COHORT DISAGGREGATION ANALYSIS OF FERTILITY DATA FROM A SAMPLE SURVEY

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Abstract—Social differentials in cumulative fertility revealed by field surveys in a number of countries typically have been interpreted with the implicit assumption that the timing of childbearing within the reproductive period remains constant. However, the reproductive histories that have been collected in such surveys provide a largely unexploited source of data for the analysis of trends in timing. An analysis by birth cohort of the fertility experience of 592 ever-married women surveyed in San Juan, Puerto Rico, in 1966 shows that significant changes in timing have occurred. Women in the more recent birth cohorts are distinguished by earlier childbearing and sustained higher fertility in consecutive age periods. The inter-cohort differences remain when adjustments are made for duration of time in legal and consensual unions.

It is infrequently the case in studies reporting on data derived from field fertility surveys that an explicit cohort approach is adopted for the analysis and presentation of data. The notable exceptions are Hatt (1952) and Yaukey (1961). The general framework also is acknowledged in the analyses of "The Growth of American Families" surveys reported by Whelpton, Campbell, and Patterson (1966).

A recent study of fertility behavior for a sample of women in San Juan, Puerto Rico, focused our attention on the utility of using a cohort approach in many of the conventional fertility and family-planning studies that are being conducted throughout the world. It would scarcely be proper to claim any originality for this view (see Henin, 1968, for an example of this approach), but its general neglect demands restatement of the essential issues and the compelling arguments for its implementation that emerged from our study. Our purpose in this paper is not to criticize previous efforts, but to indicate that a different perspective may be salutary.

Methodology of Fertility Studies

In the main, analyses of fertility performance in field surveys have tended to treat entire samples as cross-sections of women at a single point in time. To be sure, some studies have focused discussion on women of a particular parity (Westoff and others, 1961) or in a certain age range, but generally a representative sample of women in different ages and parities within the reproductive span has been sought. This is particularly true of the so-called "KAP" studies, which have been conducted in more than 30

countries (see Berelson, 1966, pp. 655–668).

The analysis of fertility performance in these studies obviously can include separate attention to women in specific age categories. For example, some analyses have been concentrated on women 30–34 and others on women who have essentially completed their childbearing, such as women 45–49. But there are reasons why this may not be desirable. For the older group, the childbearing may have extended over a thirty-year period; therefore, the analysis can say little about current conditions. To select another age category within the reproductive period for special attention means that their fertility is not completed, and the full implications of prior performance on future reproductive behavior is difficult to determine. This is further complicated by the usual measure of fertility—children ever born alive. Although reproductive histories are often obtained in these studies, they are seldom used; and more often than not, only cumulative fertility measures are reported. At the same time, failure to use reproductive histories can also be traced to pregnancy histories reported by women who have little sense of dates.

This brings us to an issue that involves the goals of the research. For the most part, extensive effort is devoted in these studies to describing fertility for a total sample of women and, subsequently, by certain relevant social characteristics of the population. For example, how does fertility differ by social class, educational attainment, income, or place of birth. Measures of average numbers of children ever born alive are then reported for each sub-category. As this measure for a sub-category represents an average of cumulative fertility figures for women of different ages, differences between sub-categories with respect to the fertility measures can reflect differences in age distributions; differences in marital duration, degree of marital stability, or age at first union; or actual changes in fertility patterns.

It is this last factor that may be most relevant, yet rarely is examination of temporal changes themselves an explicit goal of the research. The study reported by Hatt (1952) is a major exception. Generally, it is avowed that the population from which the sample was drawn has not undergone radical change in behavior or attitude due to exogenous factors, although naturally some individual changes in behavior are assumed to occur as women in the sample have aged. Therefore, it is claimed that one is justified in treating the entire sample as a cross-section of women who can be considered collectively. This is particularly rash when samples are drawn from urban areas or include sub-populations likely to be exposed to changing conditions. In fact, it may be reasonable to assume that while changes in overall completed fertility may not occur in some countries, changes in the pattern of childbearing are likely to occur.

It is this very issue that generated, and has continued to generate, discussion over the relative advantages of cohort versus period measurement in the analysis of fertility. While it is generally acknowledged that each approach may serve different purposes, it also is generally agreed that the timing of childbearing, which is usually an important element in any period fluctuation, can only be uncovered through cohort analysis. Thus, a more thorough understanding of fertility conditions from cross-sectional analyses can be brought out when an explicit longitudinal view is taken. We would argue that it is worth the additional time and effort in nearly every case.

