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On the Concentration of Childbearing in China, 1955-1981

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Foreword

Analysis of heterogeneous population dynamics has been a prominent theme in IIASA's Population Program in recent years. Heterogeneity in reproductive behavior, a phenomenon with numerous consequences with such diverse aspects as kinship patterns, socialization, household composition and care for the elderly, has received particular attention. Past research has shown that as fertility levels fall, the concentration (or relative variance) of childbearing rises. In this note Wolfgang Lutz documents an apparent exception: the case of China during the years 1955–1981. Heterogeneity is a feature of Chinese fertility, but to a lesser extent than in most other countries to which comparisons can be made.

Douglas A. Wolf
Deputy Leader
Population Program

Abstract

Based on period parity progression ratios derived from the one-per-thousand fertility survey by Feeney and Yu (1987) completed parity distributions implied by period fertility are calculated for the years 1959–1981. Concentration analysis of these distributions using Lorenz curves and the .5 fractile ("Havehalf") as a concentration coefficient shows that the proportion of women that had half the children was almost invariant over time (around 33%–35%) despite the dramatic fertility decline since the mid 1960s. This is in sharp contrast to a great number of other countries where the fertility transition has been accompanied by sharply increasing concentration. The very egalitarian way in which fertility declined in the Chinese population seems to be a unique case in world history.

Acknowledgement

The author has benefited from earlier discussions on concentration analysis in human reproduction with James Vaupel and Dianne Goodwin and from comments on the manuscript by Douglas Wolf, Nathan Keyfitz, and Babette Wils.

On the Concentration of Childbearing in China, 1955–1981

Wolfgang Lutz

1. Concentration Analysis

A population's fertility pattern and its change over time have traditionally been described in terms of the completed parity distribution's first moment: the mean family size of real or synthetic cohorts. But this disregards many important aspects of the distribution of reproduction in society. Whether, at a given level of fertility, all women have the same number of children, or a few women have many children while a high proportion remains childless, has far reaching consequences. Various important aspects of individual and social life are affected by the distribution of fertility: from family welfare and the kind of housing demanded to such issues as family support for the elderly. Also the number of siblings a child grows up with may have psychological effects on his individual socialisation, making this question relevant to other areas outside of demography.

There are a number of indicators for the distribution and concentration of fertility. One of them is the difference between the mean family size per woman and the mean number of siblings including the child (mean sibship size) per child (see Goodman, Keyfitz, and Pullum 1975, and Preston 1976). It can be shown formally that the difference between women's mean parity and mean sibship size is a function of the variance of the distribution. Because some women remain childless and children are unevenly distributed among mothers, mean sibship size in every real population is greater than the mean family size. Only in the case of an even distribution of children over all mothers, i.e. every woman having the same number of children, will the two means be identical because the variance is zero.

Another indicator of the distributional aspects of reproduction is the proportion of women accounting for a certain proportion of children in the population. This leads us to concentration analysis, an approach widely used in economics and the bio-sciences but still very rare in demography. It is common to describe the concentration of "output units" (children) with respect to "producing units" (women) with the Lorenz Curve. In our case (see Figure 1) the x-axis refers to the cumulated proportion of women, beginning with the most fertile on the left, while on the y-axis we plot the cumulated proportion of children born by the corresponding groups of women. If all women had an identical number of children (be it one or six), the increments on the y-axis would be identical to the increments on the x-axis and the Lorenz curve would be the diagonal. The farther the curve lies from the diagonal the higher the concentration of the distribution.

