WORKING PAPER

BEYOND "THE AVERAGE AMERICAN FAMILY": U.S. Cohort Parity Distributions and Fertility Concentration

Miriam L. King
Wolfgang Lutz

March 1988
WP-88-13

IIASA
International Institute
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Foreword

In recent years IIASA's Population Program has made considerable strides in the analysis of heterogeneity in population dynamics. One area of particular application of this perspective has been in the analysis of fertility. Heterogeneity in fertility behavior gives rise to concentration, or dispersion, in the reproductive experiences of women of childbearing age, which in turn has numerous consequences and implications, as spelled out in this paper. King and Lutz focus on twentieth century U.S. women, and pay particular attention to the contrasts between the "baby boom" and "baby bust" cohorts. The authors' approach reveals some new insights into the intercohort comparisons.

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Contents

	Page
Data Description	2
Research Rationale	2
Parity Distributions across Cohorts born 1901–1935	4
Changing Family Size from the Perspective of Children	8
Fertility Concentration within Cohorts	10
Differences between Social Groups in Parity Distributions and Fertility Concentration	12
Relative Importance of Between- and Within-Group Inequality	19
Long-Term Trends for Ever-Married Women	21
Relationship between Level and Concentration of Fertility	22
Conclusions and Implications	25
Notes	29
Appendix	37

BEYOND "THE AVERAGE AMERICAN FAMILY": U.S. Cohort Parity Distributions and Fertility Concentration

Miriam L. King and Wolfgang Lutz

> "Oh, we're just the average family," he said thoughtfully, "mother, father, and 2.58 children—and, as I explained, I'm the .58."
>
> "It must be rather odd being only part of a person," Milo said.
>
> "Not at all," said the child. "Every average family has 2.58 children, so I always have someone to play with. Besides, each family also has an average of 1.3 automobiles, and since I'm the only one who can drive three tenths of a car, I get to use it all the time."
>
> Norton Juster, *The Phantom Tollbooth* (1961)

The course of fertility change in the United States is usually described in terms of shifts in the birth rate or the total fertility rate. Using summary measures like the total fertility rate, demographers have addressed many questions: was fertility rising or falling across periods and cohorts? How great was the difference in average fertility between population subgroups? Nonetheless, outside of *The Phantom Tollbooth*'s Digitopolis, not all families are average, and actual reproductive performance is more heterogeneous than summary statistics might suggest. Like the statistician who drowned in a river four feet deep on average, we are in danger of assuming false homogeneity if we consider only mean reproductive behavior.

If the full parity distribution is considered instead of mean fertility, then other questions emerge. What proportion of American women had no children, one child, two children, or three or more children? How deeply entrenched were norms to have a specific number of children—say, two and only two offspring? How evenly has the burden of population reproduction—"the division of labor"—been distributed across all women?[1] And have the answers to these questions differed across social groups? These are the issues that we address in this work.

Data Description

A random sample of 1 out of 1000 households enumerated in the United States population census of 1980 (hereafter referred to as the 1980 public use sample) is our main source of data.[2] In the 1980 U.S. census, all women age 15 and older were questioned about the number of children they had ever borne. To avoid confusing the quantum and tempo of fertility, we restrict our sample to women who had completed their childbearing by 1980. We analyze in detail the parity distributions for women in seven five-year age groups (from 45–49 to 75–79) in 1980, essentially representing the birth cohorts of 1901–1905 to 1931–1935.

Those cohorts, whose reproductive years spanned the baby bust period of the 1930's and the baby boom period of the 1950's and early 1960's (hereafter referred to as baby bust women and baby boom women), are the main subject here. We briefly consider the fertility of earlier cohorts as well, in order to place the fertility of bust and boom women into perspective. For comparative purposes, we created a complete time-series of cohort parity distributions for ever-married women born 1821-1935. The data for earlier cohorts come from public use samples of the 1900 and 1940 censuses, in which ever-married women also reported their past births.[3]

Census public use samples are ideal for studying differentials in parity distributions, because data on children ever born can be cross-classified by other characteristics of individual women and their households. Retrospective data from women who survived to the end of childbearing may be flawed by reporting errors or selection bias (if survivorship is correlated with fertility), but the evidence suggests that these problems are not great for the 1980 U.S. census data.[4] In this work, we analyze parity distribution differences both between cohorts and within cohorts (with particular attention given to intracohort differences by race and educational level).

Research Rationale

This paper has two goals. The first is to describe parity distributions and inequality in the distribution of births for cohorts of American women born between 1901 and 1935. The second is to illustrate the general advantage of integrating the issues of reproductive heterogeneity and fertility concentration into demographic analysis.

Parity distribution here means the proportion of women in each cohort who bore n number of children (from 0 to 12 or more). Fertility concentration refers to how evenly the burden (or privilege) of childbearing is distributed in the population. If all women have the same number of children, then fertility is not at all concentrated. If most wom-

en are childless, and the remainder have large families, then a small proportion of women bear most of the children, and fertility is highly concentrated.

Why study parity distributions and fertility concentration? First, if we are interested in describing the actual range of childbearing experience, then information about average fertility is inadequate. Just as data on average income may mask the extent of poverty and great wealth in a society, so too does average completed family size conceal the variety of childbearing experience and reproductive norms.[5]

Further, information on parity distributions highlights the dynamics behind past fluctuations in fertility rates. Data on parity suggest the extent to which periods of "baby bust" and "baby boom" were due to contractions and expansions of higher-order births, or to shifts in the prevalence of childlessness and small families. Such data also indicate the degree of fluidity and heterogeneity in norms about "ideal family size" in the past.

Demographers do not commonly study the concentration of fertility, but studies of inequality in the distribution of some good—be it wealth or offspring—is well-established in other fields like economics and social stratification. Concentration analysis has proven fruitful in analyzing population distribution and residential segregation in human populations, and genetic replacement in animal populations.[6]

Extending the subject matter of concentration analysis to encompass the distribution of children among women raises a number of interesting issues.[7] A low level of fertility concentration implies homogeneity in the experience of adults (with most women bearing about the same number of children), and of children (with most offspring growing up with a similar number of siblings). Highly concentrated fertility suggests either heterogeneity in social norms—norms about the centrality of parenthood, about "ideal" family size, and about the acceptability of family limitation—or else barriers to fulfilling shared expectations. Some demographic theory suggests that parenting two children is an implicit prerequisite for attaining social adulthood in the United States.[8] We might well ask, what proportion of women have actually undergone this rite of passage?

Fertility concentration has practical as well as theoretical implications. Since the bearing and rearing of children is work, concentrated fertility produces an uneven division of labor in population replacement. If children contribute little to family income and the burden of child support rests largely with parents, then variance in family size contributes to disparities in economic well-being. For the elderly, concentration in past fertility produces unequal access to potential support and services from adult children. The proportion of adults who have raised or are raising offspring may influence society's willingness to direct tax revenues towards children, and to accommodate the double burden of pro-

ductive and reproductive labor.[9] Other issues linked to fertility concentration—including the dynamics of population growth, social mobility, and child socialization—are discussed in the conclusion of this paper.

Parity Distributions across Cohorts born 1901–1935

The reproductive careers of the female birth cohorts studied here encompass two periods of discontinuity in American demographic history—the "baby bust" of the 1930's and the "baby boom" of the 1950's and 1960's. For example, the cohort of women born 1906–1910 (aged 70–74 in 1980), experienced their peak childbearing years (age 20–29) during the Depression years of 1929–1939, when the period total fertility rate dropped to 2.26. By contrast, the prime childbearing years of women born 1926–1930 (aged 50–54 in 1980), overlapped the baby boom years of 1946–1959, when the period total fertility rate climbed to 3.77.[10]

Demographers have firmly established that the peaks and troughs of twentieth-century U.S. fertility rates are, to some extent, deceptive—a "period effect" in the terms of the trade. During hard times, women tended to postpone marriage and childbearing, only to catch up later in their reproductive careers; during good times, women began family building early, but then compensated by limiting births after attaining their desired number of children. The effects of fertility bust and boom are thus more muted for actual cohorts of women than for the synthetic cohorts constructed by summing age-specific period fertility rates.[11]

Concretely, the gap in average completed family size for our illustrative cohorts—2.23 children for the cohort born 1906–1910 and 2.99 children for the cohort born 1926–1930—is smaller than the difference of 1.5 children between the aforementioned period fertility rates. Clearly the "average woman" who passed through the baby bust had lower fertility than the "average woman" who passed through the baby boom, but the difference is less than period figures might suggest.

If we shift attention to the full parity distribution, the story need not end here. First, consider, how representative is the "average woman" conjured up by the statistic, cohort mean completed fertility? Table 1 provides some answers to this question. The second column gives mean completed parity for cohorts, based on the 1980 public use sample. These figures suggest that, across cohorts, women have tended to bear 2 or 3 children (with the possible exception of the youngest cohort, where the mean falls between 3 and 4). The third and fourth columns show the proportion of women who actually bore 2 and 3 children, respectively. The fourth and fifth columns present two

Table 1. Average and modal parities, by cohort.

Cohort born	Mean parity	Percentage with		Most common parity	Second most common parity	*N*
		2 births	3 births			
1931–1935	3.08	21.1	22.1	3 (22.1)	2 (21.1)	5583
1926–1930	2.99	22.7	20.9	2 (22.7)	3 (20.9)	6145
1921–1925	2.74	25.1	19.0	2 (25.1)	3 (19.0)	6112
1916–1920	2.50	24.4	17.7	2 (24.4)	3 (17.7)	5433
1911–1915	2.24	23.2	15.3	2 (23.2)	0 (22.8)	4970
1906–1910	2.23	23.3	13.8	0 (24.8)	2 (23.3)	4018
1901–1905	2.64	20.9	13.5	0 (24.7)	2 (20.9)	2959

Source: Tabulated from the public use sample of the 1980 U.S. Census.

"modal parities"—that is, the parities characteristic of the largest and second largest numbers of women, and the proportions within cohorts falling into these categories.

For this population, average parity exemplifies the experience of a minority of women. The share of all women who bore between 2 and 3 children—the fertility of the "average" woman—ranges from 44 percent for the cohort born 1926–1930, to 34 percent for the cohort born 1901–1905. The match between modal parities and average parity is quite good for those cohorts whose childbearing years overlapped the baby boom (born 1921–1935). But this is not so for the baby bust women (born 1901–1915). While mean parity for women born between 1901 and 1910 was about 2.5 children, the most common parity status for cohort members was childless.

The results in Table 1 illustrate the need for examining full parity distributions to understand and compare reproductive performance. Figure 1, which shows the number at each parity (0 to 12 births) per 1000 women by cohort, provides such detail. Evident is a sharp divergence in the parity distributions of "baby bust women" (born 1901–1915) and "baby boom women" (born 1921–1935).

The largest difference between these cohort groups is found at parity zero. About one-fourth of the women in the two oldest cohorts bore no children, compared to 12 percent of those in the two youngest cohorts. The difference in the share of women with one birth is nearly as great—about 18 percent versus approximately 10 percent. The gap narrows at parity two, widens again at parities three and four, and thereafter narrows, becoming insignificant by parity seven.

While illustrative of the range of demographic experience, the relative frequency distribution shown above is an imperfect indicator of reproductive decision-making, since clustering at one point (e.g., parity zero) affects all other values. Questions remain about the extent of cohort differentials for those women who did become mothers. We address

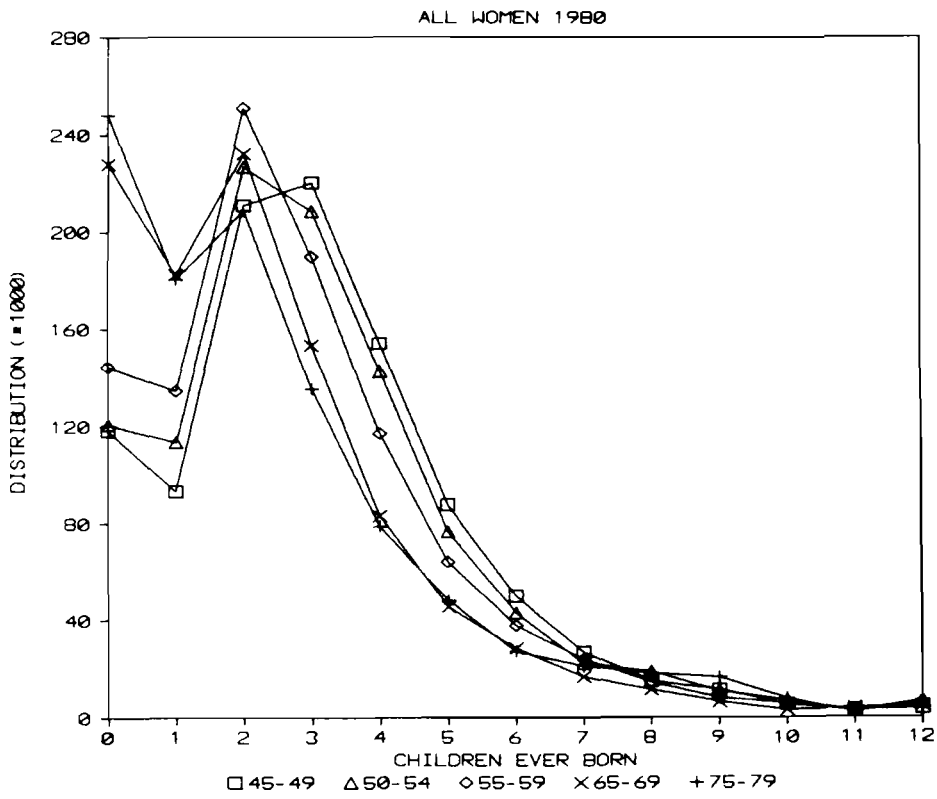


Figure 1. Completed parity distributions for five selected cohorts of women.

these, first by excluding childless women from the sample, and then by considering transitions between parities.