The lesson is a valid one for survey analysts. Seldom do conditions remain stable over the 35-year period of time that is involved when women in the range of the reproductive ages are covered. What is required is investigation

of fertility not only by age, parity, or exposure, but also by the reproductive experience of women at previous periods of time in their own lives. In reality this can only be perfectly accomplished for women who have already passed through the reproductive span. However, by considering earlier ages or age periods through which all women have passed, the fertility experience of each cohort can be determined. It is these dynamic factors, including those relating to fertility such as family-planning practices, which should receive more attention in most fertility surveys. We trust that the following analysis of empirical evidence demonstrates this point.

Description of the Study

The data reported in this study were drawn from an investigation of urban housing and related demographic, economic, social and health factors conducted in San Juan, Puerto Rico, in 1966. (For a detailed discussion of the methodology, see Myers, Morris, and Beyer, 1967.) A portion of the research was focused on fertility experience and family-planning attitudes, knowledge, and practice. The original areal probability sample of households used in the survey was selected from four specific types of neighborhoods found in San Juan—slum, lower-class residential, middle-class residential, and public housing. In no sense can the final sample of women drawn from these households be thought of as a representative sample of all San Juan women, but it does provide a fair selection of women in the reproductive years living in neighborhoods that range over the lower and middle spectrum of the socio-economic scale. (This issue is explored in Weller, 1967.) For this analysis only the 592 ever-married women between the ages of 20 and 49 years of age who were born in Puerto Rico are considered.

The interviews were conducted by native Puerto Ricans with a schedule that was carefully developed and pretested in preliminary trials. The coding also was accomplished by Puerto Ricans under the supervision of the professional staff. Fertility histories, in particular, were given special attention in the field and later in the coding to assure accuracy and comparability with other information obtained in the interview.

The Analyses

The investigation which initially generated the problem discussed in this article concerned the relation between migration experience and fertility behavior for ever-married women, controlling for age, educational attainment, and age at movement into the San Juan metropolitan area for women born outside the metropolitan area.

Age Differentials

The average number of children ever born alive was calculated for women in each five-year interval of current age. These data on live births were derived from the reported pregnancy histories. Although one might expect a monotonically increasing progression by age, the differences observed between the age-specific averages are more difficult to evaluate. The averages for the younger women were higher than might normally be expected, especially when compared to those for women in the older age categories (see Table 1).

It should be noted that the cumulative birth figures for women in the current age categories do not reflect the total fertility that would be expected of the group of women who had reached the upper age limit of the interval. Although measures for current age-categories of women are frequently employed, relatively little attention has ever been given to this point in the existing literature. A few authors have reported terminal rates for only women who have reached the upper age limit of the interval or have used person-years as a base (see Bogue,

TABLE 1.—Number of Live Births Reported in Pregnancy History and in Response to a Question on Children Ever Born Alive, for Ever-Married Women Aged 20–49, by Age: San Juan, Puerto Rico, 1966.

Age in 1966	Birth years	Number of respondents	Ratio of years lived to maximum[a]	Average live births reported		Number of discrepant reports per 100 women[b]
				History	Question	
20 to 49	1917-46	592	...	3.56	3.64	7
20 to 24	1942-46	78	.58	2.35	2.36	2
25 to 29	1937-41	95	.51	3.06	3.08	2
30 to 34	1932-36	119	.58	3.82	3.88	5
35 to 39	1927-31	115	.43	4.18	4.28	7
40 to 44	1922-26	106	.51	3.78	3.92	13
45 to 49	1917-21	79	.38	3.76	3.84	9

a - Ratio of years lived within the age interval by respondents to the hypothetical maximum person-years to be lived (excluding mortality risks).

b - Includes only cases in which women reported fewer live births in history.

Source: Unpublished tabulations from San Juan Pilot Study.

1965, pp. 130–136). The ratio of years lived within the age interval by respondents to the hypothetical maximum person-years to be lived (excluding mortality risks) was calculated for each of the six age categories (see Table 1). For example, in the group of women aged 20–24, the women were aged either 20, 21, 22, 23, or 24 years of age at the time of the interview; the ratio represents another method of reporting the average age of women in that particular age category. If the ratio is 0.5, then the women in that age category have passed through half the period on the average (i.e., if the ratio is 0.5 for a group of women aged 20–24, the average age of that group is between 22 and 23 years of age).

