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THE DEMOGRAPHIC RESPONSE TO ECONOMIC CRISIS IN HISTORICAL AND CONTEMPORARY POPULATIONS*

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SUMMARY

In contemporary industrialized countries patterns of demographic response to economic fluctuations are obscure and continue to generate controversy. However, in the many historical and third world populations that have been studied, there are surprisingly many shared patterns of demographic response. They permit the following generalizations:

(*a*) The demographic effects of an economic fluctuation are spread out over a number of years;

(*b*) Fertility, mortality, nuptiality and migration all respond to economic fluctuations, although fertility and mortality are most frequently studied;

(*c*) It is a common mistake to attribute short-run fertility fluctuations to fluctuations in marriages; they are mainly due to marital fertility;

(*d*) Increases in deaths and declines in births are both responsible for population loss in crises, but mortality has greater responsibility in poorer settings and fertility in richer settings;

(*e*) If the decline in fertility and births is not taken into account, the increase in mortality will be underestimated by crude death rates or numbers of deaths;

(*f*) The mortality increase following an economic crisis is not necessarily contemporaneous with the crisis and may be substantially delayed. It may be followed by a period of below-normal mortality;

(*g*) Fertility responds in a regular fluctuating pattern shaped by the biology of the interbirth interval;

(*h*) Migration plays an important role in the demographic response to economic crisis;

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(*i*) Demographic response to economic crisis is seldom a quantitatively important influence on population trends;

(*j*) The demographic response—at least for mortality—may increase more than proportionately with the size of the crisis;

(*k*) Responses occur even for small price variations, and even for food price *reductions*.

Introduction

In the past decade, many developing economies have experienced severe fluctuations. What have been the demographic consequences? Rather than address the question directly, I shall place it in perspective by discussing the influence of economic fluctuations on vital rates in earlier periods, in both developed and developing countries. A sufficient number of studies have been done, using a common methodology, to permit a comparative analysis, and we shall see that there are many shared patterns of demographic response. The patterns discussed here are rather abstract and statistical and can be observed in the simplest data—time series of vital events and food prices. Richer historical and anthropological sources (e.g., Caldwell and Caldwell, 1987) yield additional fascinating detail but are beyond the scope of this brief review.

There are, of course, many important differences between short-run fluctuations in the past and in the modern world. Infectious disease has been greatly reduced in importance by improved living conditions and preventive measures. Contraception is vastly improved. Transportation and communications have developed to the point where harvest failures are more effectively offset by the market, and the international community can intervene in a more effective and timely manner. The role of agriculture in national economies has decreased, and crises arising from international trade and finance, rather than from poor weather, have grown in relative importance. There has surely been a general increase in the proportion of the total labour force which is landless and primarily engaged in wage labour, at least when the non-agricultural sector is included in the accounting; for such workers, high food prices are an undiluted misfortune. In practice, third world countries fall on a continuum ranging from those for which the pre-industrial European setting may be relevant to those for which the experience of contemporary developed countries may be more germane.

This paper is concerned explicitly with the effects of economic crisis on demographic variables, and so it is specifically about short-run fluctuations. More generally, however, we study short-run fluctuations to try to learn something about broader issues concerning fertility and mortality. For this purpose, the study of short-run fluctuations has the advantage of requiring very little data and being highly resistant to problems of poor data, underregistration, lack of reliable denominators for rates and so on.

It has a considerable disadvantage in that the behavioural response to short-run economic shocks may be entirely different from that to long-run changes. Thus, it may be misleading to generalize from the study of short-run fluctuations.

Theory

There are many kinds of economic crisis. Most typically, perhaps, in the economies and populations to be discussed below, a crisis originates in a weather-induced harvest failure, in which there is simultaneously a reduction in agricultural output and an increase in agricultural prices. For landless labourers, this is an unmitigated disaster. Large land-owners may be net beneficiaries, depending on the price elasticity of demand for food and the degree of closure of the local food market. Smallholders occupy an intermediate position. Non-agricultural labourers may be doubly hurt, because rural demand for their products may decline at the same time as food prices rise. Sen (1981) and Ravallion (1987) have argued that sharp rises in food prices may sometimes occur despite normal harvests, arising from the inaccurate expectations of grain speculators. Such crises should have slightly different effects. Certainly the importance of food-price variations will decline directly with the share of food in the household budget, which varies inversely with per capita income. Other crises may originate from the industrial sector or from the international economy; the current crisis in Latin America is of this sort. Finally, political and military events may cause crises, sometimes in combination with other causes, as in China's Great Leap Forward or in Ethiopia.