After childless women are excluded, marked differences in cohort parity distributions persist. The prevalence of one-child families was about twice as great for two oldest cohorts (23–24 percent of women with children) than for two youngest cohorts (11–13 percent of women with children). Conversely, three- and four-child families were more common among the youngest women (25 percent and 16 percent, respectively) than among the oldest women (18 and 10 percent, respectively). But the difference is largely confined to these low-order births; in every cohort, about 80 percent of mothers had four or fewer births, and about 90 percent had five or less.

Another aspect of the story emerges when we consider movement between parities, shown in Table 2 by parity progression ratios (i.e., the proportion of women with n births who had an n+1-th birth). The figures for lower-order births largely reinforce the point already made: baby bust women were less likely to move from childlessness to a first

Table 2. Parity progression ratios by cohort.

	Age of women in 1980						
	45–49	50–54	55–59	60–64	65–69	70–74	75–79
p0–p1	.88	.88	.86	.83	.77	.75	.75
p1–p2	.90	.87	.84	.81	.76	.77	.75
p2–p3	.73	.70	.65	.63	.61	.60	.64
p3–p4	.62	.61	.60	.58	.57	.60	.63
p4–p5	.57	.57	.58	.58	.59	.60	.63
p5–p6	.57	.59	.61	.57	.62	.65	.66
p6–p7	.59	.61	.62	.60	.62	.68	.67
p7–p8	.61	.67	.61	.62	.64	.66	.73
p8–p9	.52	.59	.61	.64	.62	.67	.70

Source: Calculated from tabulations from the public use sample of the 1980 U.S. Census.

birth, and from a first birth to a second or third. But with the transition from the fourth birth to the fifth, a different pattern appears. At higher parities, the baby bust women were *more* likely to continue childbearing than were their counterparts from the baby boom period.

What, then, can one conclude from these data on parity distributions? First, the results might be read as a cautionary tale about the limitations of summary statistics. The time-series of mean parity figures suggested that two- and three-child families have consistently dominated the twentieth-century American demographic landscape; the time-series of parity distributions indicate the opposite. A minority of American women born between 1901 and 1935 bore two or three children, although a secular decline in higher-order births and the low rate of childlessness during the baby boom edged actual reproductive performance closer to "average" performance. Nor can we assume that childbearing has necessarily marked the transition to adulthood for nearly all women in the past, since the modal parity status of baby bust women was childless.

This information about parity distributions also yields insight into the dynamics underlying the discontinuities—or busts and booms—of twentieth-century American fertility. Our findings support the contention of Norman Ryder and others that the baby boom fertility increase was due largely to a decrease in childlessness and an increase in the proportion of mothers having second and third births.[12] Indeed, the upsurge in low parity births during this period was partly countered by continued decline in higher-order births. The result was greater homogeneity in the division of reproductive labor, discussed in detail below.

The Depression years left their mark on cohort fertility through a different path. Here a parallel can be drawn with the economic impact of the Depression. The fact that one-third of the labor force was unemployed does not mean that most workers were unemployed one-third of the time; rather, some experienced long periods of joblessness, while others were relatively untouched.[13] Similarly, women who passed through their childbearing years in the 1930's did not all limit their fertility to the same degree. Instead, about one-quarter of these women remained childless; about a fifth bore a single child; a third had an "average" family of two or three children; and the remainder were nearly as likely as their predecessors to move to higher parities after each birth. The baby bust left its mark not simply through low fertility, but rather through heterogeneity in reproductive behavior.

Changing Family Size from the Perspective of Children

Heterogeneity in parity distributions implies diverse experience not only for women, but also for their children. Outside Digitopolis, all children do not grow up with one and a half brothers and sisters; instead, they may monopolize parental attention and resources (as only children) or compete with many siblings (as members of large families). We might then ask, what proportion of baby bust and boom children had no, a few, or many brothers and sisters? And how did changes in cohort fertility affect both the distribution of children by family size and the mean number of siblings?

Table 3. Mean parity, mean sibship, and sibship distribution.

Mother's cohort	Mean parity	Mean sibship	Percent of children with n siblings						
			0	1	2	3	4	5	6+
1901–1905	2.35	4.78	8	18	17	13	10	7	27
1906–1910	2.23	4.48	8	21	19	15	10	7	20
1911–1915	2.24	4.26	8	21	21	15	10	8	17
1916–1920	2.50	4.29	6	19	21	16	12	8	18
1921–1925	2.74	4.46	5	18	21	17	12	8	19
1926–1930	2.99	4.62	4	15	21	19	13	9	19
1931–1935	3.08	4.56	3	14	21	20	14	10	18

Source: Calculated from tabulations of the public use sample of the 1980 U.S. Census.

Table 3 addresses these questions for the offspring of women born 1901–1935. Again, figures on the distribution of children by family size highlight the limitations of average parity in expressing demographic experience. Despite a mean family size from women's perspective of 2–3 births, only 30 to 40 percent of these bust and boom offspring were raised as one of two or three children. More than half came from families with four or more children.

Surprisingly, there was relatively little contrast between baby bust and baby boom children in either mean sibship size or the distribution of children by their number of siblings—despite the divergent reproductive performance of their mothers' generations. While the gap in mean parity between the cohorts of 1906–1910 and 1926–1930 was about two-thirds of a child, the parallel gap in mean sibship was only about one-tenth of a child. Baby bust children were somewhat more likely to have zero or one siblings, and somewhat less likely to have three or four, than were baby boom offspring. Yet the difference between cohorts in children's experience is slight, compared to the striking divergence in women's parity distributions (shown above in Figure 1).

The smaller gap in mean sibship than in mean parity for bust and boom women can be explained as follows. When calculating mean parity (or what is commonly termed average family size), every woman is given equal weight, regardless of the number of children she has borne. In calculating mean sibship, childless women are excluded, and a woman with eight births receives eight times more weight than a woman with one birth. The relationship between the two measures has been described by Sam Preston: "the mean family size of a child will be equal to the mean family size of women plus a term equal to the variance of women's family sizes divided by their mean."[14] The relatively large mean sibship size for low fertility baby bust cohorts is due to the persistence of large families and considerable variance in family size (evident in the parity distribution shown in Figure 1).

Similar logic explains why the distribution of children by number of siblings was quite similar for baby bust and baby boom offspring. The most striking impact of the Depression, an increase in childlessness, obviously had no impact on the number of siblings for those children who were born to baby bust women. The prevalence of one-child families did raise the share of baby bust only-children. But when measuring the experience of *all* children (rather than all families), only-children exert little weight: twelve times as many children grow up in one 12-child family than in one 1-child family. Again, the persistence of large families ensured that the majority of baby bust offspring were socialized with three or more siblings, despite the prevalence of women with one or no children.

Fertility Concentration within Cohorts

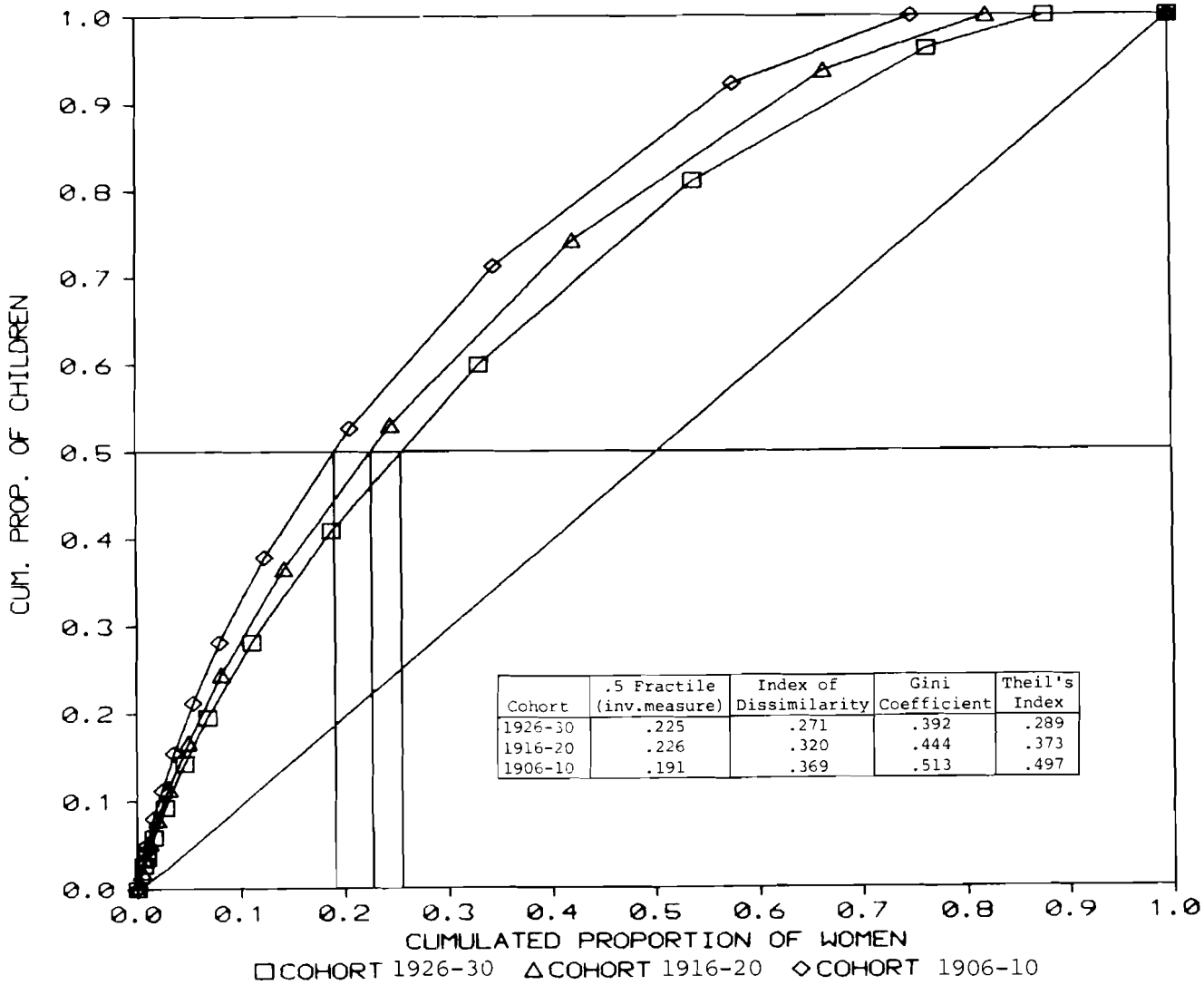
The fact that most baby bust *children* originated from large families—even though most baby bust *women* had small families—leads logically to the question of fertility concentration. By fertility concentration, we refer to inequality in the distribution of children (or reproductive labor) among women.

Concentration analysis for any good (be it corporate stock or children) measures how equally some quantity is distributed among a population. High relative concentration—or relative inequality—occurs when a small fraction of the population has most of something (e.g., a few high-parity women bear a large share of all children) and a large fraction of the population has very little (e.g., many women bear no children). It should be emphasized that high concentration does *not* mean that births are clustered (or "concentrated") at a few modal parities. That situation (occurring, for example, if all women had at least one and no more than two births) would place about the same number of children in the care of most women, distribute births fairly evenly through the female population, and produce a low degree of fertility concentration.

The degree of fertility concentration for selected cohorts of baby bust and baby boom women is shown graphically in Figure 2, in the form of a concentration (or Lorenz) curve. The x-axis gives the cumulated proportion of those who *have* some good (here, the cumulated proportion of women, ranked from highest to lowest in terms of their "production" of births); the y-axis gives the cumulated proportion of the good itself (here, the cumulative proportion of births). If children were equally distributed among women (i.e., if half of the women had half of the births), then plotting the relationship between x and y would produce a diagonal line. The greater the degree of inequality, the more the actual plot curves above the diagonal.[15] If women were ranked from lowest to highest "productivity"—as an economist would do—the curve would be under the diagonal.

A glance at Figure 2 shows that the fairly homogeneous parity distribution of baby boom women (represented by the cohort born 1926–1930) produced a more even distribution of reproductive labor than did the variegated fertility of the baby bust women (represented by the cohort born 1906–1910). The cohort born 1916–1920 takes an intermediate position. The extent of inequality—and differentials in concentration between cohorts—is summarized succinctly in four accompanying statistics: the .5 fractile, the index of dissimilarity, the Gini coefficient, and Theil's measure of inequality.

