases—that is, CF_{39}^{1935} and CF_{39}^{1945}—the woman's educational level coefficient changes sign from a negative gross effect to a positive net effect.[28] In isolation, educational level picks up indirect effects of other omitted covariates with which it is correlated, notably age at marriage and/or age at the first birth—demographic variates that have very strong effects on subsequent fertility as shown above. Other potential correlates of educational level are occupation, the husband's education and occupation, and to some extent place of residence. When adjustments are introduced for these variables, a *positive* net effect of education results: the higher the woman's education the higher her completed fertility by age 39.

At first sight this result seems counter to the more commonly reported *negative* relationship between education and fertility. We have to qualify again the possible misinterpretation that the more educated women *necessarily* will end up having more children. It all depends on how the women with higher education distribute across the other relevant covariates.[29] Now, the fact that the positive net relationship between education and fertility does not hold for CF_{29}^{1945} and CF_{29}^{1955} may just well be that the implicit 'window' of observation used in the model (from the point when women terminate their education to age 29) is not long enough as to allow the effect of education exert its full expression by age 29. The model particularly penalizes the highest educated women, who certainly have ended their education closer to age 29 than women with low education. In view of these arguments it seems safe to assert that the positive net effects of education on *quantum* fertility holds as a substantial trait of the data. In Section 5 we report other evidence concerning gross and net education/fertility effects, but from a parity-cohort perspective and focusing on two-child mothers.

With respect to husband's education, the only instance in which this variable has significant effects (when modelling CF_{39}^{1945}) it points also to positive net effects of education on fertility. We are inclined to believe that, in general, the effects of this variable are not more systematic and salient by failure to control for income.[30] Finally, the parent's education remain for the most a non significant variable. Parental characteristics seem to have thus a negligible bearing on fertility, net of other indirect effects.

[28] Admittedly, the second is only in the borderline of statistical significance.

[29] We note in this respect the results of Hoem and Hoem (1989) who—for a sample of Swedish women—found that highly educated women have considerably higher second- and third-birth intensities than women with less education. The rapid pacing of fertility for the highly educated women can eventually materialize, by age 39, as higher cumulated fertility (with the same values in the other variables).

[30] This point is returned to in the next section where the husband's income is included in the model.

5 Determinants of third-birth *quintum* probabilities

This section shares to a large extent the analytic framework of the previous one but with several substantive changes. The interest lies, as before, on inspecting the relative importance of a set of socioeconomic variables on fertility, controlling for a number of demographic and contextual covariates. The focus moves here essentially from a *birth cohort* approach to a *parity cohort* approach. The dependent variable is the 5- year probability of having a third birth—the quintum Q_3—conditional on having the second child in 1969 or in 1979—Q_3^{1969} and Q_3^{1979}, respectively. The time at the second birth is thus fixed. The demographic controls are: the age of the woman at her second birth (restricted to women who were 20–34 years old), the age difference between the spouses and the length of the birth interval.[31] The socioeconomic covariates are the same as before except that the woman's labor force participation is included distinguishing full- and part-time employment (from the number of hours of gainful employment worked during the year preceding the date of the census). The husband's income is included too.[32] This is defined as *relative income*, obtained by dividing the reported income for each fiscal year corresponding to the census years by the mean predicted income according to the joint factors of age, education and occupation. Kravdal (1990) gives further details on the construction of this variable and its retained categorization. Finally, the couple's religious denomination, place of residence, and the woman's parents education are also retained as covariates.

Table 7 shows the estimated effects of fitting a logistic model to Q_3^{1969} and Q_3^{1979}. Except for one variable—woman's education—only the net effects are shown, as the gross and net contrasts are not so different from the pattern shown in Tables 3–6. Here again, the demographic covariates stand out quite preeminently as the most important effects, notably the length of the birth interval, followed by the woman's age at her second birth. The 'stylized facts' of early and rapid initial fertility events leading to higher subsequent fertility seem clearly confirmed by the parameter estimates: among two-child mothers, the earlier the entry into parenthood and the more rapid the pace of previous fertility the higher the probability of a third birth. The husband's age seems to have a negligible effect in the delineation of that process.[33]

The contextual variable place of residence is also very prominent in its overall

[31]The timing of first-birth relative to marriage was left out because the exact timing of marriage was unknown for 27 percent of the women having their second birth in 1969. The sample is restricted, as mentioned before, to continuously married women (until the end of the quintum observation period).