If capital markets were perfect, then households would borrow or not save when real income was temporarily low. The demographic response to economic crisis would then be muted, but probably still present. It would remain, in part, because it would still be rational to consume less food, for example, when food prices are unusually high, and changed nutrition might then affect demographic outcomes. Furthermore, involuntary unemployment and altered incentives to work would alter time use and its costs. Thus Butz and Ward (1979) have argued that women with a labour-force attachment would seek to time their births during periods of economic slack. The crisis may also lead to displacement of family members in search of work in distant places, which, on the one hand, may spread disease and affect their mortality risks, and on the other hand, may lead to periods of sustained abstinence from coitus.

In reality, of course, capital markets are far from perfect. Labourers with patrons may be able to go into debt. More typically, those with assets in the form of land, livestock or jewelery will sell them to raise money. Other household expenditures will be reduced to buy food, and there will be a shift within food expenditures to cheaper sources of energy (which will not necessarily be less nutritious; see Behrman and Deolalikar, 1988). Nonetheless, nutrition will likely suffer, housing may be more crowded, sanitary conditions and health care may slip, and there may be greater

exposure to pathogens. Because of these changes, morbidity and mortality will likely rise, although that is less likely to happen when food takes a smaller share of the normal budget; when the diet initially includes more costly items, such as meat, which can be reduced; and when the exposure to infectious disease is lower, due to public health measures.

Births are likely to be voluntarily postponed in such times because they require additional caloric intake by the mother and because they interfere with her ability to devote time to coping in whatever way with the crisis—foraging, seeking work, taking on extra agricultural tasks while the husband temporarily migrates, and so on. Additionally, reduced nutrition, if severe, may reduce fecundity, spousal separation may reduce sex, psychic stress may lead to amenorrhea or reduce coitus and marriages may be postponed. If the crisis leads to greater morbidity, this will also lead to lower fertility for various reasons. All of these changes would tend to reduce births.

Certainly not all people will be affected in the same way by a crisis. Some will be more isolated from major markets for buying imported food or selling off personal assets. Large landholders may be net agricultural producers, and may actually benefit from a harvest failure, if the price elasticity of demand for food is sufficiently low. Poor landless labourers will be the hardest hit by a crop failure, but will be less affected, perhaps, by an economic crisis of international origins.

Methods

The basic method and its rationale are set out in Lee (1981); most of the studies to be reviewed here adopt a similar approach, often with some refinements. Some researchers propose a different approach (Schultz, 1986; Bengtsson and Brostrom, 1986); I continue to prefer the one described below. The necessary data for the most basic study include annual time series of births, deaths and grain prices. The series should be at least 30 years long, although a successful study can sometimes be made using as little as 10 years of data when the purpose is to investigate a specific major crisis. If crude rates or more refined measures of fertility and mortality are available, so much the better, but they are not needed, since the population size and age distribution change rather slowly relative to the fluctuations we wish to study . The exception is that during a crisis, births fall, which in itself would cause a decline in deaths. If this compositional effect is not taken into account, the rise in mortality will be underestimated.[1] These data series should generally be detrended either by first-differencing all series (or their logarithms) or by dividing by a moving average (a 9- or 11-year moving average is often used for this purpose).