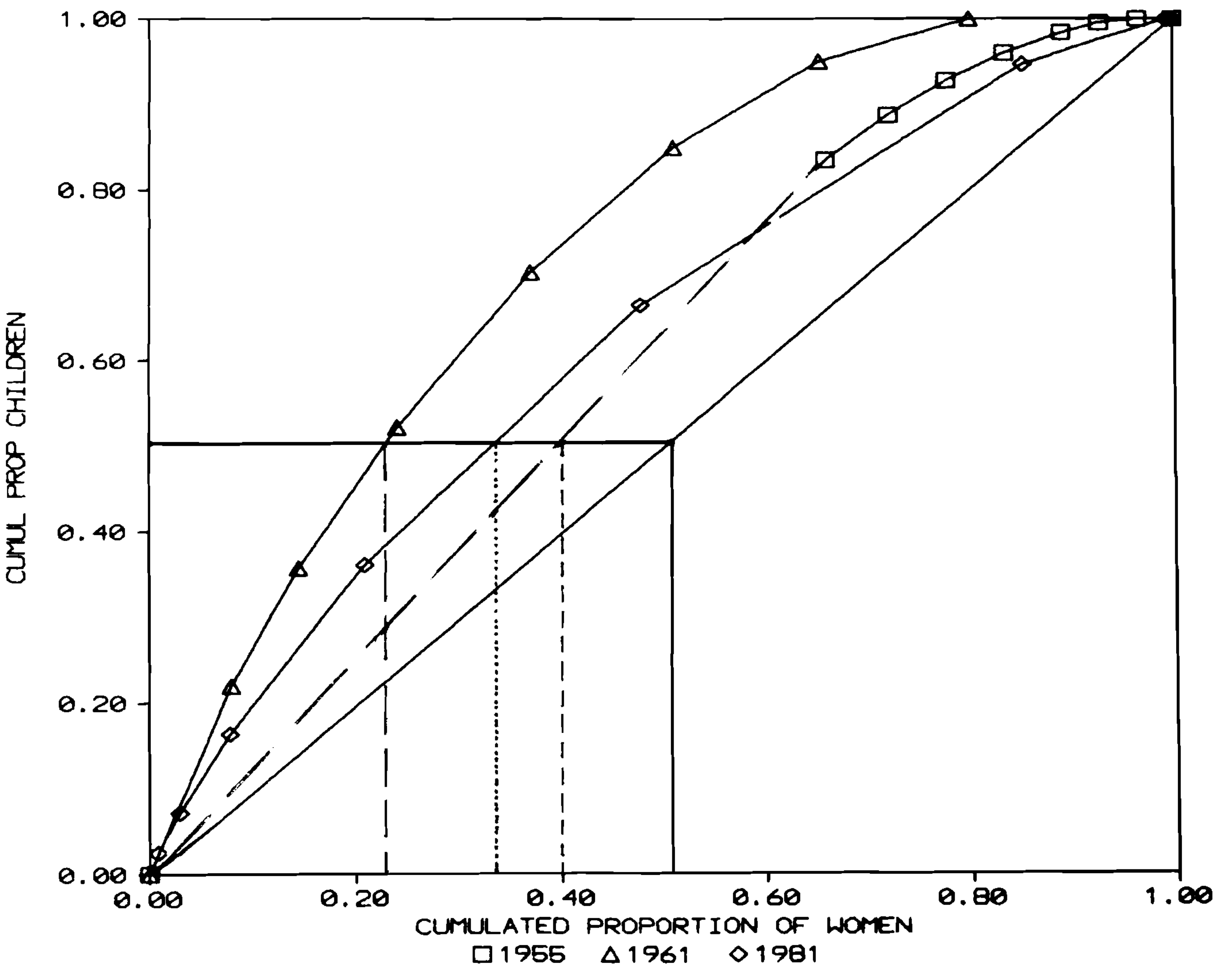

Figure 1. Lorenz curves for the concentration of fertility in China 1955, 1961, and 1981.

Although the Lorenz curve gives the most complete picture of concentration and makes it easy to see which of two populations is more highly concentrated, researchers have often looked for a single quantitative indicator of the extent of concentration. The best known indicator is probably the Gini coefficient, which refers to the size of the area between the concentration curve and the diagonal. It is, however, rather difficult to interpret. A more intuitive, straightforward measure is the fractile. The fractiles tell us what proportion of all women have 100%, 50%, 25%, etc. of all children. The disadvantage of fractiles is that they do not give the full information presented by the Lorenz curve. Especially fractiles that are close to one end of the curve tend to characterize the specific shape of the curve around that area rather than the overall concentration. The .5 fractile seems more preferable because it describes the deviation from the diagonal around the middle of the curve. It indicates the proportion of all women who have half of all children. A higher .5 fractile means lower concentration and vice versa. Vaupel and Goodwin (1986) also call the .5 fractile the "havehalf". In the following study this measure will be used as the quantitative indicator of concentration.