[32]Income was added to the 1970 and 1980 census files by individually matching recorded income data from the Tax Register. The definitions for the two years are not strictly comparable, however. For 1970 it refers to net income during the fiscal year January–December 1970, while for 1980 it is closer to personal disposable income for the corresponding fiscal year. The overall level of deductibles (notably mortgage interest payments) was not so high in 1970, which brings the two measures somewhat closer.

[33]Curiously enough, couples where the husband is younger seem to have higher third-birth intensities.

Table 7: Parameter estimates of logistic regression models for the probability Q_3 of having a third-birth within five years after the second. Continuously married women. (Standard errors in parenthesis)

		Second birth 1969		Second birth 1979		Gross effects 1969		1979	
WOMAN'S AGE	20-22	0.06	(0.05)	0.25	(0.07)				
	* 23-25	0		0					
	26-28	-0.08	(0.05)	-0.12	(0.06)				
	29-31	-0.26	(0.07)	-0.39	(0.07)				
	32-34	-0.65	(0.10)	-0.69	(0.09)				
AGE DIFFERENCE BETWEEN SPOUSES	Husband more than 6 ys. older	0.02	(0.05)	0.04	(0.07)				
	* Husband 3-5 ys. older	0		0					
	Husband 0-2 ys. older	0.05	(0.04)	0.01	(0.05)				
	Woman older	0.25	(0.07)	0.25	(0.08)				
INTERVAL BETWEEN 1. AND 2. BIRTH	0-23 months	0.48	(0.04)	0.68	(0.06)				
	* 24-47 months	0		0					
	48+ months	-0.49	(0.06)	-0.57	(0.05)				
WOMAN'S EDUCATION	* 7- 9 ys. school attendance	0		0		0		0	
	10 ys. school attendance	-0.17	(0.05)	0.09	(0.05)	-0.27	(0.04)	0.28	(0.05)
	11-12 ys. school attendance	0.14	(0.07)	0.15	(0.07)	-0.03	(0.06)	0.32	(0.06)
	13-14 ys. school attendance	0.25	(0.09)	0.44	(0.08)	0.03	(0.07)	0.55	(0.06)
	15+ ys. school attendance	0.35	(0.16)	0.40	(0.11)	0.08	(0.13)	0.56	(0.08)
HUSBAND'S EDUCATION	* 7- 9 ys. school attendance	0		0					
	10 ys. school attendance	-0.15	(0.05)	0.10	(0.06)				
	11-12 ys. school attendance	-0.12	(0.06)	0.12	(0.06)				
	13-14 ys. school attendance	-0.15	(0.09)	0.18	(0.09)				
	15-16 ys. school attendance	-0.04	(0.13)	0.45	(0.12)				
	17+ ys. school attendance	0.18	(0.11)	0.56	(0.10)				
WOMAN'S LAB. FORCE PARTICIP.	* Not employed (less than 100h)	0		0					
	100-999 hours	-0.03	(0.06)	0.01	(0.05)				
	1000+ hours	-0.14	(0.07)	-0.04	(0.07)				
HUSBAND'S OCCUPATION	Technical, scientific work	-0.01	(0.09)	0.02	(0.08)				
	Medical work	-0.05	(0.16)	0.26	(0.14)				
	Pedagogical work	0.03	(0.11)	0.07	(0.11)				
	Administration	0.06	(0.10)	-0.06	(0.10)				
	Clerical work	-0.14	(0.08)	0.09	(0.11)				
	Sales work, commerce	-0.21	(0.07)	-0.11	(0.09)				
	Agriculture	0.40	(0.08)	0.43	(0.09)				
	Transport, communications	-0.07	(0.06)	0.09	(0.08)				
	* Industry, craft	0		0					
	Other occupations	0.00	(0.08)	0.00	(0.08)				
HUSBAND'S RELATIVE INCOME	-0.75	0.16	(0.07)	0.22	(0.08)				
	0.76-0.90	0.11	(0.06)	0.14	(0.07)				
	* 0.91-1.00	0		0					
	1.01-1.10	-0.02	(0.06)	0.04	(0.07)				
	1.11-1.25	-0.02	(0.06)	0.06	(0.07)				
	1.25+	0.00	(0.06)	0.03	(0.07)				
PLACE OF RESIDENCE	East, non-rural	-0.25	(0.06)	-0.20	(0.08)				
	* East, rural	0		0					
	South and West, non-rural	0.26	(0.06)	0.42	(0.08)				
	South and West, rural	0.72	(0.07)	0.82	(0.08)				
	Middle and North, non-rural	0.04	(0.07)	0.12	(0.09)				
	Middle and North, rural	0.40	(0.08)	0.40	(0.10)				
PARENTS' EDUCATION	Not living with parents, or education unknown	-0.05	(0.07)	1.05	(0.54)				
	* 7- 9 years school attendance	0		0					
	10-12 years school attendance	-0.06	(0.08)	0.24	(0.07)				
	13+ years school attendance	0.23	(0.12)	0.03	(0.12)				
RELIGIOUS DENOMINATION	* Both spouses members of the Norwegian Church	0		0					
	Both spouses members of another religious society	0.52	(0.14)	0.91	(0.13)				
	None of the spouses members of a religious society	-0.27	(0.27)	-0.26	(0.15)				
	All other combinations	0.11	(0.08)	0.10	(0.07)				
CONSTANT TERM		-0.73	(0.08)	-1.59	(0.10)				