The .5 fractile (marked by perpendicular lines) indicates the proportion of women responsible for half the births, and ranges from .26 for the cohort born 1926–1930, to .19 for the cohort born 1901–1905.[16] Formally, the index of dissimilarity summarizes the maximum vertical distance between the diagonal line and the concentration curve; sub-



Cohort	.5 Fractile (inv.measure)	Index of Dissimilarity	Gini Coefficient	Theil's Index
1926-30	.225	.271	.392	.289
1916-20	.226	.320	.444	.373
1906-10	.191	.369	.513	.497

Figure 2. Lorenz curve and selected concentration indices for three birth cohorts.

stantively, this measure implies that 27 percent of the children born to the youngest cohort of 1926–1930 and 37 percent of those born to the cohort of 1906–1910 would have had to change mothers for fertility to be equally distributed. The two other measures—the Gini coefficient (which refers to the area between the concentration curve and the diagonal) and Theil's measure (which is useful for decomposition)—are included for comparative purposes. They are also listed in Figure 2 for comparative purposes. All concentration measures tell the same story of higher concentration for the baby bust women and lower concentration thereafter.

The causes of the differential concentration in Figure 2 are readily apparent. The prevalence of childless and one-child families left a large share of baby bust women with a small proportion of the cohorts' births; the persistence of large families among a minority concentrated reproductive labor among a small segment of the female population. In contrast, greater equality in the distribution of children accompanied the near-universal childbearing and more homogeneous parity distributions of baby boom women.

Possible implications of the different degrees of fertility concentration for baby bust and baby boom women are discussed later in this paper. It is, however, worth noting here that concentration analysis, like consideration of the full parity distribution, provides a different perspective on these turning points in American demographic history. Baby bust cohorts experienced not simply low fertility, but also heterogeneous reproductive behavior and inequality in the division of reproductive labor. The baby boom cohorts, on the other hand, were characterized by homogeneity in reproductive behavior and relative equality in the distribution of children, as well as high average family size.

Differences between Social Groups in Parity Distributions and Fertility Concentration

The divergent fertility of baby bust and baby boom women supports Norman Ryder's claim that, "Each cohort has a distinctive... character reflecting the circumstances of its unique origination and history."[17] At the same time, differences within cohorts may coexist with differences between cohorts; as Ryder notes, "the meaning of sharing a common historical location is modified and adumbrated by other identifying characteristics."[18] Indeed, heterogeneous cohort parity distributions—like that for the baby bust women—suggest alternative fertility regimes governing subgroups of those born in the same period.

Our focus thus shifts to differences in the parity distributions and fertility concentration of subpopulation. We address the following questions: to what extent did subgroups differ in average family size, parity distribution, and fertility concentration? Did the distinctive features of baby bust fertility (a high incidence of childlessness and one-child families) and baby boom fertility (near-universal childbearing and a drop-off in high-order births) characterize reproduction for all social groups within these cohorts?

For the most part, population subgroups within the baby boom and baby bust cohorts exhibited rather similar parity distributions and fertility concentration. Regional differences, for example, are practically invisible (see Figures A–1 and A–2, Appendix A). Native-born and foreign-born women shared a common fertility pattern, although ex-

tremes of bust and boom were more muted for the latter (see Figures A–3 and A–4). For the baby bust cohorts, women born outside the United States were less likely to be childless and more likely to bear two children; for the baby boom cohorts, immigrants exhibited a less-universal tendency to bear at least two children. Mean family size for the native- and foreign-born differed by about one-fourth of a child, but parallels in the shape of their parity distributions suggest differences in degree rather than kind.

Some differences in family size norms and a higher average fertility level set the farm and non-urban population apart from other baby bust women (see Figures A–5 and A–7). Higher farm fertility reflected an unusually low rate of childlessness; higher non-urban fertility derived from less clustering at parity two and more clustering at parities five and six. But among baby boom women, these differences had largely evaporated (see Figures A–6 and A–8). Farm and non-metropolitan residents still had higher mean parity, but the gap came largely from a small subset of women with very large families. Despite some differences, then, population subgroups defined by nativity and by regional, farm, and metropolitan residence had similar reproductive performance, implying shared norms and behavior.[19]

Evidence of contrasting fertility regimes within cohorts does appear when women are broken down by race, however.[20] Figures on average family size are one indicator of this differential fertility: mean parity was 2.68 children and 3.76 children for black women born 1906–1910 and 1926–1930, respectively, versus 2.18 and 2.90 children for their white counterparts.

But the single fact that black women had, on average, higher fertility leaves much of the story untold. The basis for this differential becomes clearer in Figures 3a and 3b, which show the proportion of women at each parity by race for the two selected cohorts. The lower fertility of whites cannot be ascribed to a greater prevalence of white women with zero or one birth, for the proportion of blacks in these categories was consistently higher. Instead, the lower fertility of whites within both boom and bust cohorts derived from their greater likelihood of curtailing childbearing after their second or third child—evident in the greater clustering of white women at low-order parities in Figures 3a and 3b.

The differences in family limitation practices for black and white mothers were profound. Among white baby bust mothers (born 1906–1910), 23 percent had one child, 41 percent had two or three, and only 15 percent had five or more births. Among black mothers in this cohort, a larger share (29 percent) had one birth, but the proportion with two to three fell to 30 percent, and 30 percent had five or more births. For baby boom mothers, the gap by race was even wider. Fifty-two percent of white mothers born

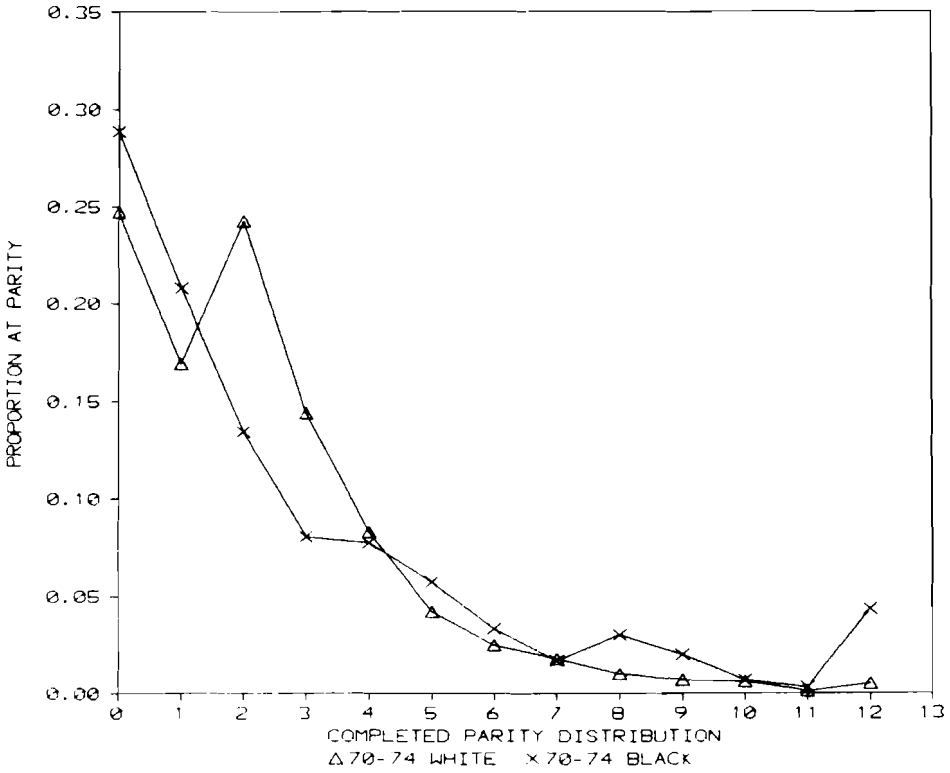


Figure 3a. Completed parity distributions by race, cohort aged 70–74 in 1980.

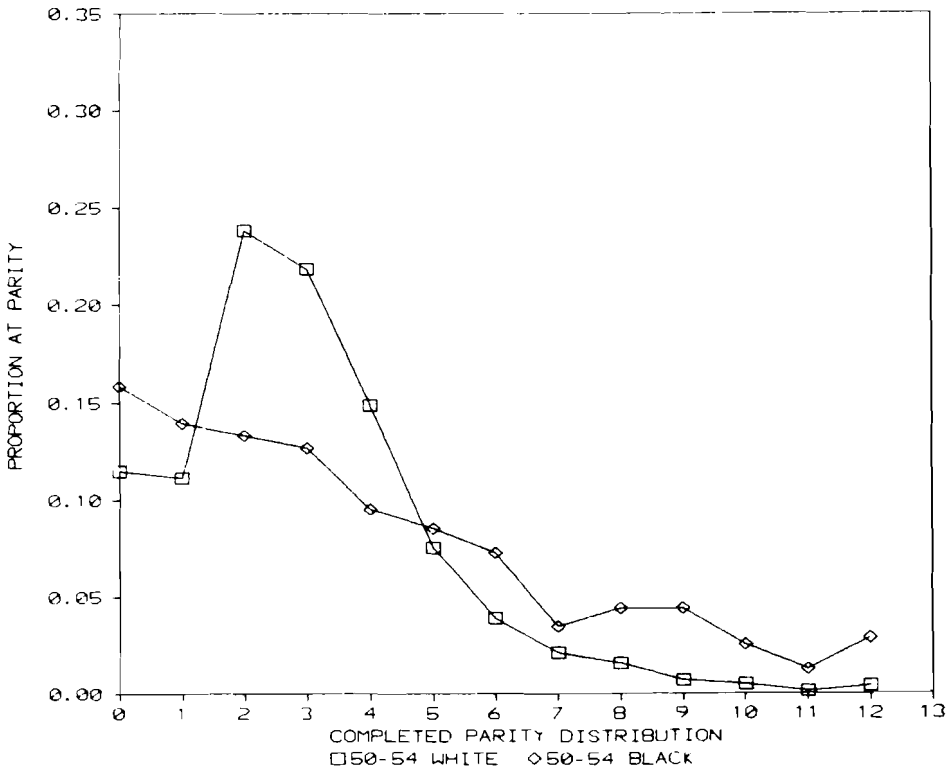


Figure 3b. Completed parity distributions by race, cohort aged 50–54 in 1980.

1926–1930 had two or three children and 19 percent had five or more; 31 percent of the black mothers had two or three births, and 41 percent had five or more. Parity progression ratios tell the same story: the probability of a further birth dropped sharply for white women after their third child, but hardly changed at all for blacks at transitions to higher parities.[21]

An exceptionally high degree of within-group fertility concentration resulted from this distinctive fertility regime for blacks. Among the baby bust cohort of 1906–1910, for example, 15 percent of black women bore half of the children, compared to 20 percent for whites. For both blacks and whites, declines in the share of childless and one-child women produced lower fertility concentration among the baby boom women. But the absence of clustering at lower-order births (two or three children) maintained a high level of concentration for blacks—with 21 percent of black women (born 1926–1930) bearing half the children, compared to a .5 fractile of .27 for whites.

The other variable which points to the existence of alternative fertility regimes within cohorts is women's education. Because overall levels of education rose with each succeeding cohort, measures of relative education specific to each cohort were adopted. Women within each cohort were divided into three educational categories: low education (including the lowest quartile for the cohort in terms of completed schooling); medium education (above the lowest quartile but no more than highschool graduation); and high (at least some college).[22]

Differentials by education, like those by race, were manifested in divergent fertility *levels*. Baby bust women of low education bore, on average, twice as many children as highly educated women (3.O births versus 1.5 for the cohort born 1906–1910). Fertility *concentration* was similar across educational levels for these cohorts, however, with about one-fifth of women bearing half the children.

Figures 4a and 4b and Table 4 show the contrasting parity configurations which produced similar fertility concentration within educational categories. Among baby bust women (exemplified by the cohort born 1906–1910), childlessness was more widespread among the well-educated, with over one-third of the college-educated bearing no children (versus slightly over 20 percent in the other educational categories). The high level of childlessness among the well-educated was offset by considerable clustering at a few parity statuses, however, with 65 percent of well-educated mothers bearing one or two children, and only 6 percent bearing five or more. Poorly-educated baby bust women, on the other hand, were less likely to bear no or only one child. Like black mothers, this group showed little targeting of particular family sizes, with 29 percent bearing five or more children.

Table 4. Fertility by education, cohorts born 1906–1910 and 1926–1930.

	Cohort born 1906–1910		
	Low education	Medium education	High education
Mean parity	3.0	2.17	1.54
Mean sibship	5.73	4.16	3.13
.5 fractile	.19	.20	.20
% Childless	21.4	23.4	34.1
% Mothers with:			
– One birth	17.9	23.3	28.5
– Two births	27.4	32.7	36.8
– Three births	16.8	18.6	19.9
– Four births	13.5	10.8	8.6
– Five+ births	29.4	14.7	6.2

	Cohort born 1926–1930		
	Low education	Medium education	High education
Mean parity	3.47	2.84	2.70
Mean sibship	5.61	4.21	3.91
.5 fractile	.23	.27	.28
% Childless	12.7	11.1	13.4
% Mothers with:			
– One birth	12.9	13.7	10.9
– Two births	20.9	27.3	28.8
– Three births	19.2	25.0	26.7
– Four births	14.8	15.6	19.5
– Five+ births	32.2	27.3	14.1

Source: Calculated from tabulations of the public use sample of the 1980 U.S. Census.