Although the differences recorded here are probably not sufficient to distort the comparisons among age groups, some variation may be noted. The ratio is lowest (0.38) for the oldest age category and highest (0.58) for the groups aged 20–24 and 30–34. The lower the ratio, the greater is the exposure to additional childbearing; however, we would expect low fertility to be experienced by women in the oldest age category during the remaining years to be lived in the interval. Thus, although the period of exposure to additional childbearing is greatest among the older women, their total fertility upon reaching age 50 is probably not seriously underestimated. These grouping effects could reflect age mis-statements, peculiarities in the sample, or mortality risks that increase with age. No evaluation is attempted of these factors here, though further research along these lines seems needed.

Cohort Differentials in Timing

The next step was to tabulate for women in each five-year interval of current age the number of children born alive in prior five-year periods. Groups of women identified by age on the survey date are redefined as birth cohorts, for example, women aged 45–49 in 1966 had been born in the period 1917–1921. The tabulations then represent the num-

ber of births occurring to cohort members in each five-year period, beginning with ages 15–19 and terminating with the current age. The timing of births for the women through the reproductive period or their cumulative fertility by a given age can be compared.

The striking evidence is that the more recent cohorts of women have higher fertility in the earlier age periods than the earlier cohorts had (see Table 2, upper panel). These differences tend to persist within age periods (read down each column), with recent cohorts having higher fertility. Some variation is noticed for the cohort of women born in 1922–1926 during the first three age periods. Note, too, that the last cell entry in each column, with the exception of the age period 15–19, represents incompleted fertility, as pointed out previously.

Another way of noting these patterns is to examine the increases in cumulative fertility occurring between successive five-year periods, a procedure that approximates an age-specific birth rate for a five-year period (Table 2, lower panel). Within each cohort, the pattern of childbearing can be determined up until the current age period. With the exception of the cohort born between 1922 and 1926, the highest rates are found in the ages 20–24, followed by a decline. However, there are also differences between cohorts that can be characterized as follows: one, earlier childbearing, which is reflected in the increasing rates for the 15–19 category for the more recent cohorts; two, higher rates in the 20–24 age period for these younger cohorts; and three, the fact that recent cohorts have sustained higher fertility in consecutive

TABLE 2.—Cumulative Average of Live Births and Average Number of Live Births Occurring in Age Period, for Ever-Married Women Born 1917–1946, by Birth Cohort: San Juan, Puerto Rico, 1966.

Birth years of cohort	Age period						
	15–19	20–24	25–29	30–34	35–39	40–44	45–49
				cumulative			
1917–21	0.48	1.60	2.67	3.34	3.61	3.76	3.76[a]
1922–26	0.37	1.42	2.60	3.34	3.70	3.78[a]	...
1927–31	0.64	2.05	3.42	3.96	4.18[a]	...	...
1932–36	0.66	2.10	3.48	3.82[a]	...	...	...
1937–41	0.85	2.40	3.06[a]	...	...	...	...
1942–46	1.14	2.35[a]	...	...	...	...	...
				incremental			
1917–21	0.48	1.12	1.07	0.67	0.27	0.15	0.00[a]
1922–26	0.37	1.05	1.18	0.74	0.36	0.08[a]	...
1927–31	0.64	1.41	1.37	0.54	0.22[a]	...	...
1932–36	0.66	1.44	1.38	0.34[a]	...	...	...
1937–41	0.85	1.55	0.66[a]	...	...	...	...
1942–46	1.14	1.21[a]	...	...	...	...	...

... Cohort has not entered age period.

a - Live births underestimated because cohort was entered, but not passed through age period.

Source: See Table 1.

age periods, especially if one keeps in mind the incomplete fertility of the last period for each cohort. A general impression that derives from these data on Puerto Rican women is that childbearing appears to be starting earlier and is more concentrated. It also is producing numbers of children within a shorter range of years that approach very closely the completed fertility of women nearing or past menopause.

Differential Recall

Before proceeding with any additional analyses of changing patterns of childbearing, the problem of differential recall biases obviously requires some attention. Numerous researchers have cited the possibility of these types of error entering into retrospective data, but seldom is there adequate empirical support for determining the extent of error and adjusting for it. In this research much effort was expended on obtaining accurate information in the pregnancy histories and interlocking contraceptive and employment histories. In addition, questions requesting a simple statement of the number of pregnancies, children dying in infancy and later, and children presently living also were included on the schedules.

