Factors Associated with Child Mortality in Pakistan and Implications for the National Health Programs

by Tauseef Ahmed

Pakistan's infant and child mortality rates are high even by the standard of less developed countries. In the absence of a good vital registration system, surveys offer the best means of measuring child mortality as an indicator of social and economic development. This study attempts to establish the levels of infant and child mortality in Pakistan using an indirect estimation technique to analyze data from the 1984-85 Pakistan Contraceptive Prevalence Survey.

The levels of infant and child mortality derived from the analysis are similar to those produced by the Pakistan Demographic Survey of 1984, indicating that children's survival chances have hardly improved in recent years. Rural areas continue to have much higher child mortality than urban areas, despite recent efforts by the government to meet basic health needs in the countryside. As expected, parents with some education exhibited a greater tendency than those with no formal education to engage in modern child-care practices, but only in urban areas did the educational level of mothers have a statistically significant effect on children's survival chances. Suggestions are offered on ways to improve the effectiveness of rural health programs.

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THE HEALTH status of Pakistani children typifies that of a developing country. According to Grant (1992:74), more than a quarter of infants born in Pakistan during 1980–88 had low birth weights. At least one of every 10 Pakistani infants dies before reaching his or her first birthday (Rukanuddin and Farooqui 1988:69).

The government of Pakistan has made the reduction of infant mortality a prime public health goal in recent years. Policy documents and budget allocations for health programs emphasize preventive measures (Government of Pakistan 1982). Immunization coverage for children increased substantially over the period 1977–84 (Government of Pakistan, Federal Bureau of Statistics, 1986: table 5.3).

Nevertheless, government-supported health facilities are far from adequate. Although 50% of Pakistanis live within 2 miles (3.2 km) of a public or semipublic health facility, a serious shortage of health personnel limits the services that can be provided to those in need. The national expenditure on health increased 34 fold over the 1971–86 period, but because of population growth the annual per capita expenditure remained at only Rs. 20.49 (US $0.80) at the end of the period (Rukanuddin and Farooqui 1988:159).

The concentration of health facilities in urban areas has contributed to the higher rate of infant and child mortality in rural than in urban areas. Other social and economic factors such as the family’s economic status and the mother’s education are also known to affect infant and child mortality.

The Pakistan Contraceptive Prevalence Survey, conducted between October 1984 and February 1985, collected information from a nationally representative sample of women of reproductive age about their fertility histories, survival of children born, maternal characteristics thought to be associated with children’s survival, and the mothers’ own health behavior during the three years preceding the survey. The data provide a unique opportunity to study national trends in child survival and the factors associated with it. The present study uses data from the survey to estimate the levels of Pakistani infant and child mortality and to examine its covariates.

Recent Trends in Pakistani Infant Mortality and Theoretical Assumptions

Estimates of infant mortality in Pakistan have varied, according to the data sources used (Rukanuddin and Farooqui 1988). Pakistan lacks a good vital registration system, and in its absence an elaborate dual record system known as Population Growth Estimation (PGE) was established in the early 1960s. Estimates of infant mortality based on PGE and data from several surveys have indicated a decline from approximately 150 deaths per 1,000 live births in the early 1960s to slightly more than 100 deaths per 1,000 live births in the mid-1980s (Table 1). In comparison, the average infant mortality rate for the less developed countries as a group in 1991 was 75 and for the more developed countries it was 14 (Population Reference Bureau 1991).
Infant mortality in Pakistan in the mid-1980s has been estimated at slightly above 100 deaths per 1,000 live births, compared with an average rate of 75 per 1,000 for the less developed countries as a group in 1991 and 14 per thousand in the developed countries.

In Pakistan the principal causes of infant death after the first month of life are acute respiratory infections, gastroenteritis, other communicable diseases, and malnutrition (Awan 1986:188). Results from the National Health Survey of 1982–83 have revealed that better facilities, such as piped drinking water, flush toilets, and gas cooking stoves, tend to improve the health standard of the community (Government of Pakistan, Federal Bureau of Statistics, 1986:30).

**Proximate determinants of child survival.** Mosley and Chen (1984) have developed a theoretical framework in which they treat available health care and mothers' and children's nutritional status as proximate variables, through which social, economic, and demographic factors affect child survival. An infant's survival during the first month of life has been found to be closely associated with the mother's health and nutritional status during pregnancy. Malnourished mothers tend to produce infants with low birth weights who have a higher than average risk of infant mortality (Lechtig et al. 1978; Galway et al. 1987). This risk may be aggravated by a poor feeding pattern and insufficient breast milk. Prenatal care and the presence of a medically qualified attendant at a child's delivery can prevent birth injuries and provide necessary medical care in case of an emergency (Meegama 1986).