2. Concentration Implied by Chinese Period Parity Progression Ratios, 1955–1981

Feeney and Yu (1987) recently presented estimates for period parity progression ratios for China as a whole and for urban and rural areas for the period 1955–1981, based on the National One-per-Thousand Fertility Survey. The method used for estimating period parity progression ratios is based on earlier work by Feeney (1983) and shall not be discussed here.[1] We also do not want to repeat the analysis of period fertility fluctuations in China between 1955 and 1981. This research note wants to build on the given information, highlighting one aspect not mentioned by Feeney and Yu. We will also show that the Chinese trends, with respect to concentration of fertility, are quite distinct from most other countries in the world.

For each year completed parity distributions implied by the given period parity progression ratios $p(i)$, (i referring to parity) were calculated by successively applying the ratios to a radix of 1000 women, $l(0)$, starting the process of reproduction at parity zero.[2]

[1] The parity progression ratios given by Feeney and Yu (1987) seem to refer only to married women. But since marriage is almost universal (progression to first marriage is between 0.98 and 0.99 over most of the period) this need not be of much concern and we may speak of total fertility instead of marital fertility.

[2] The notation used here comes from the model of a life table approach to parity progression where age is replaced by parity as the indexing variable (see Chiang and van den Berg (1982) and Lutz and Feichtinger (1985)).

The proportion of women who drop out of the process of reproduction at parity i, $d(i)$, and hence have completed parity i is calculated by