Some convergence in fertility behavior across educational barriers appeared among baby boom women. The college-educated were no longer set apart by high childlessness, and all three educational groups showed some tendency to cluster at a few parity statuses. The degree of clustering around an "ideal family size" still differed, however; the proportion of mothers born 1926–1930 who had two to four births fell from 75 percent among the well-educated, to 56 percent among the poorly-educated. The persistence of large families among the lowest strata produced more inequality in the distribution of children for this group.

The existence and persistence of distinct fertility regimes for blacks and whites and for women of differing educational attainment points to strong race and class barriers.[23] How permeable and distinct were these two sets of barriers? Did the reproductive performance of elite college-educated black women match that of well-educated white women—or did racial caste override class?

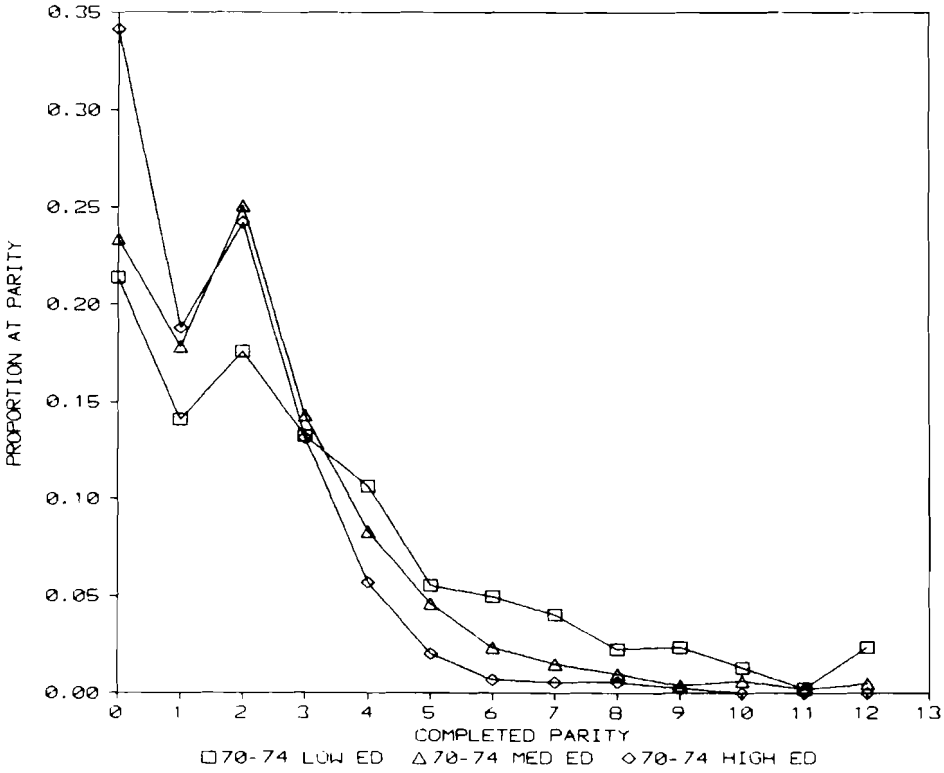


Figure 4a. **Completed parity distributions by women's education, cohort aged 70–74 in 1980.**

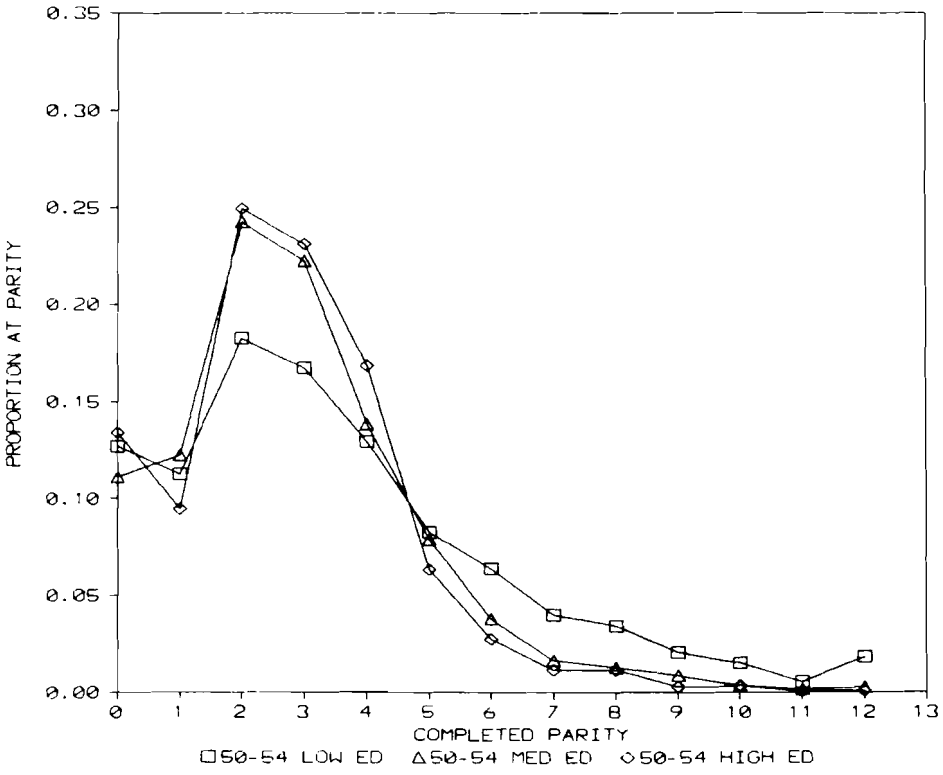


Figure 4b. **Completed parity distributions by women's education, cohort aged 50–54 in 1980.**

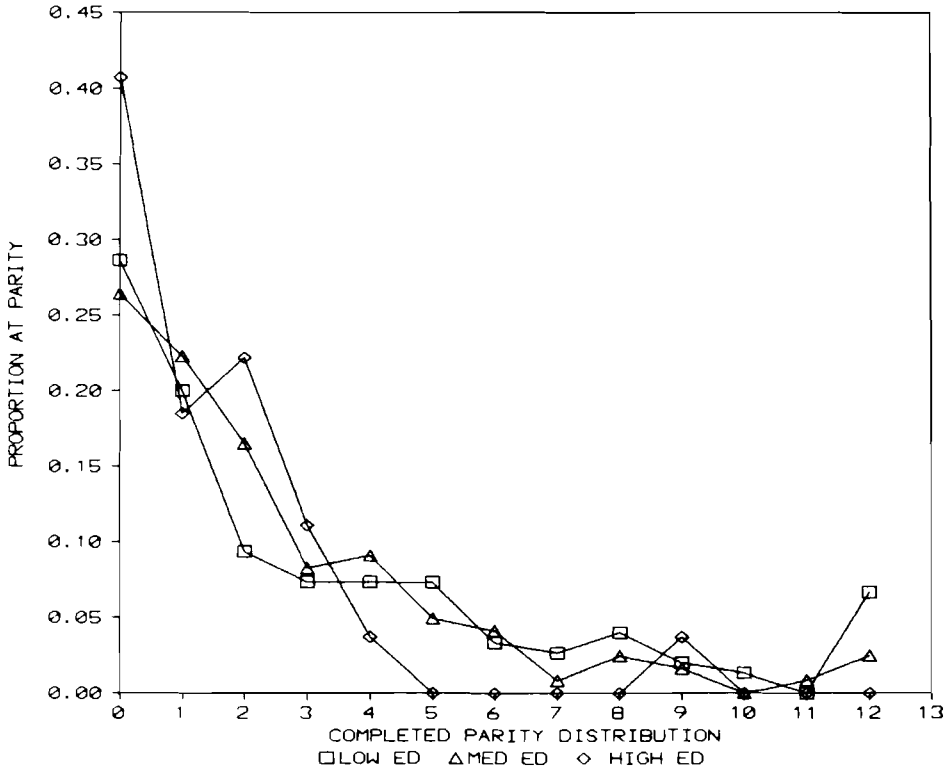


Figure 5a. Completed parity distribution for blacks by education, cohort aged 70–74 in 1980.

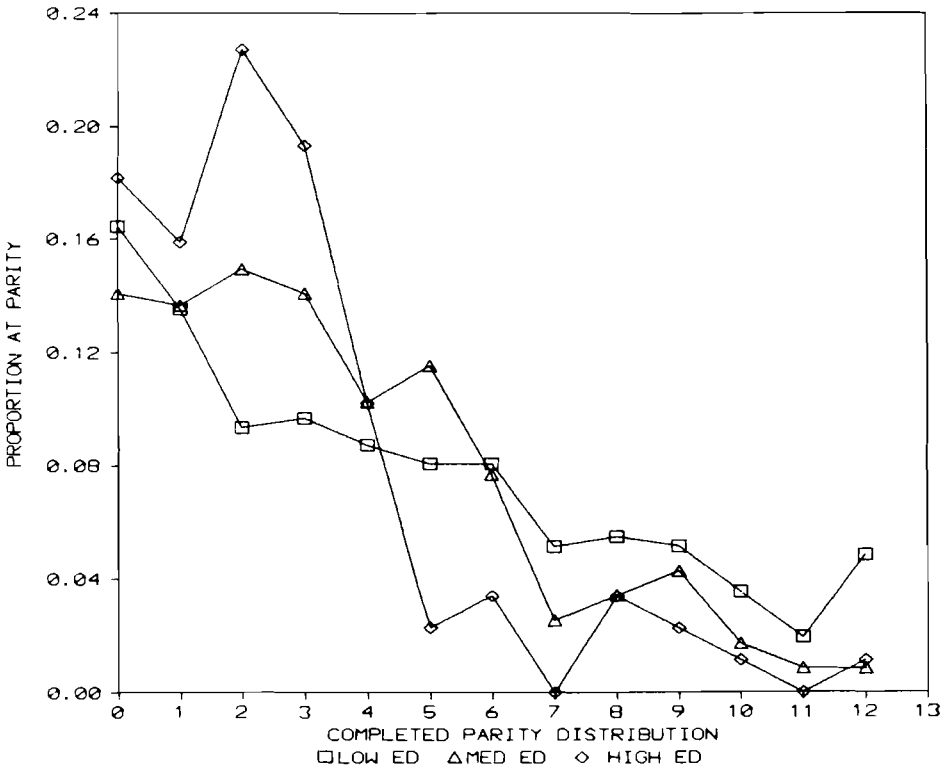


Figure 5b. Completed parity distribution for blacks by education, cohort aged 50–54 in 1980.

Figures 5a and 5b answer this question. Among baby bust women (again exemplified by the cohort born 1906–1910), the shape of the parity distribution is similar for poorly-educated and college-educated blacks (see Figure 5a). Well-educated whites' practice of limiting family size to two or three children was not followed by college-educated blacks. But a different picture emerges for black baby boom women in Figure 5b. Like their white counterparts, well-educated black women born 1926–1930 adopted the middle-class practices of near-universal childbearing and restriction of higher-order births. Still, such family limitation was largely confined to the black elite. While a near-natural fertility pattern of little control of high-order births characterized only the most poorly educated whites, black baby boom women of both low and medium education followed such a regime.

Relative Importance of Between- and Within-Group Inequality

The existence of racially- and educationally-based fertility regimes raises another question: to what extent was heterogeneity in the parity distribution for cohorts due to family size differences *between* racial and educational groups, rather than differences *within* groups? For an answer, we turn to a decomposable statistic of inequality, developed by Theil, which measures the contribution of between group inequality and within group inequality to total inequality.[24]

Table 5 gives, separately for all women and for mothers, results from applying Theil's measure of inequality and its decomposition to cohorts classified by race and education. The rank order of results from this measure—a higher value meaning higher concentration—is consistent with that from the .5-fractile statistics. For our data the Theil index values range from a high of .68 for black women born 1901–1905 to a low of .12 for highly-educated baby boom mothers.

The decomposition figures (given in the column labeled "percent of total" in Table 5) show that only a small proportion of total inequality in the distribution of children was attributable to between-group differences. The explanation is simple: any subgroup of the population defined by socio-economic characteristics will almost certainly contain both childless and high-parity members; the variance of the total parity distribution is echoed in that of its constituent groups. Populations in which one subgroup has consistently high fertility and another has consistently low fertility are theoretically interesting but rarely encountered.

Table 5. Theil's index of concentration decomposed into within-group and between-group effects for education and race by cohort.