A comparison of the results from the histories and simple elicitation of children ever born alive from mothers indicates that 39 women out of the 592 reported fewer children in the histories than in response to the question on "the number of children ever born alive." Some of the older cohorts, particularly the 1922–1926 cohort, have a higher discrepancy rate than the more recent cohorts. Although the number of discrepant responses is small, and the discrepancies in all but seven cases consist of only a single child, the differences between cohorts could be affected. Accepting the responses to the "children ever born" question as accurate, however, does not alter the general pattern of inter-cohort differences based on the histories. (Compare means in Table 1.) In fact, the fertility is increased even more for the cohorts 1922–1926 and 1927–1931 than the oldest cohort, thus producing a smoother progression. It is impossible, of course, to indicate where these "extra" births may have come in terms of age periods for each cohort.

Cohort Differentials in Marital Patterns

At this point in the analysis, we became aware of a methodological problem that could seriously affect the conclusions arrived at through the preliminary analysis. By restricting the analysis to women who were married at some point in their lives, we were in effect "loading" the analysis in favor of higher fertility for younger women. For example, nearly all women in the recent cohorts were "currently" married on the survey date; and almost certainly they had married at an early age. However, women included in the older cohorts may have been no longer married and may not have been married in the earlier age periods. Thus, two factors connected with marital patterns are present—age at first union, and the duration of time spent within marital unions. It should be noted that the "assumption" is made that childbearing occurs within the marital state, and in the case of these Puerto Rican women, the marital state includes consensual as well as legal unions.

Examination of mean levels of age at first union for each cohort suggested that the unions were entered into at a much earlier age for the younger cohorts than was true for the older cohorts. This was understandable in terms of the built-in distortion. In turn, we expected and subsequently found that the age at which the first child was born for the different cohorts was affected. Thus, it seemed clear that to avoid these distortion effects some consideration be given to marital fertility in order to appraise the

fertility patterns revealed in the preliminary analysis.

Cohort Differentials in Marital Fertility

Two options existed for examining marital fertility. First, an age-cohort specific marital fertility rate can be calculated in which the person-years lived in the marital state within each age period for each cohort is used as a base and the births recorded for that period used as a numerator. Second, instead of using age periods for the cohort, it is possible to use marriage-duration intervals starting with the date of first union as an initial time point. Within each interval, the time spent in the marital state again is used.

For this analysis both types of rates were calculated, with an additional control introduced for sterilization. As Puerto Rican women have frequently resorted to sterilization, it seemed wise to introduce this factor into the calculation of rates.

Although the differences between cohorts with respect to age-specific marital fertility rates are understandably small, the patterns are very similar to those noted previously with respect to age-specific fertility rates. (Compare the patterns of differences within columns in Table 3 and the lower panel of Table 2.) With the exception of the age interval 25–29, the rates are progressively larger within each age period the more recent the cohort. It also can be noted that the age interval of maximum fertility has become earlier for cohorts born more recently.

Generally, the same patterns of inter-cohort differences as found previously hold true when marital fertility rates for five-year intervals after first union are examined (see Table 4, upper panel). There seems to have been a change in the timing of childbearing that could produce higher completed fertility for the younger women unless a deviation from the trend in the later years of childbearing is experienced.

Even with this type of control for marital exposure, it is possible that the rates are a product of differentials in the age at first marriage. To control for this, adjusted rates were calculated which were weighted on the basis of three categories of age at first union—15–19 years, 20–24 years, and 25–29 years (see Table 4, lower panel). The adjustment makes no alteration in the previous results in spite of some evidence that the age at first union has declined for younger women in the sample, which, in turn,

TABLE 3.—Cohort-Specific Marital Fertility Rates for Ever-Married Women, by Age Periods: San Juan, Puerto Rico, 1966.

Birth years of cohort	Age period						
	15–19	20–24	25–29	30–34	35–39	40–44	45–49
1917–21	.32	.35	.38	.20	.12	.05	.01
1922–26	.32	.36	.36	.21	.14	.06	...
1927–31	.35	.40	.37	.22	.15	...	...
1932–36	.38	.42	.35	.26	...	...	...
1937–41	.48	.44	.34	...	...	...	...
1942–46	.51	.48	...	...	...	...	...