$$d(i) = l(i)(1 - p(i)) \quad \text{where}$$

$$l(i) = l(i-1)p(i-1).$$

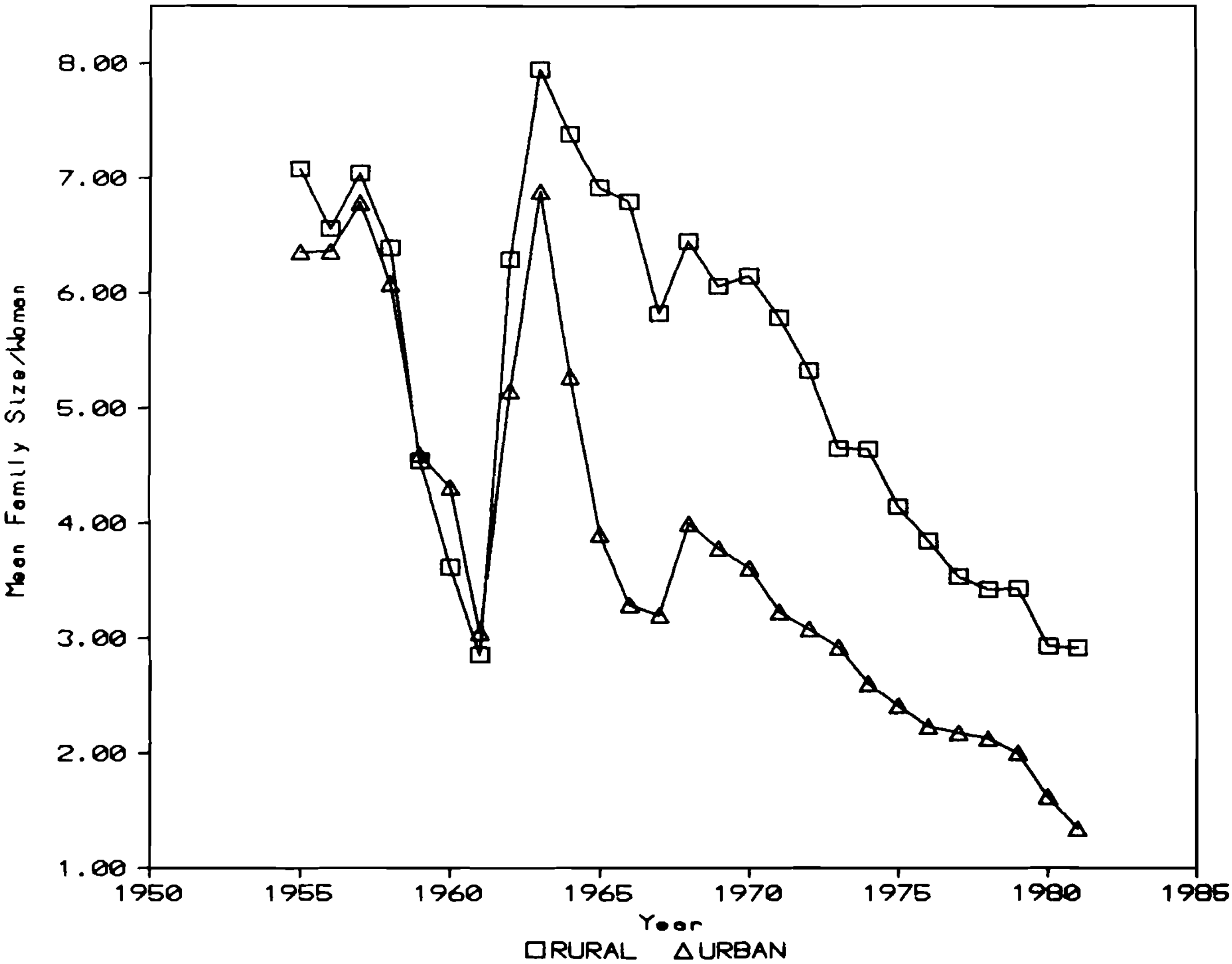

Figure 2. Trends in the mean family size per woman for urban and rural China, 1955–1981.

Figure 2 gives the mean family sizes of women, calculated as a weighted average of the completed parity distributions. These averages are comparable to the total fertility rates calculated from age-specific rates: both give the mean number of children of a synthetic cohort based on period observations. The mean family sizes calculated by completed parity distributions are not exact in considering births of orders 8 and above.[3] The time series of total fertility rates and mean family sizes under a parity-specific approach cannot be expected to be identical because one approach considers the age distribution of the population while the other is based on the parity distribution. But since age and parity are highly correlated the empirical findings should not be too different.

Feeney and Yu (1987) mention two significant empirical differences between the time series of TFR's and the series of mean family sizes based on a parity-specific view: the total fertility rate is higher than the mean family size during the late 1960s and lower during the 1970s; secondly the age-specific approach implies a reversal of the long fertility decline shortly before the survey, i.e. an increase from 2.24 in 1980 to 2.63 in 1981, whereas the parity-specific approach indicates a further, although somewhat slower, decline. Which indicator should we believe? In a country where fertility is controlled in dependence on parity (such as in China) the parity-specific approach is less sensitive to period fluctuations in the timing of births (e.g. women delaying first births for some reason) and hence can be expected to give a more stable picture of cohort behavior. The completed parity distributions implied by period fertility in 1980 and 1981 show that the relatively modest decline in mean family size was the result of two counteracting trends: the proportions of women with expected parities of two or more consistently decreased, but at the same time the expected proportion of childless women also decreased; only the proportions of women expected to have one child saw significant increases. Hence the fertility results for 1981 do not necessarily mean a failure of recent birth control policies, but the parity-specific findings indicate that more women than ever before tend towards the one-child family. Figure 2 shows the mean family size as seen by the parity-specific approach for urban and rural areas separately. We see an initial fertility decline between 1957 and 1961, and a second, larger decline, after 1963.

Figure 3 plots the trends in the .5 fractile or "havehalf", from 1955 to 1981 for rural and urban areas. Although the level of fertility has been substantially higher in rural areas than in the cities of China since 1963, the extent of concentration in the distribution of period completed parity distributions has not differed much. Generally, about 35 per-

[3]Since the parity progression ratios given by Feeney and Yu (1987) ended at parity eight, one must make adjustments for higher order births. In this paper it is assumed that women with eight or more births have, on the average, nine births.