Because the repercussions of an economic shock take a number of years to work their way through the demographic system, as is discussed below, it is essential to allow for effects spread over time. The failure to do so is the major failing of the dozens of older studies. This is conveniently done by using a distributed lag model, in which lags of up to

four years are included. Thus deaths are regressed on contemporary grain prices, and prices lagged one year, two years, three years and four years (for shorter data series, only lags of up to two years can be used). The total effect of a price variation is found by summing all these distributed lag coefficients. If the data were first logged or divided by a moving average, then the coefficients and their sum are elasticities, indicating the ratio of a proportional change in mortality to a proportional change in prices. Thus, a sum of +.25 would mean that a 10 per cent increase in prices for one year would eventually lead to an excess number of deaths equal to .025 (=.25 × .10) times the normal annual number of deaths. Standard methods may be used to adjust for serially correlated residuals.

A similar analysis can be performed for births, but two comments are in order. First, it is very important *not* to include current and lagged marriages as explanatory variables. Estimates will always show them to have a strong effect, but this is almost always spurious (see Lee, 1975 and 1981). The same events that lead to lower marital fertility also lead people to postpone marriage. To assess the genuine causal effects of marriage on births, one must use an average schedule for the distribution of births by duration of marriage, applied to the actual time series of marriages, to calculate expected fluctuations in the number of births if the duration schedule were to remain constant. Secondly, in pre-industrial populations, there is always a very strong negative covariation of mortality and fertility. As with marriages, this covariation does not reflect causality in either direction.[2] Unlike the case of marriages, however, it is readily interpretable and interesting: it reflects the common influence of morbidity on both fecundity and mortality. When the death rate is high, morbidity must be far higher, and it affects fecundity in a number of ways, ranging from foetal loss to reduction in coital frequency. The influence of these variations in unobserved morbidity can be controlled by including lagged adjusted deaths as right-hand variables. Any interpretation of the estimated coefficients as indicating an "effect" of mortality on fertility must be rigourously avoided, however; the covariation arises from correlated disturbances in the two equations, due to the omitted variable, morbidity.

Data and empirical findings

Pre-industrial Europe

I will begin by reviewing the findings of studies of pre-industrial European populations. Results have been remarkably consistent across populations and time periods, despite some variations in method. This is most strikingly evident in the work of Galloway (1988, 1989), who has analysed dozens of data sets in a comparative setting.

Almost always, marital fertility is negatively related to grain prices, with cumulative elasticities in the range −.05 to −.3. Mortality is positively related to prices, with cumulative elasticities in the range +.05 to +.6. Nuptiality is negatively related to prices, with cumulative elasticities in the range 0 to −.3. Galloway (1988) has shown that elasticities, partic-

ularly for mortality, are generally higher in absolute value in poorer, more agricultural settings.

Similarity in the timing of the response to an economic crisis is particularly striking. Strangely, mortality often remains high for two years following the crisis, then drops to below its normal level for a time, because there are fewer old and weak than usual. Fertility is lowest in the year following the crisis, then rebounds to above-normal levels before returning to normal. This has a clear biometric interpretation, discussed below. Nuptiality behaves more erratically. Typical shapes of distributed lag responses for Europe are shown in figures I and II. They will be discussed later.

Third world countries

The studies reviewed above for Europe are not studies of crises or famines *per se*; rather they are studies of the demographic response to whatever food-price variations are recorded in the data—large and small, upwards and downwards. Occasionally the effects of major price shocks are studied separately, but this is unusual (see Lee, 1981, and Galloway, 1987, for example). For the third world, studies of the usual kind done for Europe are available, but there are also studies specifically of the recent major famines in Bangladesh and China, which I will review first.

In Bangladesh, in 1974–1975, rice prices rose briefly to two and half times their normal level, causing severe famine conditions. Langsten (1980) estimated a monthly distributed lag model similar to mine, on data from Matlab in Bangladesh, from 1966 to 1976. Despite the shortness of the series, his results are quite similar to mine for England. The cumulated elasticity of the crude death rate with respect to rice prices is $+.288$ and for the crude birth rate is $-.277$ (versus $+.234$ and $-.144$ for England); these are both taken over 18-month lags. It is also interesting that Langsten found far stronger results using prices than using agricultural production. This is not surprising, since Sen (1981) has shown that food production was slightly higher than normal during that famine. This provides encouraging support for the common practice of analysing price data rather than quantity data.[3]

The shapes of the lag patterns Langsten found are also similar to those in Europe: fertility has a trough from eight to 14 months after a price shock, and then experiences a rebound. Mortality shows its main effect four to eight months after a price shock, and then by ten months after the shock there is a slight compensating rebound.