... Cohort has not entered age period.

Source: See Table 1.

TABLE 4.—Cohort-Specific Marital Fertility Rates, for Ever-Married Women, by Interval Since First Marriage: San Juan, Puerto Rico, 1966.

Birth years of cohort	Interval since marriage, in years						
	0-4	5-9	10-14	15-19	20-24	25-29	30-34
1917-21	.34	.28	.13	.10	.06	.01	.00
1922-26	.35	.31	.17	.09	.13	.03	...
1927-31	.41	.38	.20	.10	.06	...	...
1932-36	.43	.29	.26	.10	...	...	...
1937-41	.46	.34	.09	...	...	...	...
1942-46	.50	.42	...	...	...	...	...
	rates adjusted for differentials in age at first marriage						
1917-21	.36	.34	.14	.12	.06	...	...
1922-26	.37	.34	.19	.09	.12	...	...
1927-31	.41	.39	.19	.10	...	...	...
1932-36	.44	.31	.27	.07	...	...	...
1937-41	.47	.32	...	...	...	...	...
1942-46	.48	.37	...	...	...	...	...

Source: See Table 1.

would have an effect on earlier childbearing.

In short, analysis of the marital fertility rates suggests strongly that basic changes in the tempo of childbearing have occurred between the older and more recent cohorts of women currently living in San Juan. We were particularly interested in whether the changes could be explained in terms of migratory experience. There is some evidence that women born in the urban center may differ from migrant women in terms of their childbearing experience, but the differential is not firmly established (see Myers, forthcoming; Myers and Morris, 1966).

The established pattern of inter-cohort differences seems to hold for both natives of San Juan and migrants into the metropolitan area (Table 5). However, there is more variability in the rates, reflecting in part the small number of sample cases. No clear pattern emerges from comparing the fertility performances of migrants and natives. For both the earliest and the most recent cohorts —1917–1921, 1922–1926, and 1942–1946 —the native women exhibit higher fertility throughout their marital experience, while in other cohorts the higher rates are for migrants. Within cohorts, little can be said about differences by migration status. In general, the results are inconclusive; but they do indicate that migration experience is not responsible for the changing pattern.

SUMMARY

This paper is an effort to demonstrate the methodological advantages and difficulties inherent in the use of cohort analysis for survey data. The data from a study in San Juan indicate that for these women the more recent cohorts have experienced higher fertility than older cohorts for the same periods, measured in terms of both age and interval since first marriage. This indicates an alteration in the pattern of childbearing toward greater fertility in the earlier years of marital life. It should be emphasized that we are not prepared to generalize from these results, since the

TABLE 5.—Cohort-Specific Marital Fertility Rates for Ever-Married Women by Interval Since First Marriage and Migration Status: San Juan, Puerto Rico, 1966.

Birth years of cohort and migration status	Number of respondents	Interval since marriage, in years					
		0-4	5-9	10-14	15-19	20-24	25-29
1917-21							
Natives	17	.44	.38	.02	.05	.10	...
In-migrants	62	.32	.26	.16	.12	.05	.02
1922-26							
Natives	20	.33	.40	.42	.02	...	...
In-migrants	86	.35	.29	.12	.07	.08	.03
1927-31							
Natives	36	.38	.37	.18	.13	...	...
In-migrants	79	.41	.38	.21	.09	.06	...
1932-36							
Natives	34	.42	.24	.15	...	...	...
In-migrants	85	.44	.31	.30	.17	...	...
1937-41							
Natives	28	.46	.29	...	...	...	...
In-migrants	67	.46	.24	.10	...	...	...
1942-46							
Natives	35	.53	.46	...	...	...	...
In-migrants	43	.48	.36	...	...	...	...

Source: See Table 1.

sample was relatively small and representative of only women living in certain types of neighborhoods in San Juan. Finally, controlling for age at first union, marital exposure, and migration status did not disturb this general pattern.

The analysis by cohorts uncovered a number of methodological problems that seemed to merit some consideration. In spite of these problems, cohort disaggregation methods are very meaningful in analysis of survey data and should be utilized more frequently by demographers. These methods offer a powerful tool for studying changes in fertility patterns that may be occurring in populations under examination. Though no effort has been made to estimate completed fertility for cohorts that have passed through only a portion of the childbearing period, this need is recognized and it should be noted that the methodological procedures suggested here have been carried forward in a recent paper (Hartford, 1968).

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