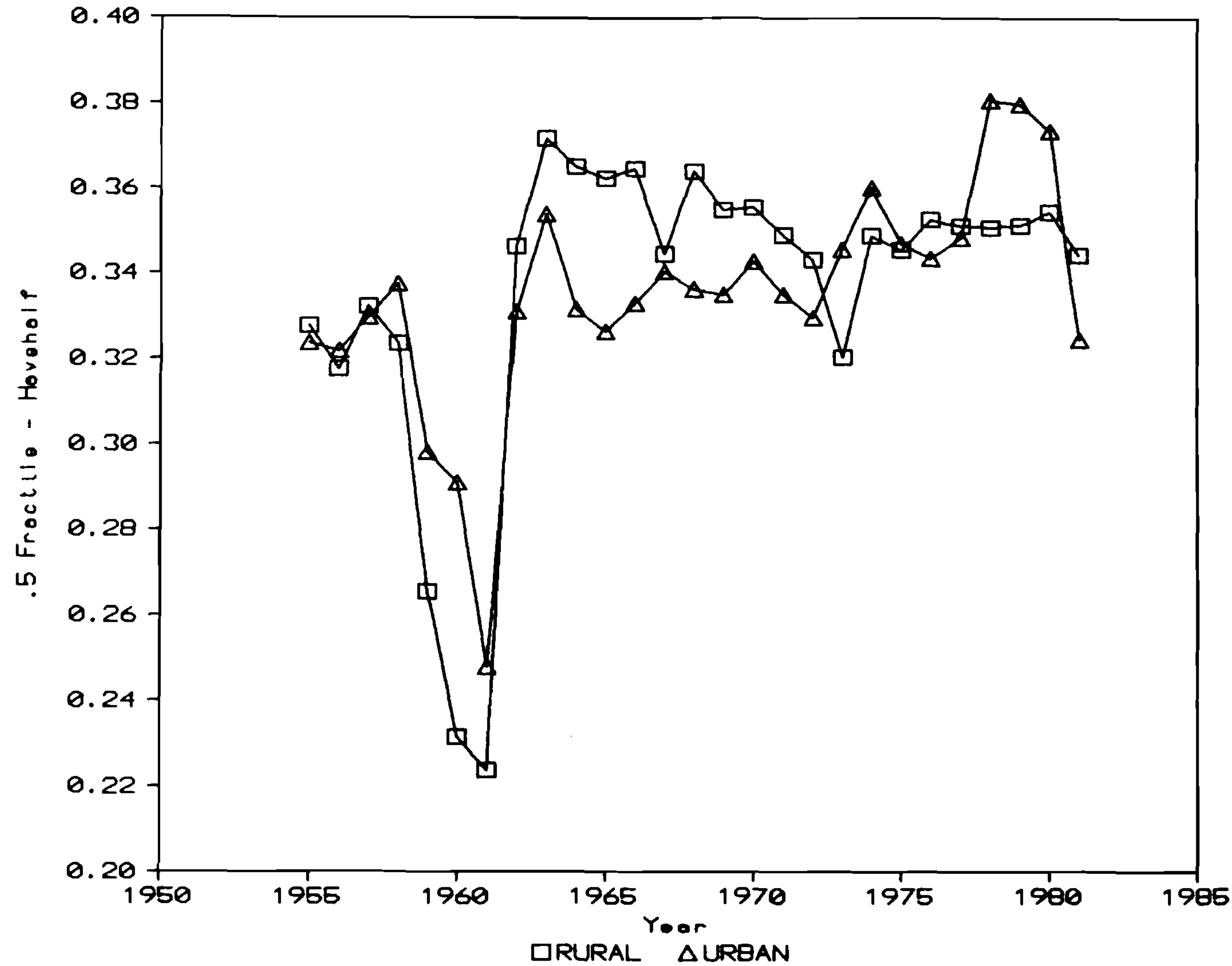

Figure 3. Trends in the concentration of fertility for urban and rural China, 1955–1981.

cent of all women have had half the children since 1961. This percentage is much higher, i.e. the concentration is much lower, than in most other countries with controlled fertility. In industrialized countries with total fertility rates between 2.0 and 3.0 usually 22% to 26% of all women have half the children (see Vaupel and Goodwin 1986, Lutz 1987).

Table 1 and Figure 3 also indicate that the fertility declines China experienced between 1957 and 1961, and that since 1963 are of very different nature. An analysis of the period parity progression ratios, not shown here, indicates that the first decline, which led to a minimum of 2.88 children per mother in 1961, was highly selective and did not

Table 1. Mean family sizes and concentration of fertility in China, 1955–1981.