During the Great Leap Forward, China experienced a severe decline in grain production, causing a reduction by about 25 per cent in food energy available per capita (see Ashton and others, 1984), and a number of demographers have documented the enormous loss of life (30 million excess deaths) and a decline in fertility by nearly 50 per cent (see Ashton and others, 1984). Unfortunately, the time series available to me for analysis were very short, covering only the 12 years from 1953 to 1964. I

took my basic data from Ashton and others; doubtless at least 20 years could be added to that series, but its variance would be dominated by the single great fluctuation. The brevity of the series makes all estimated patterns quite unreliable. Grain-price data were not available, so quantity measures were used. Consequently, it is difficult to compare the estimated elasticities to those for other countries and periods. However, the price elasticity of demand for food is probably close to -1 for impoverished populations; therefore, simply changing the sign on the quantity elasticities for China should render them roughly comparable. My estimates, based on data in Ashton and others (1984), give a cumulated elasticity for fertility of $+.33$, with a lag pattern similar to the standard. For mortality, the sum is very near 0 (over lags of 0, 1 and 2 years), which is surely a distortion of reality. However, the estimates do show very strong timing effects consistent with the general European pattern and with Bangladesh. Mortality rises sharply in the first year of a shortage, is still high one year later, and then declines below normal after two years.

These studies of crises in Bangladesh and China focus on brief episodes known to be associated with major food-production shortfalls or price increases. With Patrick Galloway (see Galloway and Lee, 1985) I also studied some longer time series from India, Japan and the Province of Taiwan, China, in which estimated response patterns reflect price fluctuations of all magnitudes and the vital rates are also buffeted by other forces; these results represent more typical situations, and should be more comparable to those for pre-industrial Europe. In addition, there have been studies of an earlier period in Japan (Feeney and Hamano, 1988) and historical Mexico (Reher, 1989). The table below presents cumulated elasticities for those seven third-world populations, as well as summary data for Europe. It will be seen that there is considerable variation, but that all but two of the 14 developing countries' numbers have the expected sign. The medians are close to $-.3$ for fertility and $+.3$ for mortality; thus, a 10 per cent rise in prices would engender a total change in births or deaths equal to about 3 per cent of their typical annual number. Based on Galloway's (1988) results for European populations, the higher cumulated mortality elasticities would be expected for populations with per capita incomes in the range of United States $200-$300 (1970) and are not as high as those found for Tuscany or Austria in the nineteenth century. The responses of fertility in Europe are never found to be over 0.2 in absolute value, so their far higher values in a number of developing countries represent a challenging departure from previous experience.

All these analyses reveal timing patterns that are consistent with the standard pattern. The lag sums are generally, but not always, consistent as well. The timing patterns associated with the cumulated effects are displayed in figures I and II. Figure I shows median values of the mortality response by years since the price variation. It should be understood that there is a great deal of variation in the mortality patterns for individual populations, in contrast to the great similarity observed for fertility. None the less, there is useful information in these median patterns. For Europe,

TABLE. ESTIMATED CUMULATIVE ELASTICITIES OF DEMOGRAPHIC RESPONSE TO ECONOMIC CRISIS FOR SELECTED THIRD WORLD POPULATIONS OVER THE PAST CENTURY

Population	*Date*	*Fertility lag (sum)*	*Mortality lag (sum)*
Bombay	1883-1925	−.292	+.119
Taiwan (Province of China)	1914-1938	−.073	−.296
Japan	1882-1940	+.044	+.286
Japan	1807-1886	−.163	-
Bangladesh	1966-1976	−.277	+.288
China	1953-1964	−.330	0
Mexico	1750-1810	−.460	+.588
Europe	1540-1870	−.136	+.160