Age group	Education					Race				
	within			between		within		between		
	Low	Medium	High	Abs.	US% of total	White	Black	Abs.	% of total	
	All women			Total*						
45–49	.26	.24	.28	.008	2.8%	.25	.34	.005	1.7%	.267
50–54	.32	.26	.26	.005	1.8%	.27	.39	.004	1.3%	.289
55–59	.35	.31	.32	.006	1.7%	.30	.49	.002	.7%	.328
60–64	.41	.34	.38	.006	1.5%	.35	.53	.002	.5%	.373
65–69	.43	.44	.51	.015	3.2%	.44	.63	.001	.1%	.458
70–71	.47	.46	.56	.022	4.3%	.48	.64	.002	.3%	.497
75–79	.43	.50	.57	.027	5.2%	.50	.68	.000	.0%	.511
Total	.37	.35	.37	.008	2.3%	.38	.49	.003	.8%	.368
	Mothers only									
45–49	.16	.13	.12	.006	4.2%	.13	.19	.006	4.0%	.141
50–54	.19	.15	.12	.006	3.5%	.15	.22	.005	3.2%	.160
55–59	.20	.16	.15	.005	3.2%	.15	.25	.004	2.5%	.172
60–64	.21	.16	.16	.006	3.5%	.16	.26	.003	1.9%	.179
65–69	.22	.17	.16	.008	4.2%	.18	.27	.002	1.0%	.199
70–74	.23	.70	.15	.012	6.1%	.20	.30	.003	1.3%	.211
75–79	.22	.22	.16	.015	6.7%	.22	.27	.001	.5%	.226
Total	.20	.16	.14	.006	3.8%	.16	.24	.004	2.3%	.178

* Total for education and race were not identical because of slightly different numbers of women included.

Although the overall effect of between-group differences may be slight, their *relative* importance is of interest. Overall, differences between educational groups explain a greater share of total inequality than do racial differentials, because educational subgroups had a lower degree of within-group concentration than black and white women studied separately.[25] The importance of educational differences waned over time, however, due to convergence in fertility across educational categories. In contrast, the importance of racial differentials increased, as almost natural fertility among non-elite blacks became increasingly distinct from the homogeneous small families of other baby boom women.

Predictably, the transition from all women to mothers considerably reduces the inequality measure—by more than half for black women from the baby bust cohorts. But while this reduction highlights the importance of childlessness in concentrating fertility, it is obviously not the only factor, since blacks still exhibit higher concentration than other mothers. The proportion of total inequality explained by between-group differentials is higher for mothers than for all women, due to the reduction in within-group concentration when childless women are excluded. For the baby bust cohorts of mothers, more than 6 percent of total concentration is explained by the differential fertility patterns of educational subgroups.

Long-Term Trends for Ever-Married Women

The sequence of cohorts born between 1901 and 1935 that we can be studied from the 1980 public use sample provides information on a relatively restricted period of U.S. fertility history. For more recent cohorts, it is not possible to analyze completed fertility without making restrictive assumptions about future childbearing. But we can expand the time frame by turning to public use samples of earlier censuses and applying analogous procedures to derive completed parity distributions, means, and concentration statistics.

Together, the 1900, 1940, and 1980 census samples offer information on a nearly complete time-series of cohorts born between 1821 and 1935 (see Table A–1). In the 1900 and 1940 censuses, children ever born are reported only for ever-married women. Lacking information on illegitimacy, we restrict the analysis of long-term trends to the fertility of ever-married women. Because the prevalence of childlessness is lower for ever-married women, mean fertility is higher and concentration is lower for ever-married women than for all women.

Figure 6 shows the long-term cohort trends over 110 years of U.S. fertility history, using four measures: mean parity, mean sibship size, the .5 fractile, and the proportion childless. The first seven cohorts of ever-married women (born 1821 to 1855) show relative stability in these indicators. Mean completed family size and mean sibship size were almost constant at a level slightly above five children and around eight children, respectively; concentration and the proportion childless do not exhibit significant trends.

The second period, which includes cohorts born between 1856 and 1910, shows fundamental change in all indicators. Mean parity of ever-married women declined by more than half, to a level of around 2.4 children; mean sibship declined by somewhat less than half, to around 4.3 children. As might be inferred from the difference in the extent of change for the two means, relative variance and concentration of fertility increased during this period; the .5 fractile declined from .26 to .21. Part of this increase in concentration was due to increases in childlessness among ever-married women (from 9.2 percent in the cohort born 1851–1855 to 19.4 percent in the cohort born 1906–1910). For the cohorts born after 1910, the trend of each of the indicators is completely reversed. Mean fertility increases again, and concentration and the proportion childless decrease.

Placed in this longer comparative perspective, the marital fertility of baby bust and baby boom women seems less anamalogous. The low fertility of baby bust married women carries forward a long secular decline in average parity and sibship size. Fertility concentration and childlessness within marriage peaked for baby bust cohorts, but concentration and childlessness had been high since the birth cohorts of the 1870s. And the low level of childlessness within marriage that marked the baby boom women is matched by married women born prior to 1860.

Relationship Between Level and Concentration of Fertility

Figure 6 shows that the decline in average completed family size in the United States for ever-married women born between 1821 and 1910 was accompanied by an increase in fertility concentration (as measured by the .5 fractile). For cohorts of ever-married women born after 1910, both trends reversed: mean parity rose, while the distribution of children among women became more equal. This specific empirical example suggests the possibility of a general negative relationship between fertility level and fertility concentration.

Figure 7, which plots the value of mean parity against the .5 fractile for several populations, brings more evidence to bear on this question. The connected points represent values for U.S. cohorts of ever-married women. Here, three distinct patterns are discerni-

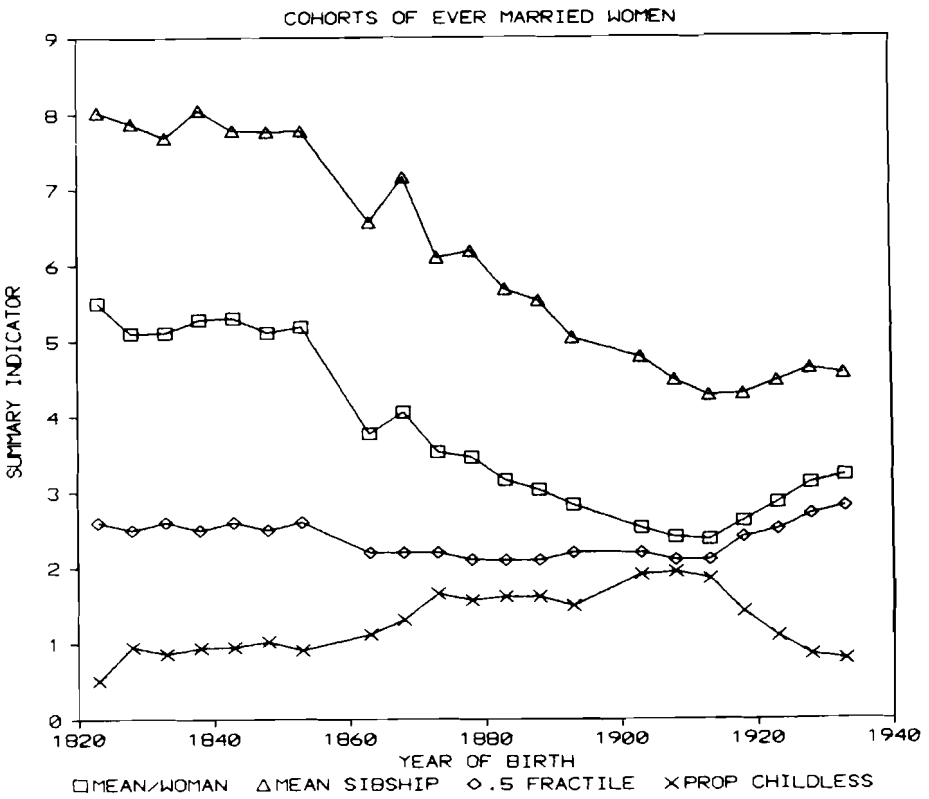


Figure 6. Selected indicators of the completed parity distributions of cohorts of ever-married women born 1821–1935.

ble: an initial period of stability in both average fertility and concentration (for the cohorts born 1821–1860); a second phase of fertility decline accompanied by increased concentration (for the cohorts born 1860–1910); and a third period of increasing fertility and increasing equality in the distribution of births (for the cohorts born 1911–1935).

Note the steep slope of the line connecting points for the most recent U.S. cohorts, which indicates a sharp drop in concentration per unit increase in mean completed fertility during the shift from baby bust to baby boom. The overall degree of concentration for the third, most recent phase, was about the same as for the earliest phase—but at a considerably lower average fertility level.

The positive association between high fertility and substantial equality in the distribution of births for the U.S. is mirrored in comparable data from other national settings. The triangular plots in Figure 7—which are also based on the completed fertility of ever-married women—reflect the experience of 41 less-developed countries participating in the World Fertility Survey. Here too there is a clear positive relationship between the aver-

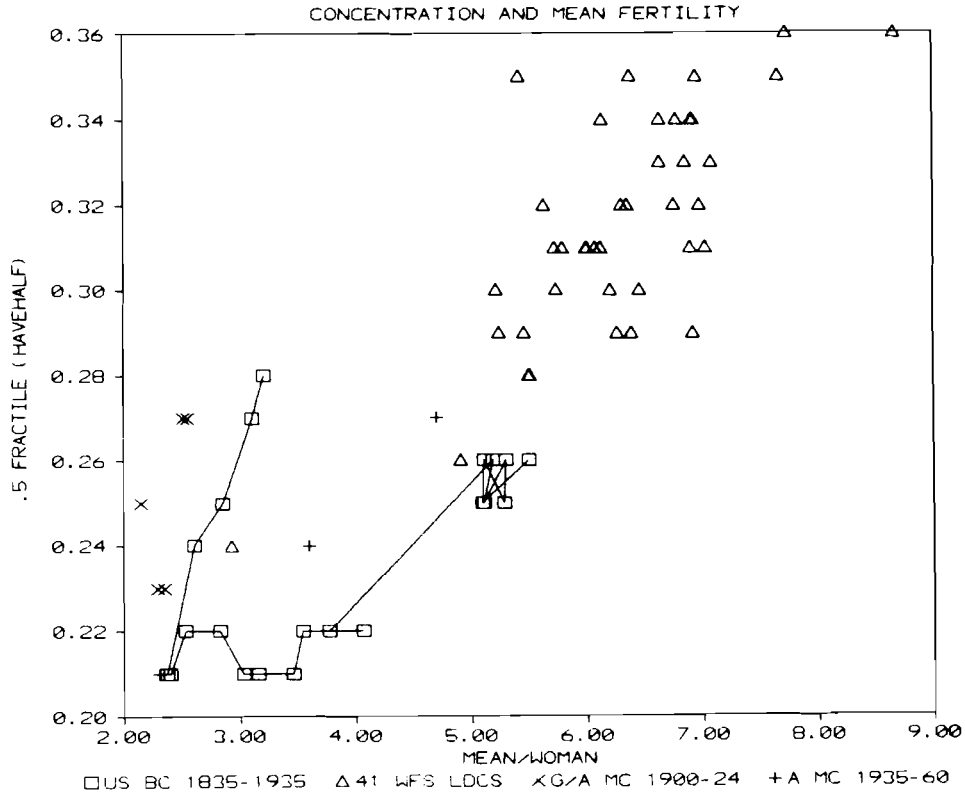


Figure 7. Plot of mean completed parity against concentration (.5 fractile) for cohorts of ever-married U.S. women in 1821–1935, marriage cohorts of 1900–1960 in Austria, and a cross-section of 41 LDC's participating in the WFS.

age fertility level and the degree of equality in the distribution of births.[26] Although these data are cross-sectional, they may be compared to the longitudinal U.S. cohort data by assuming that countries are at different stages of a general shift from high to low fertility.

Time-series data for Germany and Austria, covering selected marriage cohorts between 1900 and 1960 (marked by crosses in Figure 7) provide a final basis of longitudinal comparison with the U.S. data and further confirmation of the inverse relationship between fertility level and concentration.[27] The change over time in these data reveals an association between concentration and mean fertility, that almost exactly mirrors the American pattern, though at a consistently lower level of marital fertility.

Why this apparently universal association between high fertility level and low fertility concentration? Consider first the case of natural fertility populations. Here, the absence of parity-specific family limitation tends to yield high mean fertility. Heterogeneity

is introduced only by differential natural fecundability, lactation, and exposure to intercourse. The introduction of family limitation, on the other hand, not only reduces overall fertility, but also adds a new source of variability (and thus of concentration).

In real populations experiencing demographic transition, family limitation is seldom adopted by all women simultaneously. Instead, some women sharply limit their childbearing to attain a small "ideal" family size, while others continue to bear large families under the old natural fertility regime. The coexistence of large and small family norms produces heterogeneity in marital fertility and inequality in the distribution of children.

While the second phase of this general process is reminiscent of the racial and educational differentials observed for baby bust women, the dynamics of decreasing concentration for baby boom women are rather different. The rather even distribution of children during the post-World War II baby boom derived from quite homogeneous family size choices within a contracepting society, with most women marrying and bearing two to five children. The dearth of childless and one-child families not only raised average completed fertility, but also distributed births more evenly among women; the drop-off in the highest parity births similarly reduced concentration.