* Baseline group

·) Living in a first never broken marriage at second birth and 5 years afterwards

effect. We say 'contextual' for lack of more specificity and because, as mentioned before, it is a variable largely independent of the others. The resulting pattern is virtually the same as the previous one reported in Section 4, except for the new coding in Table 7 intended to emphasize the rural/non-rural distinction. Evidently, a number of factors favor higher fertility in rural areas than in non-rural areas.[34]

Religious denomination comes next in importance. Here, we merely reconfirm the results obtained before: couples where both spouses are members of religious creeds other than the official Norwegian Church—and that we presume as a whole more religiously active than the majority of the members of the Norwegian Church—tend to have a substantially higher third-birth probability.[35]

Next come the socioeconomic variables proper, with woman's education having substantially significant effects. It shows a net positive effect in all cases except for mothers with 10 years of school attendance at the birth of their second child in 1969. For Q_3^{1979} the gradient of the positive net effect even increases slightly. What appears somewhat surprising is that the *gross* coefficients of education seem to have a positive effect on third-birth progressions also for Q_3^{1979}. So far in Section 4 no gross positive effects were found for quantum fertility. This result calls therefore for a further inspection of this relationship. In Figure 8 we show plots of the quintum probability Q_3 for women having their second child in 1964, 1969, 1974 and 1979, cross classified by number of years of education.[36] The only 'control' used is to restrict the age at second birth equal to 25–29 years. The most salient feature is that, as a whole, the level of Q_3 declines over time, followed by a levelling off after 1974. With respect to the effect of education, after an unclear and somewhat haphazard pattern for Q_3^{1964}–Q_3^{1974}, a neat positive (linear) relationship emerges for Q_3^{1979}. Figure 7 shows thus evidence—for Q_3^{1979}—of a positive *gross* relationship between educational level and the probability of third-birth transition progression. Kravdal (1990) explores in detail the gross and net effects of education and fertility and demonstrates that the emergence of the positive effect coincides with the halting of the secular decline in third-birth transitions shown in Figure 4 as well as with a rise in the number of women taking more than compulsory education.