Sources: For Bombay, Taiwan (Province of China) and Japan, 1882-1940: Patrick Galloway and Ronald Lee, "Some possibilities for the analysis of aggregate historical demographic data from China", a paper presented at the Workshop on Qing Population History, Pasadena, California, 26-30 August 1985. For Japan, 1807-1886: Griffith Feeney and Kiyoshi Hamano, "Rice price fluctuations and population change in late Tokugawa Japan", a working draft (Honolulu, East-West Population Institute, 1988). The number shown is the average of their results for 13 different prefectures. For Bangladesh: Raymond Lewis Langsten, "Causes of changes in vital rates: the case of Bangladesh", unpublished dissertation (Ann Arbor, University of Michigan). For China: author's estimate (see text). For Mexico: the number shown is the median for estimates for seven populations, based on David Sven Reher, "Population and economy in eighteenth century Mexico: an analysis of short-term fluctuations", a paper prepared for the IUSSP Conference on the Population History of Latin America, Ouro Preto, Brazil, 2-6 July 1989. For Europe: these are averages of Galloway's 1988 estimates for 14 European populations for varying time periods starting from 1540, but mainly in the period 1750-1870.

note that high mortality continues for two years past the year in which the price variation occurs. This suggests that famine weakens some people who never regain their strength, and later die from causes other than starvation. This pattern was found in England, a relatively rich country, and in Tuscany and Austria, relatively poor. The Caldwells (1987) report a similar phenomenon following an African famine.

In the median European pattern, there is very little rebound of mortality, yet many countries show a strong tendency for mortality to fall *below* its normal levels some time after the initial increase. The median developing countries data show a rather different pattern. Following a price increase, the mortality response is not only larger but it is also concentrated in the initial year, after which mortality drops below normal. This median pattern also shows very strongly in the estimates for Mexico and Bombay. I speculate that really severe crises kill outright and leave fewer weakened survivors.

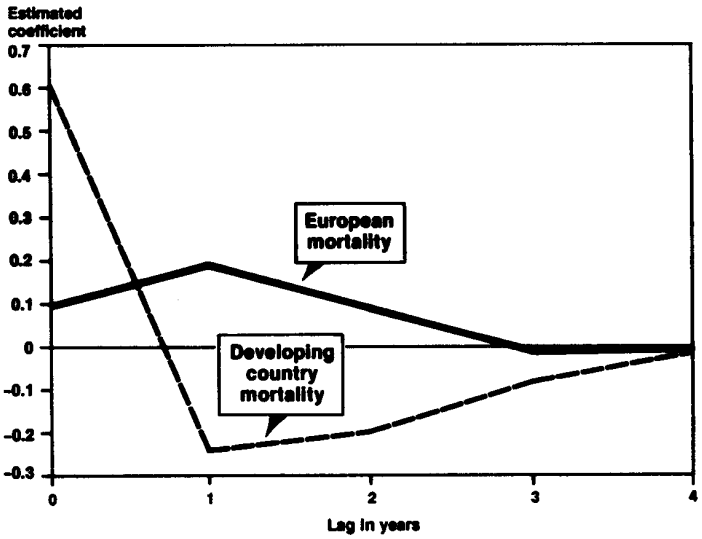
Turning now to figure II, showing the response of fertility to a food-price variation, we find very similar patterns among European populations and those of the third world. This similarity is even more apparent in figure III, in which the coefficients have been divided by their cumulated values to standardize the strength of response, allowing the timing pattern to emerge more clearly.[4] In the year of a price variation there is little response, because of the nine-month gestation period, and a normal wait-

ing period of a few months before a planned conception occurs; there would also be a delay before reduced food intake leads to a change in nutritional or health status. A year later the brunt of the fertility reduction occurs, whether due to conscious control or to socio-biological response. In the following year (at lag 2) fewer women than usual are removed from risk of conception by pregnancy or lactational amenorrhea, so more than usual conceive, leading to *more* births than usual. The next two years see a continuation of this oscillating pattern. The basic pattern is exactly what one would expect from biometric models such as those developed in Henry (1972) or Sheps and Menken (1973). Occasionally the major response occurs at lag 0, which might reflect greater reliance on abortion.