Mathematically, there need be no association between fertility level and concentration. Theoretically, transition to lower, controlled fertility could occur with no change in relative concentration—if all women reduced their fertility proportionately. But this is unlikely for two reasons: 1) children do not come in divisible units, and 2) family limitation generally follows a diffusion process, with some women reducing family size sharply, and others, not at all. Indeed, some additional element—like universal, state-supported incentives for a target family size—may be an empirical prerequisite for very low fertility to coexist with low concentration. This is, in fact, the situation in the most striking empirical counter-example, contemporary China, where the mean family size implied by period fertility declined from 7.83 in 1963 to 2.66 in 1981, while the .5 fractile stayed consistently at about .35.[28]

Conclusions and Implications

At the start of this paper, we claimed that the analysis of heterogeneous parity distributions and fertility concentration offer information hidden by statistics on average family size. One test of this claim is the variety of insights into the fertility of baby bust and boom women (born 1901–1935) yielded by this approach. Our main conclusions here are as follows:

- A minority of women in the cohorts born 1901–1935 bore the number of children implied by figures on average family size. Indeed, among baby bust women, the modal parity status was childless—although the "average" woman had two to three births.
- The difference between baby bust and boom cohorts lies not simply in "low" versus "high" fertility, but rather in the relative frequency of particular parity statuses. Baby bust cohorts had a high proportion of women with zero or one birth, and a high incidence of large families; baby boom women were characterized by near-universal childbearing, clustering at two to four births, and a drop-off in high-order (seven or more) births.
- Despite sharp contrasts in women's experience, the distribution of children by number of siblings was quite stable. The majority of offspring of both boom and bust mothers were raised in families of four or more children.
- Heterogeneity in Depression era fertility produced marked inequality in the distribution of children, with about 19 percent of baby bust women bearing half their cohort's offspring. The more homogeneous parity distributions of baby boom women reduced fertility concentration, with about 26 percent of women having half the births.
- Distinctive fertility regimes, bounded by race and education (perhaps indicating social class), are discernible within the parity distributions for these cohorts. Contrary to their cohorts' overall pattern, black women who bore at least two children, and poorly educated women as a group, showed little tendency to seek some "ideal" family sizes during the Depression (and, to a lesser extent, during the baby boom). Racial caste, rather than class, set the fertility pattern of elite black baby bust women, but well-educated black and white baby boom women exhibited similar reproductive behavior.
- Despite marked educational and racial differences in parity distributions, total inequality in the distribution of births was due more to heterogeneity within groups than to differences between groups.

Considering the full parity distribution, and the distribution of children among women, may have advantages beyond providing a realistic description of cohorts' experience and insights into fertility change. Concentration analysis also raises new issues within population studies. An example is the question of relationships between fertility transition, the level of fertility, and the distribution of births among women. As shown above, a negative association between fertility level and fertility concentration is observable for baby bust and baby boom women, cohorts of ever-married U.S. women born

1821–1935, and among historical European and contemporary Third World populations. The tendency for more even distribution of children to accompany higher fertility is pronounced, but neither theoretically necessary nor empirically universal.

Other demographic consequences of the unequal distribution of children are easily imaginable. In population dynamics, it can be shown that fertility concentration (resulting in differences between mean parity and mean sibship), together with an orientation of daughters' fertility on their mothers' fertility, *ceteris paribus* tends to increase the level of fertility from one generation to the next.[29] In the extreme case, where all daughters have exactly the same number of daughters as their mothers, the population would soon explode, unless all mothers had the same number of children.

Further, the issue of inequality in the distribution of births links demographic phenomena to the broader issues of social stratification and cultural attitudes. Consider, for example, the relationship between reproductive concentration and economic inequality. The decision to postpone or forego the economic burden of childbearing by some baby bust women may have lessened the economic stresses of the Depression for individual women. But it was blacks and the poorly educated—who were most vulnerable to prolonged unemployment—that continued to bear large families during the 1930's. At the group level, then, the concentration of fertility exaggerated the economic inequalities and hardships of the Depression Era.

Concentration of reproduction may also be tied to social stratification in other ways. If fertility is concentrated within certain socio-economic strata, this implies not only differential growth rates for groups, but also a driving force for social mobility. If the proportion of high and low status jobs were fixed, then concentration of births—via higher fertility in the bottom strata—could produce continued upward mobility without corresponding downward mobility. Along with technological innovation, this mechanism may explain why more people have the subjective sense of climbing up the social scale than of falling down.

Another aspect of reproductive heterogeneity with even further reaching psychological and cultural consequences is the fact that the number of siblings children have is an important factor in their socialization. It may matter considerably, in terms of character, aspirations, and even health and development, whether a majority of children has no, one, or many brothers and sisters—alternatives that can exist even with the same "average American family size".

Notes

1. Use of the term "division of labor" to describe the distribution of births among women was coined by James Vaupel.

2. More formally, the source of data was *Census of Population and Housing: Public-Use Microdata Sample (A Sample)*, prepared by the Bureau of the Census, Washington: The Bureau (1983). The data are described in *Census of Population and Housing, 1980: Public-Use Microdata Samples Technical Documentation*, prepared by the Data User Services Division, Bureau of the Census, Washington: The Bureau (1983).

3. United States Census Data, *1900: Public Use Sample*; Census of Population, *1940: Public Use Microdata Sample.*

   The question about children ever born was one of a series of "sample questions" in the 1940 census, and was directed at a randomly selected household member within a sampled household. We analyzed data for only the subgroup of women who responded to these additional sample questions. With the use of appropriate sample and household weights, this subgroup comprises a nationally representative sample of all women enumerated in the 1940 census.

4. Births may be either underreported, if women "forget" to mention children who died in infancy or who have left home, or overreported, if adopted and stillborn children are incorrectly included. Further, selection bias may produce a biased picture of the whole cohort's fertility, if survivorship is correlated with unusually high or low fertility.

   Fortunately, some evidence suggests that the extent of these biases is not great for recent U.S. data. Kiser et al. compared the results from retrospective reports on parity for women aged 45–49 in the 1960 census to vital registration data. After adjustment for non-response, the average number of children ever born yielded by the census data was only three percent lower than the comparable figure from registered births. See Clyde V. Kiser, Wilson H. Grabill, and Arthur A. Campbell, *Trends and*

Variations in Fertility in the United States, Cambridge: Harvard University Press (1968), p. 306. Moreover, the estimated understatement of births from retrospective reports was considerably lower for the 1960 census (3 percent) than for the 1940 census (9 percent). See Pascal K. Whelpton, *Cohort Fertility: Native White Women in the United States*, Princeton: Princeton University Press (1954), p. 447. This suggests improvement over time due to increased survivorship and lower respondent error. If so, the 1980 data can be assumed more accurate than that for 1960 and thus subject to very little bias.

Those biases which do persist due to correlations between mortality and parity would tend to understate the proportion of childless and low-parity women in the older cohorts, since mortality is higher for nonmarried persons than for married persons, and higher for married persons without children than for married persons with children. See Francis E. Kobrin and Gerry E. Hendershot, "Do Family Ties Reduce Mortality? Evidence from the United States, 1966–1968", *Journal of Marriage and the Family* (1977), pp. 737–745. Such bias could lead to understatement of cohort differences in parity distributions and fertility concentration, but would not alter the main conclusions of this paper.

5. The same limitations characterize other summary measures of average fertility, such as the total fertility rate (the sum of age-specific fertility rates for a cohort or for all women of reproductive age at a given point in time).

6. See e.g. Shryock and Siegel, "The Methods and Materials of Demography", U.S. Bureau of the Census, Washington D.C. (1975). Some demographic studies of differential mortality have applied statistics related to concentration analysis, such as the index of dissimilarity. See, for example, Elsie Pamuk, "Social-Class Inequality in Mortality from 1921 to 1972 in England and Wales," *Population Studies* 39 (1985), pp. 17–31.

   For discussion of measures of concentration and examples of concentration analysis applied to animal populations, see Dianne Goodwin and James Vaupel, *Concentration Curves and Have-Statistics for Ecological Analysis of Diversity: Part I: Dominance and Evenness in Reproductive Success*, WP–85–72; *Part II: Species and Other Diversity*, WP–85–90; and *Part III: Comparison of Measures of Diversity*, WP–85–91, Laxenburg, Austria: International Institute for Applied Systems Analysis (1985).

7. For other examples of concentration analysis applied to human fertility, see James Vaupel and Dianne Goodwin, "A Division of Labor: The Concentration of Reproduction Among U.S. Women, 1917–1980," submitted to *Demography* as a research

note, 1986; Wolfgang Lutz and James Vaupel, "The Division of Labor for Society's Reproduction: On the Concentration of Childbearing and Rearing in Austria," *Österreichische Zeitschrift für Statistik und Information* **17** (1987), pp. 81–96; Wolfgang Lutz, *The Concentration of Reproduction: A Global Perspective*, WP–87–51, Laxenburg, Austria: International Institute for Applied Systems Analysis (1987); Wolfgang Lutz, "Birth Control and the Concentration of Fertility: A Study of Eleven European Countries", paper prepared for the European Population Conference, Jyväskylä, Finland, June 11–16, 1987.

8. See, for example, Judith Blake, "Are Babies Consumer Durables?", *Population Studies* **22** (1968), pp. 5–25.

9. Samuel H. Preston, "Children and the Elderly: Divergent Paths for America's Dependents," *Demography* **23** (1984), pp. 435–457; Lutz and Vaupel, "The Division of Labor for Society's Reproduction", *op.cit.* in FN 7.

10. U.S. Department of Commerce, Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*, Part I, pp. 50–53, Washington, D.C.: Government Printing Office (1975).

11. Norman B. Ryder, *The Cohort Approach: Essays in the Measurement of Temporal Variations in Demographic Behavior*, Ayer Company Publishers (1980). Classic examples of the cohort perspective on U.S. fertility include Kiser, Grabill, and Campbell; and Whelpton, *op. cit.* in FN 4. More recently, some demographers have tried to estimate the separate effects of age, period, and cohort in twentieth-century U.S. fertility. See Thomas W. Pullum, "Separating Age, Period, and Cohort Effects in White U.S. Fertility, 1920–1970", *Social Science Research* **9** (1980), pp. 225–244; Larry Isaac, Phillips Cutright, and Elton Jackson, "Period Effects of Race- and Parity-Specific Birth Probabilities of American Women, 1917–1976: A New Measure of Fertility", *Social Science Research* **11** (1982), pp. 176–200; and N. Namboori, "On Factors Affecting Fertility at Different Stages in the Reproduction History: An Exercise in Cohort Analysis", *Social Forces* **59** (1981), pp. 1114–1129.

12. Norman Ryder, "The Emergence of a Modern Fertility Pattern: United States, 1917–1966," in *Fertility and Family Planning*, edited by S.J. Behrman, L. Corsa, Jr., and R. Freedman, Ann Arbor: University of Michigan Press (1969), pp. 94–126; Norman B. Ryder and Charles F. Westoff, *Reproduction in the United States: 1965*, Princeton: Princeton University Press (1971).

13. See, for example, Glen Elder, *Children in the Great Depression*, Chicago: University of Chicago Press (1974).

14. Samuel H. Preston, "Family Sizes of Children and Family Sizes of Women", *Demography* **13** (1976), pp. 105–114. More formally, Preston shows that

$$\bar{c} = \frac{\sigma_x^2}{\bar{x}} + \bar{x}$$

where $\bar{c}$ equals average family size for children

$\bar{x}$ equals average family size for women

and δ_x^2 is the variance of the distribution of family sizes among women.

15. For a description of the methods for calculating concentration curves and associated statistics (index of dissimilarity and Gini coefficient), see H.S. Shryock, J.S. Siegal, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, U.S. Govt. Printing Office (1973). See also: W. Piesch, *Statistische Konzentrationsmasse*, Tübingen (1975) and P.D. Allison, "Measures of Inequality", *American Sociological Review* **43** (1979), pp. 865–880.

16. For discussion of the properties of the .5 fractile and other measures of inequality, see Goodwin and Vaupel, *Comparison of Measures of Diversity, op.cit.* in FN 6.

17. Norman Ryder, "The Cohort as a Concept in the Study of Social Change", *American Sociological Review* **30** (1965), p. 845.

18. Ibid.

19. Other background variables could, of course, have been included. The covariates analyzed were chosen on the basis of three criteria. First, the variables included have been associated with differential reproductive performance in other populations, either in Europe and the United States historically, or in contemporary Third World populations. Second, we excluded theoretically interesting variables for which age effects would confound comparisons between cohorts. For example, husband's occupation and family income were excluded because the values of these variables would be likely to change after the end of the woman's reproductive span, and to change especially sharply for women over 60, whose husbands had generally retired from work. Third, because this study represents part of a larger research project analyzing parity distributions for cohorts born between 1821 and 1935, we limited the analysis to variables which can be easily compared across censuses and over time.