	Total			Rural			Urban		
Year	Mean/ Woman	Mean/ Child	Havehalf	Mean/ Woman	Mean/ Child	Havehalf	Mean/ Woman	Mean/ Child	Havehalf
1955	6.99	8.14	0.33	7.08	8.19	0.33	6.36	7.70	0.32
1956	6.53	7.92	0.32	6.56	7.94	0.32	6.36	7.74	0.32
1957	7.02	8.08	0.33	7.04	8.11	0.33	6.79	7.89	0.33
1958	6.35	7.65	0.33	6.39	7.71	0.32	6.09	7.29	0.34
1959	4.57	6.54	0.27	4.55	6.62	0.27	4.60	6.10	0.30
1960	3.77	5.94	0.24	3.62	5.94	0.23	4.31	5.80	0.29
1961	2.88	4.86	0.23	2.86	4.88	0.22	3.05	4.74	0.25
1962	6.12	7.19	0.34	6.30	7.34	0.35	5.16	6.24	0.33
1963	7.83	8.27	0.37	7.95	8.34	0.37	6.89	7.77	0.35
1964	7.13	7.88	0.36	7.38	8.02	0.36	5.28	6.32	0.33
1965	6.37	7.33	0.35	6.92	7.72	0.36	3.91	4.77	0.33
1966	6.11	7.07	0.35	6.80	7.57	0.36	3.29	4.05	0.33
1967	5.20	6.30	0.35	5.83	6.84	0.34	3.20	3.83	0.34
1968	5.95	6.86	0.35	6.45	7.24	0.36	4.00	4.77	0.34
1969	5.64	6.62	0.34	6.06	6.94	0.35	3.79	4.59	0.34
1970	5.72	6.71	0.34	6.15	7.04	0.36	3.61	4.33	0.34
1971	5.36	6.39	0.34	5.79	6.72	0.35	3.23	3.90	0.34
1972	4.93	5.97	0.33	5.33	6.29	0.34	3.09	3.73	0.33
1973	4.57	5.55	0.33	4.66	5.80	0.32	2.93	3.45	0.35
1974	4.28	5.10	0.34	4.65	5.43	0.35	2.61	3.03	0.36
1975	3.83	4.59	0.34	4.15	4.88	0.35	2.41	2.84	0.35
1976	3.55	4.23	0.34	3.85	4.49	0.35	2.23	2.63	0.34
1977	3.29	3.92	0.34	3.53	4.14	0.35	2.17	2.55	0.35
1978	3.21	3.79	0.34	3.43	3.99	0.35	2.12	2.42	0.38
1979	3.22	3.81	0.34	3.43	4.00	0.35	2.00	2.31	0.38
1980	2.72	3.23	0.35	2.93	3.41	0.35	1.62	1.89	0.37
1981	2.66	3.25	0.33	2.92	3.47	0.34	1.62	1.89	0.37

affect all women. The decline was largely caused by an increase in women expected to remain childless. The period parity progression ratios of 1961 imply that 20% of the women would remain childless under the observed rates, whereas other portions of the female population would still have rather high fertility. As a consequence of this uneveness the concentration of reproduction increased rapidly. In 1962 the .5 fractile jumped back up to 0.34. By 1980 and 1981 the overall level of fertility was lower than in 1961 but concentration had not increased. This means that the relative variation in the distribution remained almost stable, and that the fertility decline affected practically all Chinese women and not only certain segments of the population as before 1961 and as it is usually observed in less developed countries (see next section).

A consequence of the stable level of concentration is that the mean sibship, i.e. the mean family size from the child's perspective, declined even more strongly than the mean from the women's perspective, from 8.27 in 1963 to 3.25 in 1981. Contrarily, during the extraordinary fertility decline of 1959–1961 the mean from the children's perspective declined less than from the women's perspective because of simultaneously increasing concentration. By 1981 the mean family size from the children's perspective had declined to the very low value of 1.89 in the cities of China. This is probably the lowest value of mean sibship size of any sizable population in the whole world including the very low fertility cities of Western Germany. The reason for this is that even in a modern industrialized city where the total fertility rate might be lower than in Chinese cities, the mean family size from the children's perspective is greater because of higher concentration: this is mainly a consequence of high proportions of women expected to remain childless (generally more than 30%) in European cities. In sharp contrast to this the parity-specific fertility pattern of urban China in 1981 implies that only 1.4% of all women remain childless.