Modern developed country populations

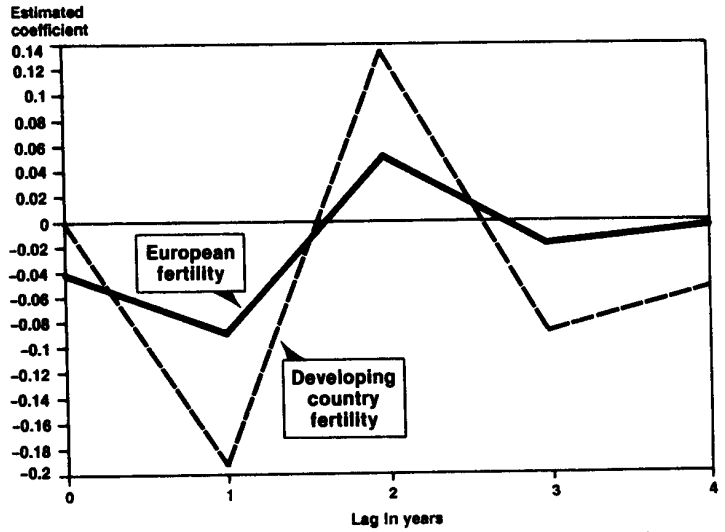
Demographic response patterns for developed countries are potentially relevant for the more developed of the third world countries, but results

Figure I. The influence of food prices on mortality: estimated lagged effects for selected populations in Europe and the third world, for various periods from the sixteenth century to the present



Sources: The estimates for Europe are taken from Patrick Galloway, "Basic patterns in annual variations in fertility, nuptiality, mortality and prices in pre-industrial Europe", *Population Studies* (London), vol. 42, No. 2 (July 1988). They are medians of the estimates in his appendix table 1, for 14 European populations, mostly for 1750-1870, but some for earlier periods. The developing-country pattern is the median of estimates for Mexico from David Sven Reher, "Population and economy in eighteenth century Mexico: an analysis of short-term fluctuations", a paper prepared for the IUSSP Conference on the Population History of Latin America, Ouro Preto, Brazil, 2-6 July 1989; and for Bombay, Taiwan (Province of China) and Japan from Patrick Galloway and Ronald Lee, "Some possibilities for the analysis of aggregate historical demographic data from China", a paper presented at the Workshop on Qing Population History, Pasadena, California, 26-30 August 1985.

Figure II. The influence of food prices on fertility: estimated lagged effects for selected populations in Europe and the third world, for various periods from the sixteenth century to the present



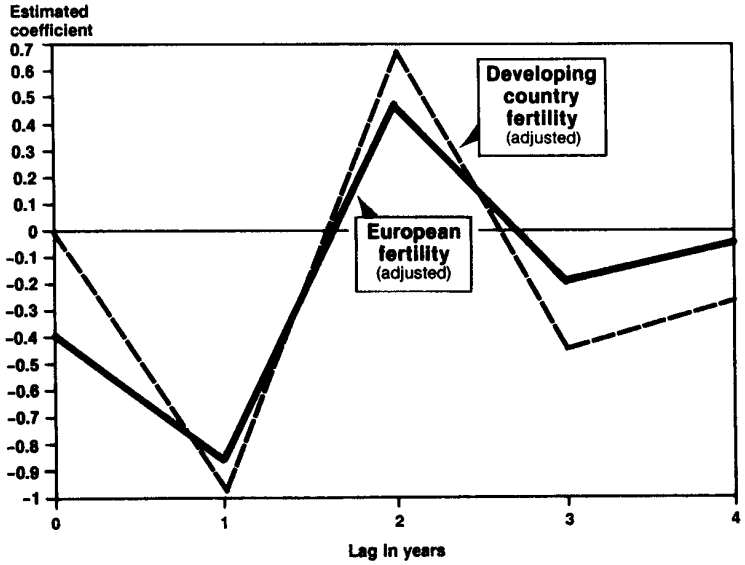
Sources: The estimates for Europe are taken from Patrick Galloway, "Basic patterns in annual variations in fertility, nuptiality, mortality and prices in pre-industrial Europe", *Population Studies* (London), vol. 42, No. 2 (July 1988). They are medians of the estimates in his appendix table 1 for 14 European populations, mostly for 1750-1870, but some for earlier periods. The developing country pattern is the median of estimates for Japan (two subperiods) from Patrick Galloway and Ronald Lee, "Some possibilities for the analysis of aggregate historical demographic data from China", a paper presented at the Workshop on Qing Population History, Pasadena, California, 26-30 August 1985, and from Griffith Feeney and Kiyoshi Hamano, "Rice price fluctuations and population change in late Tokugawa Japan", a working draft (Honolulu, East-West Population Institute, 1988); for Mexico: David Sven Reher, "Population and economy in eighteenth century Mexico: an analysis of short-term fluctuations", a paper prepared for the IUSSP Conference on the Population History of Latin America, Ouro Preto, Brazil, 2-6 July 1989; and for Taiwan (Province of China) and Bombay: Patrick Galloway and Ronald Lee, "Some possibilities for . . .", *loc. cit.*