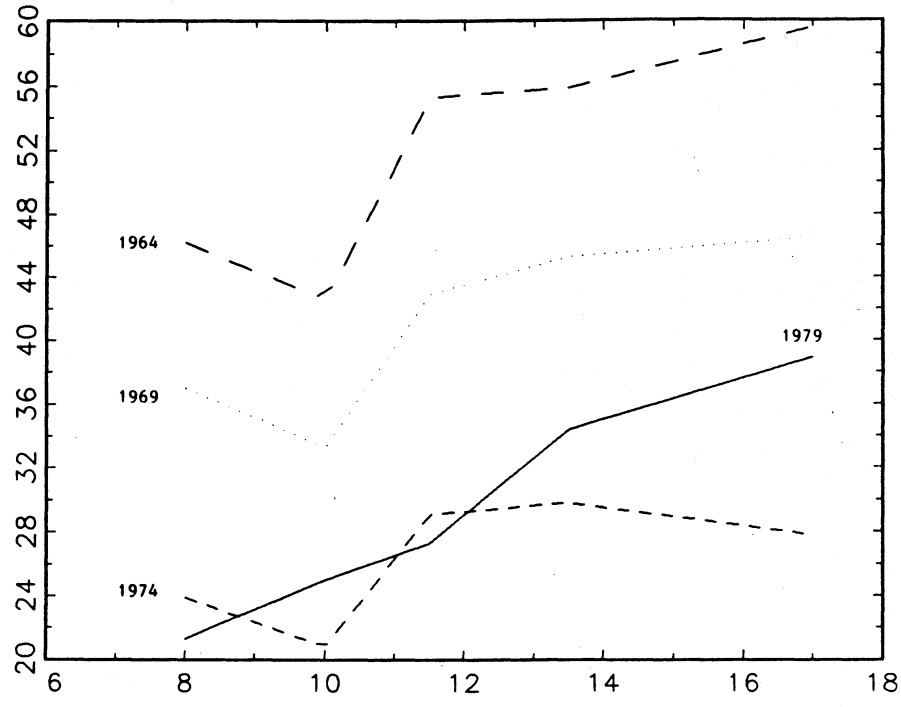
Coming to the effects of husband's education, these seem just as large as the corresponding effects for women, but are significant only for Q_3^{1979}. After different tests (notably using actual versus relative income, or excluding income altogether) we are lead to the conjecture that the effects of this variable do not particularly reflect different economic conditions. Alternative factors such as better work/family

[34]Lower direct costs of child rearing, lesser leisure and/or work alternatives to compete with family life, and more 'traditional values' can be among the factors inducing high fertility in the rural areas.

[35]In 1971 membership in these other denominations was as follows (in percent): Pentecostals (32.2), Lutheran Evangelists (17.1), Methodists (15.8), Baptists (10.7), Catholics (8.4), Adventists (5.5), other denominations (10.3).

[36]The point values for the number of years of education used in the graphs correspond to the mid values of the categories indicated in Table 7.

Figure 8: Quintum probabilities Q_3 for women aged 25–29 years, conditional on having had a second birth in 1964, 1969, 1974 and 1979



compatibility via more flexible working-time for the highly educated might be an area for speculation. This may also lead to reasons for the fact that only Q_3^{1979} proves significant.

As for husband's occupation, the picture is somewhat mixed compared with that obtained before. The sole persisting feature (and quite markedly so) is that women with husbands working in the agriculture sector have substantially higher third-birth probabilities than the rest. The previous positive effect for husbands working in the medical field weaken here. In contrast, the negative effect for husbands working in sales and commerce moves slightly to the fore.

The husband's relative income is not very salient as a whole, but it bears out the common—though not undisputable—negative effect between income and fertility. For both Q_3^{1969} and Q_3^{1979}, women whose husbands earn below 0.9 times their expected income[37] tend to have substantially higher third-birth probabilities than the baseline group (those who earn 0.9 to 1.0 times their expected income). Higher income than the expected seems not to make a significant difference.

Concerning the woman's labor force participation, it is disappointing to confirm that this variable does not show less ambiguous and more definite results. There is

[37]We recall that relative income is actual income *relative* to expected income according to the individual characteristics of age, education, and occupation.

but a tenuous negative effect for full time employment, and for Q_3^{1969} alone.[38] Finally, with respect to the education of the woman's parents, this variable remains manifestly not-significant.[39]

6 Discussion

The overall picture emerging from the results summarized above is that, on the whole, the demographic determinants overwhelmingly dominate variation in fertility. Focusing on third-birth progressions—either as duration intensities or as quintum probabilities—it is apparent that the younger the age at marriage and/or the age of the first birth, and the shorter the inter birth interval, the more rapid the pacing of third-births.[40] This evidence has been referred to as 'stylized facts' of fertility dynamics. Of interest, of course, is to put forward explanations that account for these 'empirical regularities'. In this respect, it is somewhat dismaying that the socioeconomic variables used are of so marginal importance. Place of residence and religious denomination have, on the whole, more salient effects.