2. A View to Other Countries

Time series of completed parity distributions implied by period parity-specific fertility are hardly available for comparative purposes. For the United States such data exist (Heuser 1976) and show that the fertility decline between 1917 and 1933 was associated with increased concentration peaking in a "havehalf" of less than 16% in 1933 (Vaupel and Goodwin 1986). Subsequent increases in fertility brought concentration down again and it was lowest during the time of the baby boom but never surpassed a "havehalf" of 28%. Analysis of completed parity distributions for consecutive birth cohorts based on the series of public use samples of US censuses (King and Lutz 1988) shows a similar pattern of decreasing concentration during the baby boom. Since 1970 concentration has generally been increasing again in the US.

In some European countries surveys asking for birth histories enable the calculation of cohort trends in concentration and fertility. These trends are similar to the period trends in the US. Many European countries (see Lutz 1987) show an increase in concentration during the fertility declines in the first half of this century; the post World War II baby boom was generally associated with decreasing concentration, but, as in the US, the "havehalf" hardly exceeded 28%. Recent fertility declines are again associated with increasing concentration partly because of increasing proportions of childless women.

On a global scale no data on real time trends are available. However, it might be useful to see the Chinese experience within the framework of a cross-section of countries at different stages of demographic transition. The World Fertility Survey covers 41 less developed countries and provides such an opportunity. The mean family sizes from women's perspective, and the concentration coefficients (.5 fractiles) are calculated using completed parity distributions. The cohorts are ever-married women aged 40–49 at the time of the survey living in urban or rural areas in most of the 41 countries (source: Lutz 1985). The urban and rural populations of those countries are located in the two-dimensional space given by the level of fertility and the concentration coefficient. Figure 4 shows the association between the average level of fertility and concentration for urban and rural populations in the cross-section of WFS countries.

In the group of less developed countries that are at different stages of their demographic transition the association between concentration and fertility is clearly negative: the lower the level of fertility the higher the concentration in the distribution of children. This holds for urban populations and rural populations independently: the regression lines for the two sets of subpopulations run almost exactly parallel. The same kind of association holds also within individual countries: urban fertility is mostly lower and more highly concentrated than rural fertility.

When the Chinese experience of 1955–1981 is superimposed on this pattern[4] (the "+" symbols in Figure 4) we see that, until a level of fertility around 5–6 (around 1970), China follows the general pattern. At lower fertility China deviates from it. The Chinese experience of the late 1950s fits well into the pattern of rural high fertility societies. Even the very steep fertility decline of 1959–1961 (the "+"s in the lower left corner) which was associated with highly increased concentration followed the cross-sectional pattern of countries that had entered their secular fertility declines. Between 1962 and around 1970 (upper middle) the Chinese association between fertility levels and concentration lies close to the bulk of other countries and slightly above them, i.e. has somewhat lower concentration for the given level of fertility. After 1970, however, the steep decline in Chinese fertility levels is not associated with increased concentration and the trend (upper left corner) deviates grossly from the general cross-sectionally observed pattern. It also deviates significantly from the time-series of the US and European countries discussed above.

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[4]It is always problematic to directly compare trends over time and variations in a cross-section. But if we consider the case in the cross-section as standing for different stages of a process (demographic transition), this combination may be justified. With respect to age demographers do this all the time when constructing synthetic cohorts.