for them are highly controversial, and no consensus exists even as to the signs of the responses. Many older studies (Silver, 1965; Galbraith and Thomas, 1941; and Kirk, 1960, for example) concluded that fertility was pro-cyclical in developed countries during the first half of the twentieth century. But the more recent work of Butz and Ward (1979) has argued that as the participation of women in formal market employment increased, good economic times came to impose heavier child-bearing costs than poor economic times, so that fertility became counter-cyclical. Methodological problems make interpretation difficult, and call the empirical results into question,[5] but no one has shown that the pro-cyclical pattern has continued to hold since the 1950s.

On the side of mortality the controversy is equally strong. One influential writer believes there are strong adverse health consequences of recessions in the United States and calculates a number of deaths associ-

ated with each notch in the unemployment rate (Brenner, 1983). But this work has been heavily criticized (Stern, 1983, and Wagstaff, 1985).

Figure III. The adjusted influence of food prices on fertility: estimated lagged effects for selected populations in Europe and the third world, for various periods from the sixteenth century to the present



Sources: The estimates presented in figure II were normalized by dividing them by their sums for each set of populations, to remove the influence of differences in overall sensitivity of response. The estimates for Europe are taken from Patrick Galloway, "Basic patterns in annual variations in fertility, nuptiality, mortality and prices in pre-industrial Europe", *Population Studies* (London), vol. 42, No. 2 (July 1988). They are medians of the estimates in his appendix table 1 for 14 European populations, mostly for 1750-1870, but some for earlier periods. The developing country pattern is the median of estimates for Japan (two subperiods) from Patrick Galloway and Ronald Lee, "Some possibilities for the analysis of aggregate historical demographic data from China", a paper presented at the Workshop on Qing Population History, Pasadena, California, 26-30 August 1985, and from Griffith Feeney and Kiyoshi Hamano, "Rice price fluctuations and population change in late Tokugawa Japan", a working draft (Honolulu, East-West Population Institute, 1988); for Mexico: David Sven Reher, "Population and economy in eighteenth century Mexico: an analysis of short-term fluctuations", a paper prepared for the IUSSP Conference on the Population History of Latin America, Ouro Preto, Brazil, 2-6 July 1989; and for Taiwan (Province of China) and Bombay: Patrick Galloway and Ronald Lee, "Some possibilities for . . .", *loc. cit.*

Summary

I conclude that the experience of European populations before the twentieth century is highly consistent with the experience of the poorer third-world countries up to the present, or at least of those few that have so far been examined. However, for the wealthier third-world countries, patterns might be expected to conform more closely to those of the populations of the developed countries, and those patterns are entirely obscure and provide no reliable guidance.

Similarities in response

There are a number of similarities shared by all pre-industrial periods and settings analysed.