20. Racial comparisons are here limited to differences between blacks and whites (with respondents who identified their race as Spanish origin included with whites, according to the practice followed in U.S. censuses prior to 1980). The composition of the population falling into a third "other races" category was too diverse to be grouped together and sample size for the other categories was too small to support separate analysis.

21. Among white women born 1926–1930, the proportion of women who had a first birth was .88; the proportion of those with a first birth who had a second was .87; the proportion of those with a second birth who had a third was .69; the proportion of those with a third birth who had a fourth was .59; and the proportion of those with a fourth birth who had a fifth was .53. The figures for blacks show no such drop-off in the probability of having another child with rising birth order. The comparable parity progression ratios for black women in the same cohort ranged between .84 and .79.

    The difference in parity progression ratios for white and black women born 1906–1910 is also considerable. Seventy-six percent of white women in this cohort who had a first birth also had a second, but only 58 percent of those with two births had a third. A smaller proportion of black women with a first birth had a second (70 percent), but at higher birth orders the probability of having another child actually rose for blacks. Seventy-three percent of black women with two births had a third, and 78 percent of those with a third birth had a fourth child.

22. It was not possible to divide the women exactly into quartiles according to education because the dividing line between schooling levels occurs in one-year steps (i.e., education is not a continuous variable) and because school-leaving tended to be clustered at particular points (e.g., after the eighth and twelfth grades). The "low" education category did include about 25 percent of each cohort. The proportion of women in the "high" (college-educated) category ranged from 15 percent in the oldest cohort to 25 percent in the youngest cohort.

23. A woman's education is an imperfect indicator of her social class, more directly linked to her father's social class than to her own status during childbearing. Nonetheless, husbands' and wives' education is quite strongly correlated, and both men's and women's incomes tend to rise with education, so there is some basis for equating class and women's education. As noted above (FN 19), other indices of social class such as family income and husband's occupation had more serious drawbacks.

24. Theil's basic index of equality, $H(y)$, is termed "entropy". Entropy is defined as the sum of the products of two factors: $y(i)$, the relative contribution of category i to total output (e.g., the proportion of all births that are first births), and the log of the inverse of $y(i)$.

$$H(y) = \sum_{i=1}^{\sim} y(i) \log \frac{1}{y(i)}$$

In the case of complete equality, the entropy has a maximum value of log (N), with N being the number of categories (e.g., the number of parity statuses). In the case of maximum inequality, $H(y)$ equals 0. Conversely, subtracting the entropy from its maximum value of log (N) yields a measure of inequality, with a scale from zero (complete equality) to log (N) (maximum concentration).

The following formula decomposes this index into within-group and between-group components:

$$\log N - H(y) = \sum_{i=1}^{N} y_i \log \frac{y_i}{1/N} =$$

$$\sum_{g=1}^{G} Y_g \log \frac{Y_g}{N_g/N} + \sum_{g=1}^{G} Y_g \left[\sum_{i \in S_g} \frac{y_i}{Y_g} \log \frac{y_i/Y_g}{1/N_g} \right]$$

where: G equals the number of subgroups (e.g. races),
$Y(g)$ equals the share of total output contributed by group g (e.g., the share of all children born to black women),
and $N(g)$ equals the number of contributors in group g (e.g., the number of black women).

The left-hand side of this formula is simply the measure of overall inequality, log (N) minus entropy. The first term of the right-hand side measures between-group inequality; the second term is a weighted average of within-group inequalities, with $Y(g)$, the shares of total output contributed by group g, as the weights.

For further discussion of Theil's measure, see Henri Theil, *Economics and Information Theory*, Amsterdam: North-Holland (1967). The authors are grateful to Evert van Imhoff for suggesting the use of this measure.

25. Part of the explanation for the slight explanatory power of between-race inequality also lies in the fact that blacks comprised only about 10 percent of the female population, which limited the extent to which their distinct reproductive pattern

influenced the total fertility distribution.

26. This relationship also holds when the population is broken down by education and place of residence. The regression lines for the total and the urban and rural subpopulation are almost parallel (see Lutz "The Concentration of Reproduction", *op.cit.* in FN 7).

27. For the marriage cohorts of 1900–1924 data comes from the German census of 1938 and covers the total area (including Austria) of the "Reich" at that time. For the cohorts marrying 1935–1960 data refers to Austria only. For a more detailed analysis of these data see Lutz and Vaupel, "The Division of Labor ...", *op.cit.* in FN 7.

28. Wolfgang Lutz, "Research Note: On the Concentration of Childbearing in China," *Population and Development Review* (forthcoming).

29. An IIASA Working Paper by Pullum, Lutz, and Wolf on this topic is forthcoming.

Appendix

Table A–1.

Cohort born	Mean complete parity	Mean sibship size	.5 fractile	Prop. child-less	Prop. 1 child	Prop. 2 children	Prop. 3 children	Prop. 4+ children
1821–1825	5.50	8.02	.26	.051	.141	.058	.094	.656
1826–1830	5.10	7.87	.25	.096	.149	.068	.079	.608
1831–1835	5.11	7.69	.26	.087	.101	.110	.098	.605
1836–1840	5.29	8.05	.25	.094	.104	.098	.078	.626
1841–1845	5.30	7.78	.26	.095	.081	.088	.097	.640
1846–1850	5.11	7.76	.25	.088	.103	.107	.102	.600
1851–1855	5.19	7.77	.26	.092	.094	.087	.103	.623
1861–1865	3.77	6.56	.22	.112	.136	.175	.136	.441
1866–1870	4.06	7.16	.22	.132	.111	.129	.181	.447
1871–1875	3.54	6.10	.22	.166	.109	.168	.144	.414
1876–1880	3.46	6.19	.21	.157	.142	.167	.142	.393
1881–1885	3.16	5.68	.21	.162	.184	.156	.135	.363
1886–1890	3.03	5.53	.21	.162	.163	.193	.151	.331
1891–1895	2.83	5.04	.22	.150	.167	.226	.153	.303
1901–1905	2.53	4.79	.22	.191	.193	.225	.146	.245
1906–1910	2.40	4.48	.21	.194	.184	.251	.149	.222
1911–1915	2.37	4.27	.21	.185	.192	.246	.162	.216
1916–1920	2.61	4.29	.24	.142	.163	.253	.185	.257
1921–1925	2.85	4.45	.25	.109	.139	.262	.198	.292
1926–1930	3.11	4.62	.27	.085	.115	.237	.218	.345
1931–1935	3.21	4.55	.28	.079	.096	.221	.231	.373

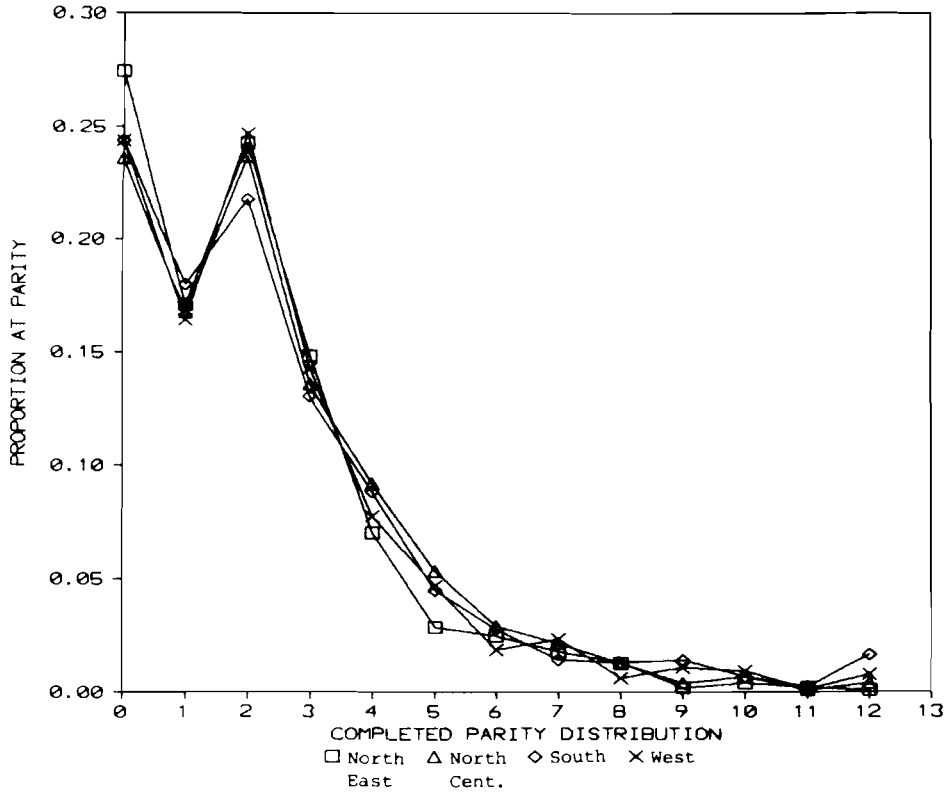


Figure A–1. **Parity distributions by regions for cohort aged 70–74 in 1980.**

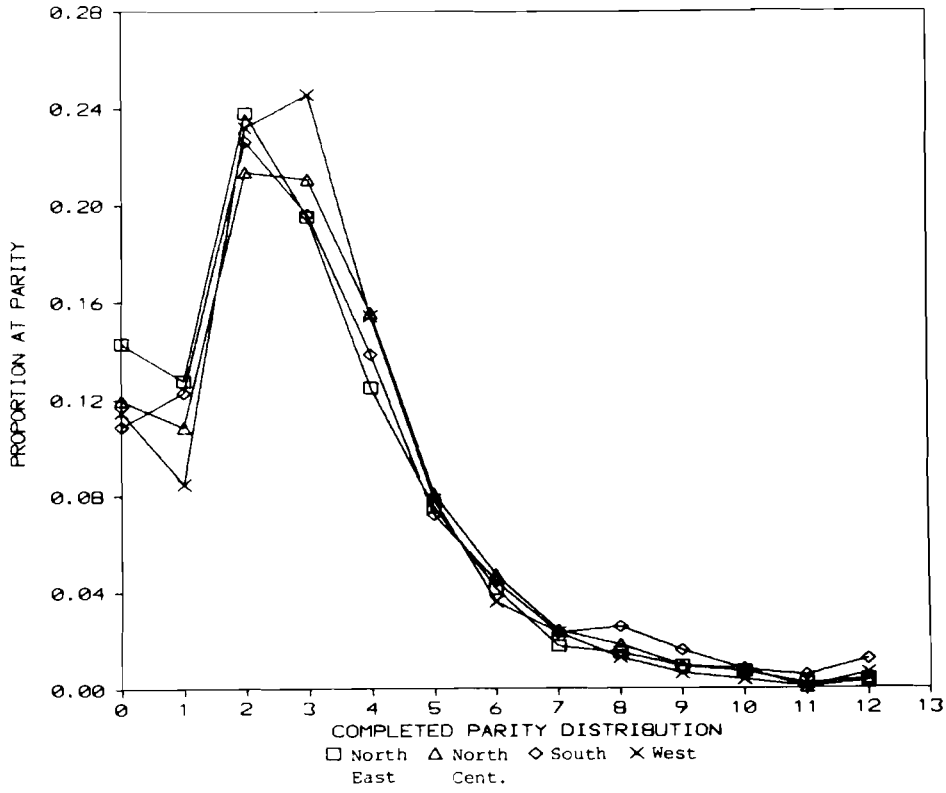


Figure A–2. **Parity distributions by regions for cohort aged 50–54 in 1980.**

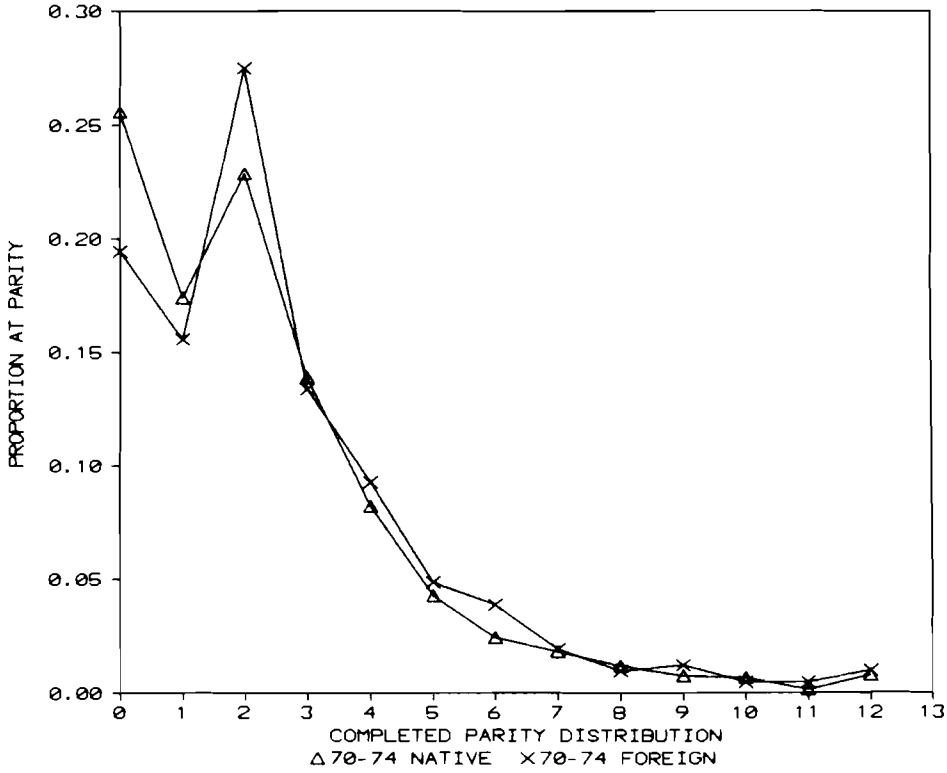


Figure A–3. Parity distribution by immigration status: cohort aged 70–74 in 1980.