Aside from limitations in the methods and deficiencies in the indicators used, this opens the way for speculating on the relative importance of moral and normative prescriptions, religiosity, and *ideational* factors vis-à-vis factors with underpinning on cost-benefit evaluations as is usually attributed to the economic factors. Along this line of reasoning, the reported positive education effects can eventually be interpreted as a strengthening of the meaning-giving supports of parenthood, instead of in terms of the view of investment in market skills. With the data at hand it is extremely difficult to approach this issue more squarely, let alone the problem of the causal direction or the mutual interplay between socioeconomic factors and the dynamics of family formation. This is obviously not a simple question to which there will be a single, incontrovertible answer.

The positive education/fertility results referred to above call for a qualifying remark. The sample is restricted to the group of women who, say by the year 1979, have reached already parity two. Now, only fewer highly educated women make the necessary transitions as to meet that inclusion criteria, indicating the possibility that

[38]Only a few women reported to be full-time employed (more than 100 hours of work) during the year following their second birth: 8 and 11 percent in 1969 and 1979, respectively. Analogous proportions for part-time employment (which can correspond to full-time employment during part of the year) are 10 and 27 percent. Kravdal (1990) shows that labor force participation is largely dependent upon the woman's age, education, length of the birth interval, and place of residence. Net of these factors it contributes virtually nothing. It is difficult thus to take it as an indicator of the woman's commitment to labor force participation, as originally intended.

[39]In addition to the 'main effects' shown, a number of interactions were also explored, but these do not contribute substantially to the overall interpretation gained. The largest and the only systematic interaction involves the demographic variables age at birth of the second child and length of the interbirth interval.

[40]A joint effect between cohort and age at second birth confirms what has been described as the adoption of the two-child family norm during the second half of the sixties and the early seventies.

education may already have exerted a selection effect at an early stage.[41] What we observe is a selected group among the highly educated, selected for their proneness to proceed to higher parities. Further research is needed to disentangle whether this selection hinges on education, as well as to assess the effects of sample selection bias on drawing inferences from a behaviorally conditioned sample.

With respect to reviewing the results in the light of the methods and the analytic approach used, the results of Heckman *et al* (1985) stand as a challenge. These authors demonstrate that the 'stylized facts' referred to above are not robust to the specification of the life-cycle birth process and that, failing to control for unobservables, some of the 'empirical regularities' are spurious and mislead the search for explanations.[42] The debate is far from being resolved on whether *always* to incorporate unobserved heterogeneity versus assessing its effects with simpler procedures. To a large extent it stands as an empirical matter awaiting further critical evidence from different experiences.[43] At issue is not the research agenda as such but to have at hand tools for more adequately addressing substantive issues. Fully dynamic models of life-cycle fertility that incorporate the sequential nature of fertility decision making are now available (see Wolpin (1984), David *et al* (1985) and Montgomery (1988) among others), the most recent ones incorporating innovative estimation techniques (Rust, 1984). In the light of this debate, certainly some of the research results summarized here invite cautionary thoughts as to their methodological robustness.

Concerning the data, some marked insufficiencies are also recognizable, particularly in view of the level of ambition of some of the questions pursued. In this regard, in short will be ready for analysis the fresh data of a fertility survey conducted in 1989.[44] It is expected that the new material will serve to complement and deepen the research results obtained so far using register data.

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[41]Kravdal (1990) shows that for the cohort of women born in 1945 (for which completed fertility is observed) a very high proportion of educated women remain childless (25.3 percent) compared to women of low education (7.5 percent). Clearly a smaller group of highly educated women reach parity two.

[42]For a sample of Swedish women Heckman *et al* demonstrate that, controlling for heterogeneity and modelling fertility as a multistate continuous-time birth process (Heckman and Singer, 1984), the age at marriage effect vanishes and the birth interval effect is reversed: the longer a preceding birth interval the shorter the subsequent one. They argue that these results suggest a *fixed target model of fertility* in which a delay in the arrival of one child is compensated for by a rapid pace in the arrival of the next child.

[43]Hoem (1989) shows a compelling example where the additional inside gained by explicitly introducing unobserved heterogeneity is to the price of reducing some desirable specifications of the model, as having to dispense with interactions or time-varying effects. This, however, is a limitation particularly akin to CTM, the computer program he used to implement unobserved heterogeneity. In a candid sense, all models are estimable save for computational expense.

[44]The survey asked for complete cohabitational, marital, educational, work and fertility histories as well as other individual factors of about 4000 Norwegian women and 1600 men.

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