(*a*) The effects of an economic fluctuation are spread out over time, and it is essential to use a statistical method which accommodates this lagged pattern of response. Most of the early studies used simple correlations, and so reported misleading results, often missing the patterns altogether;

(*b*) Fertility, mortality, nuptiality and migration all respond to economic fluctuations, although fertility and mortality are most frequently studied;

(*c*) It is a common mistake to attribute the fertility fluctuations to fluctuations in marriages. In fact, the fertility fluctuations result primarily from fluctuations in marital fertility, even in "natural fertility" populations (see Lee, 1975 and 1981). Nuptiality matters only for first births, which are typically not a large proportion of all births;

(*d*) Caldwell and Caldwell's (1987) generalization—that increases in deaths and declines in births are roughly equally responsible for population loss in crises—is correct for a certain range of per capita incomes, but mortality has greater responsibility in poorer settings and fertility in richer settings (see Galloway, 1988, p. 296);

(*e*) If the decline in fertility and births is not taken into account, the increase in mortality will be underestimated when crude death rates or numbers of deaths are used;

(*f*) A mortality crisis is often followed by a period of unusually low mortality, since deaths that were advanced in time by the crisis do not occur later; the timing of the compensating decline varies, but it occurs sooner when the crisis is more severe. The mortality increase associated with an economic crisis is not necessarily contemporaneous with the crisis; in the median European pattern, the response is distributed fairly evenly over the two years following the crisis as well as the crisis year itself;

(*g*) Fertility change follows a predictable pattern, shaped by the biology of the interbirth interval: a decrease in fertility is followed after a year or two by an increase, when an unusually large number of women are at risk of childbirth, since fewer than usual are pregnant or lactating. Oscillations of this sort have a period equal to the average length of the closed birth interval, and rapidly die out;

(*h*) Migration plays an important role in the demographic response to economic crisis. Temporary separation of husbands and wives reduces fertility, and migrants spread disease, which contributes to rising mortality;

(*i*) Demographic response to economic crisis is seldom a quantitatively important influence on population trends; even the massive Chinese famine of 1959–1961 represented loss of only a few years' natural increase (Caldwell and Caldwell, 1987; and Watkins and Menken, 1985);

(*j*) The demographic response—at least for mortality—may increase

more than proportionately with the size of the crisis. The response is often non-linear, and the more severe the crisis, the more immediate the response (see Lee, 1981, and Ravallion, 1987);

(*k*) Responses occur even for small price variations and even for food-price *reductions* (this has been examined only for England; see Lee, 1981).

As for more industrialized settings, recent research on the population of the United States has yielded highly contradictory results, and it is currently impossible to generalize. Yet it is the experience of the developed countries that should be more relevant for the more industrialized developing countries, particularly in so far as we are interested in the effects of non-agricultural economic crises. My guess is that in these countries economic crisis will be followed by a decline in fertility and perhaps marriages, but that there will be little or no discernible effect on mortality.

Demographic responses have been examined for only a very few contemporary third-world countries, and the data exist to expand the list for both richer and poorer populations. Furthermore, the models estimated here are very stripped down, and it would be preferable to include a wider range of variables, such as temperature, identifiable non-economic epidemics and political and military disturbances. With a larger collection of studies on a richer set of models, firmer generalization will be possible.

NOTES

[1] The simplest adjustment is to use an appropriate average infant mortality rate and separation factor and to subtract from the series of deaths the number of deaths of infants that would be expected each year, based on average rates and on the number of births in the current and preceding years.

[2] Careful consideration of the possible links shows that any true causal links are bound to be quite weak—for example, the death of pregnant women, the rupture of marriages or the lactation interruption effect (see Lee, 1977).

[3] Quantity data, indicating the size of the harvest, for example, have a number of difficulties, since they take no account of the possibilities of trade or of storage from earlier years by speculators, consumers or public institutions.

[4] Because the cumulated lag is a capricious measure, it would generally be better to standardize on the coefficient at lag 1, which is a more robust measure of strength of response.

[5] The original specification incorrectly used a multiplicative form for overall fertility in relation to that of women in and out of the labour force, when an additive specification was clearly called for. Furthermore, despite unsatisfactory Durbin Watson statistics, no effort was made to correct for auto-correlated disturbances. Efforts to replicate the results with a more statistically appropriate procedure have been unsuccessful. Also, the analysis did not distinguish between the response to short-run fluctuations and to longer-run movements. Finally, the lag patterns of response that were found are very suspicious.

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