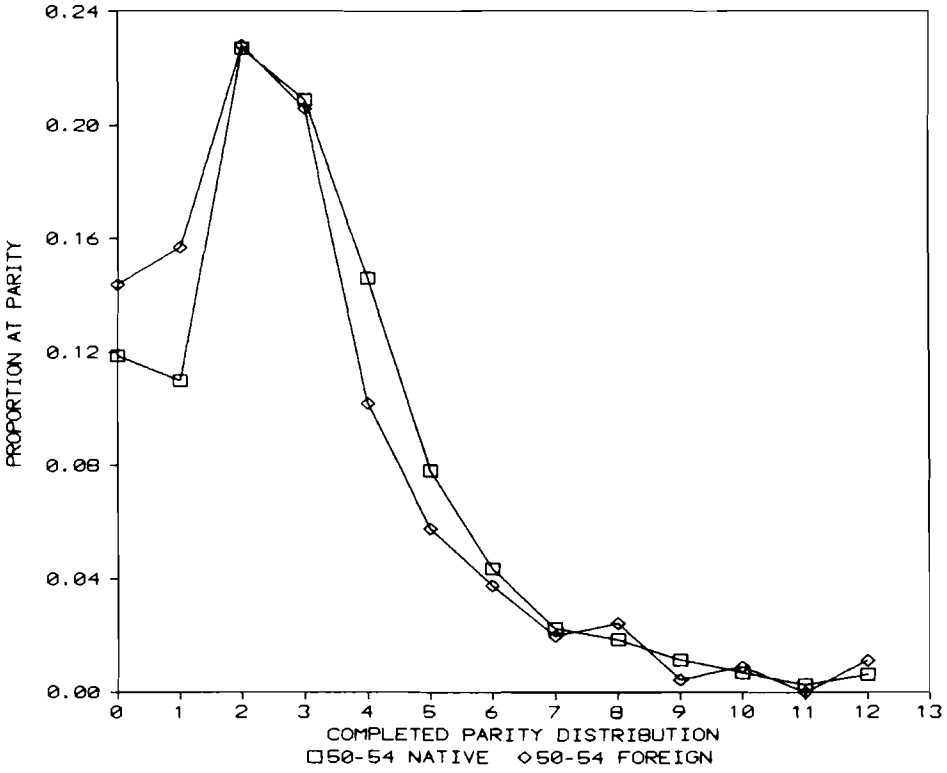


Figure A–4. Parity distribution by immigration status: cohort aged 50–54 in 1980.

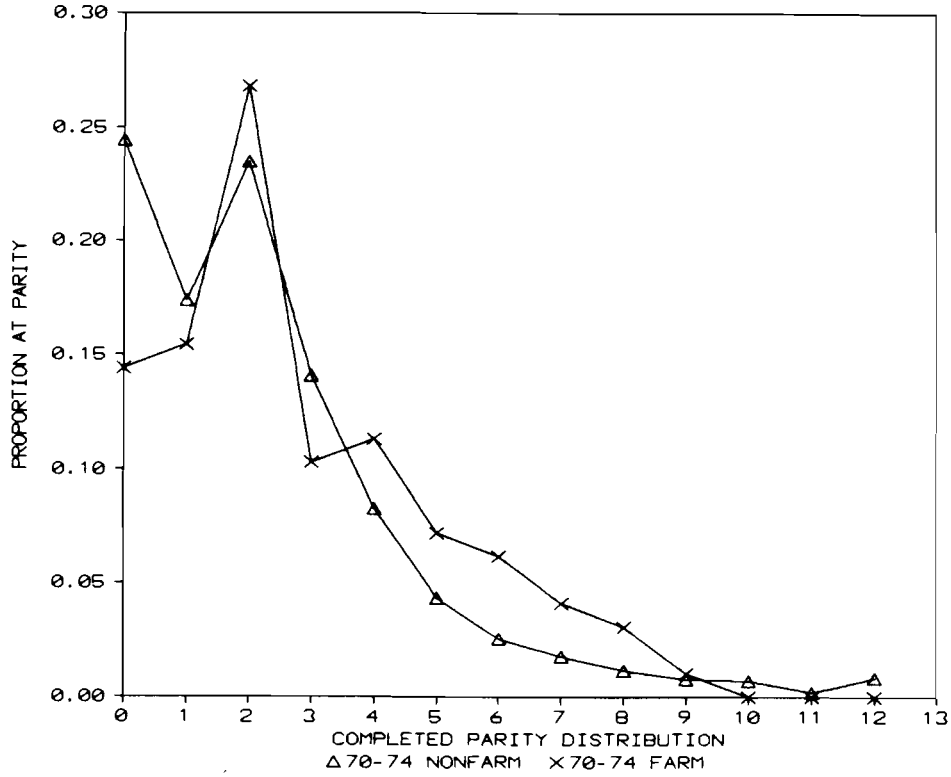


Figure A–5. **Parity distributions for farm and non-farm women aged 70–74 in 1980.**

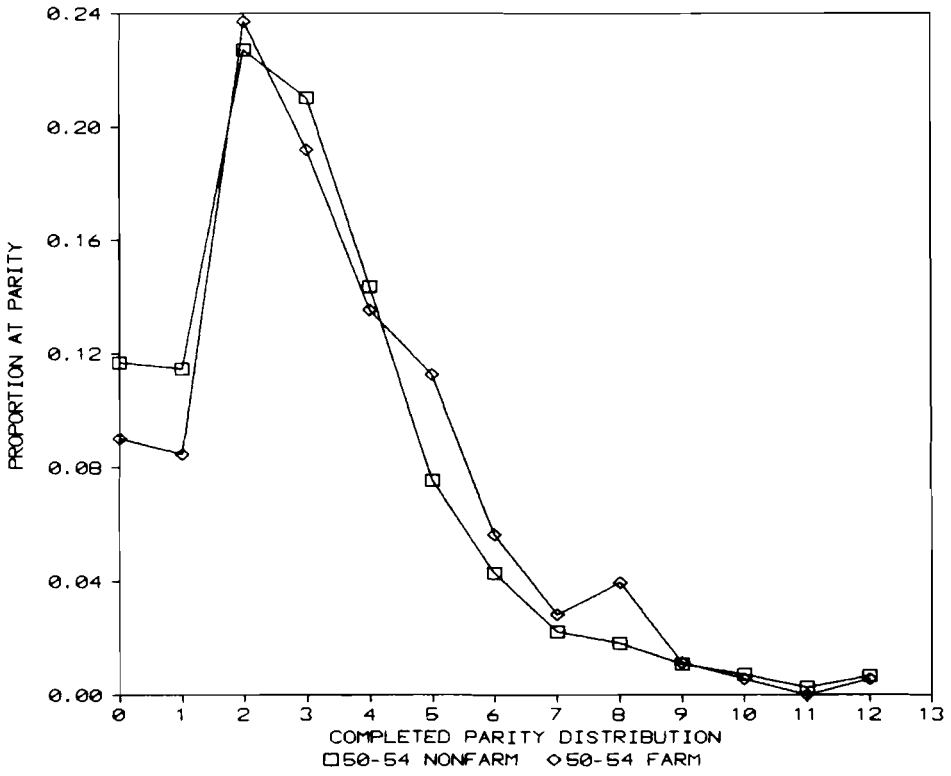


Figure A–6. **Parity distributions for farm and non-farm women aged 50–54 in 1980.**

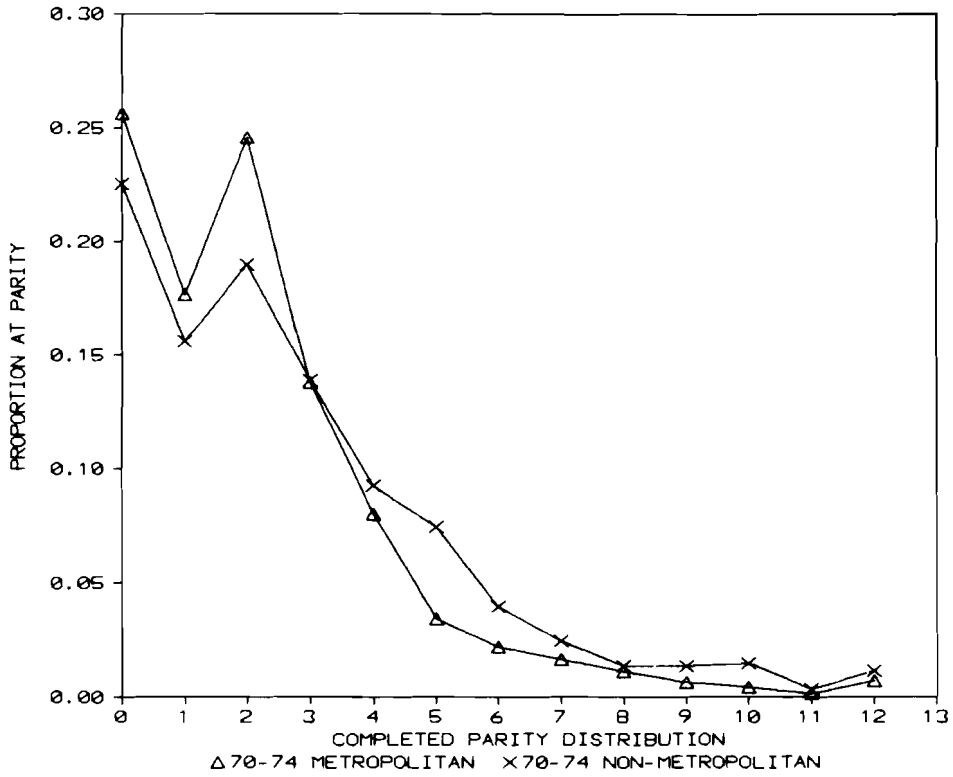


Figure A–7. Parity distributions for metropolitan and non-metropolitan women aged 70–74 in 1980.

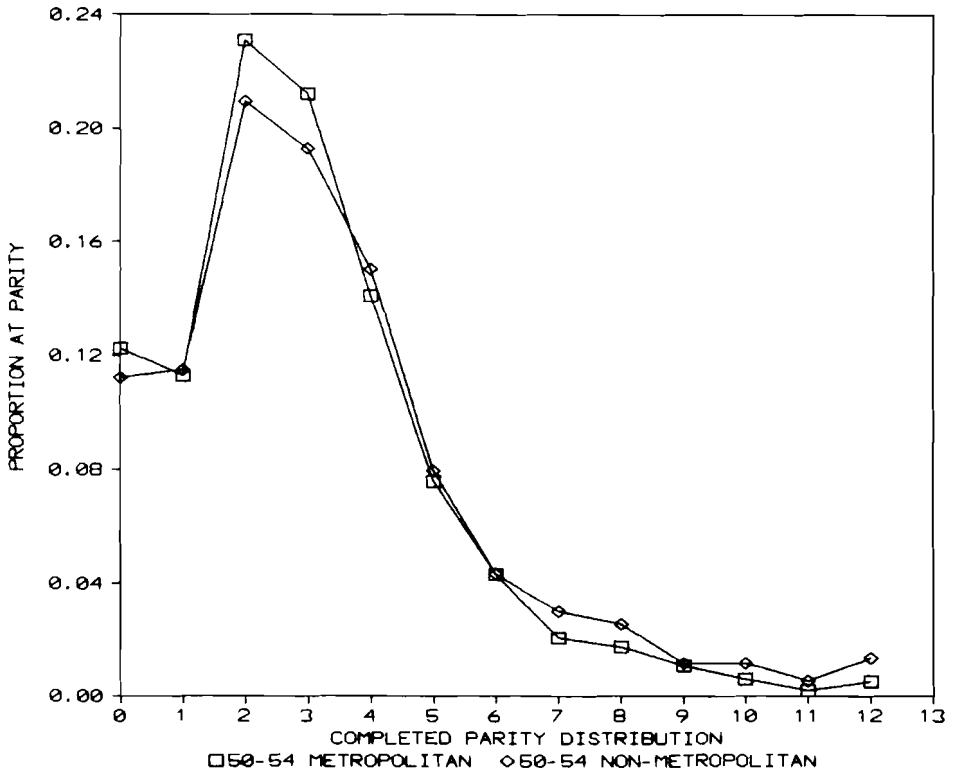


Figure A–8. Parity distributions for metropolitan and non-metropolitan women aged 50–54 in 1980.

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