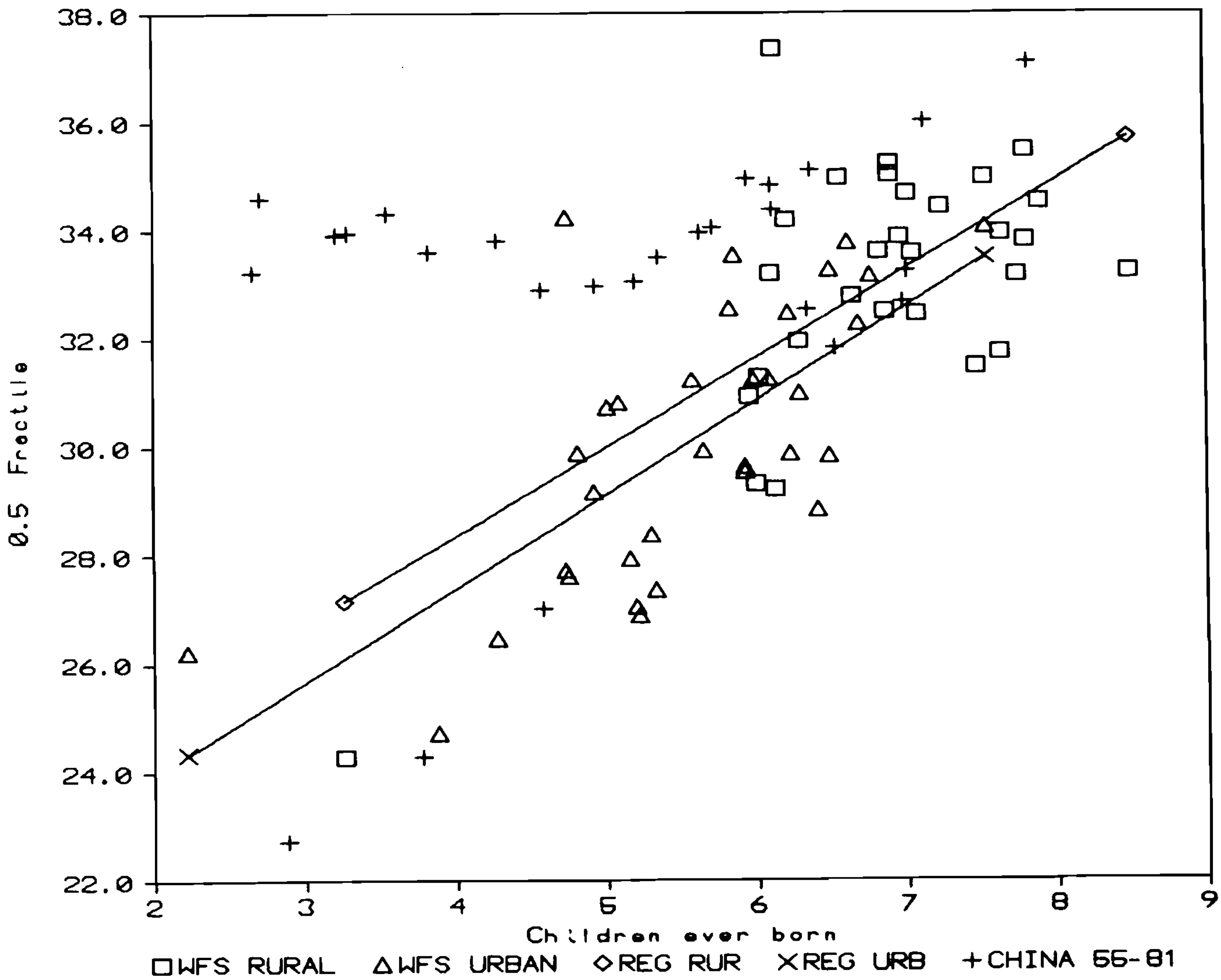

Figure 4. Relationship between mean completed family size and the concentration of fertility for a cross-section of LDC's and China, 1955–1981.

The general pattern of increasing concentration with declining fertility as it is observed in the cross-section of LDC's and in historical USA and Europe can be explained thus: in addition to the already existing variation due to differential fecundability and differential exposure, the introduction and differential practice of birth control brings a new source of variation into the distribution of family sizes.

But why is the Chinese pattern of parity-specific fertility decline so completely different from that observed in any other population? A strictly demographic answer would be that relative variation in the distribution did not increase because the decline affected all segments of the population to a similar extent. It might also be said that this extraordinary development was clearly a consequence of the Chinese population policy, a policy that despite its problems seems to have been very successful and brought about a surprisingly egalitarian fertility pattern. But an explanation of this phenomenon should be given by experts in Chinese population trends, policies, and culture. This research note only wanted to point at the observed fact.

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