Other, exogenous health-care variables, which Mosley and Chen (1984) characterize as environmental contamination, adversely affect child survival. They include mothers' exposure to postpartum infections and families' lack of access to safe drinking water, sanitary toilets, or disease-prevention measures such as inoculation programs. The introduction of sanitary toilet facilities has been found to reduce infant mortality in the Philippines (Martin et al. 1983) and in Malaysia (Peterson et al. 1986). Improved water supplies and sanitation proved to be significant factors in the decline of infant mortality in Malaysia among mothers who were not breast-feeding (DaVanzo and Habicht 1986).

Malnourished children are at a heightened risk of acquiring diseases for prolonged periods because their immune systems are weakened (Galway et al. 1987). Measles, malaria, diarrhea, and other communicable diseases are prominent killers of infants in developing countries where malnutrition is widespread (Hill and Kaufman 1987). The availability, accessibility, and appropriateness of health services are important determinants of child survival (Galway et al. 1987).

### Table 1. Estimated infant mortality rates from various sources: Pakistan

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate per 1,000</th>
<th>Method</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962</td>
<td>152</td>
<td>Indirect</td>
<td>Population Growth Estimation</td>
</tr>
<tr>
<td>1963</td>
<td>137</td>
<td>Indirect</td>
<td>Population Growth Estimation</td>
</tr>
<tr>
<td>1964</td>
<td>136</td>
<td>Indirect</td>
<td>Population Growth Estimation</td>
</tr>
<tr>
<td>1965</td>
<td>118</td>
<td>Indirect</td>
<td>Population Growth Estimation</td>
</tr>
<tr>
<td>1968</td>
<td>124</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1969</td>
<td>111</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1970</td>
<td>109</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1971</td>
<td>106</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1976</td>
<td>87</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1977</td>
<td>100</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1978</td>
<td>95</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1979</td>
<td>95</td>
<td>Indirect</td>
<td>Population Growth Survey</td>
</tr>
<tr>
<td>1984</td>
<td>127</td>
<td>Direct</td>
<td>Pakistan Demographic Survey</td>
</tr>
<tr>
<td>1985</td>
<td>116</td>
<td>Direct</td>
<td>Pakistan Demographic Survey</td>
</tr>
<tr>
<td>1986</td>
<td>106</td>
<td>Direct</td>
<td>Pakistan Demographic Survey</td>
</tr>
<tr>
<td>1987</td>
<td>104</td>
<td>Direct</td>
<td>Pakistan Demographic Survey</td>
</tr>
</tbody>
</table>

*Source: Rukanuddin and Farooqui (1988: table 6.2).*
Demographic factors. Demographic factors such as a child’s birth order and sex, the mother’s age, the duration of the preceding and following birth intervals, and whether the mother has had a prior experience of child loss are known to affect child survival in many populations (see, for example, Hobcraft et al. 1983). Rapid, successive childbearing results in low birthweight infants and increased risk of child mortality. Successive childbearing and short birth intervals may also result in greater competition between siblings for scarce resources, resulting in poor nutrition and high infant mortality (Hobcraft et al. 1983; Choe 1987; Winikoff 1983). A short birth interval implies early weaning of the older child, which may cause that child to be exposed to malnutrition or infectious agents in food. Having a large number of very young children may increase their exposure to communicable diseases that can lead to death.

Successive childbearing and short birth intervals lead to underweight infants, competition among children for scarce resources, and early weaning of older siblings—increasing the children’s risk of malnutrition, infection, and exposure to communicable diseases.

In societies where early marriage is the norm, childbearing starts early in a woman’s life, and for many women childbearing continues late in the reproductive age span. Firstborn children of very young women are at especial risk of infant mortality because of their mothers’ physical immaturity (Gubhaju 1986; Rutssein 1983). A mother’s experience of losing a child is strongly associated with her greater risk of subsequent infant mortality (Cleland and Van Ginneken 1988; Sathar 1987; Gubhaju et al 1987). Births to women at older ages, especially after age 35, also entail a higher risk of infant mortality (Galway et al. 1987).

Social and economic factors. Social and economic factors have been found to affect a child’s chances of survival in many populations. These include ethnicity, the family’s socioeconomic status, the mother’s work pattern, her education, the parents’ sex preference, and their place of residence. Peterson et al. (1986) and Choe et al. (1989) report ethnic differences in infant mortality in Malaysia and Nepal. Higher family income can generally be taken as an indicator of better nutrition and greater access to health facilities, which improve an infant’s chances of survival. Preston (1974) suggests that certain diseases may be linked to a family’s living standard.

Cultural values associated with gender make an infant’s sex an important factor in survival. Excessive female mortality, especially in late infancy and early childhood, has been found in Bangladesh (Chen et al. 1981), Pakistan (Sathar 1987), and the Republic of Korea (Choe 1987). Chen et al. also report gender differences in nutritional levels and the amount of care provided to infants in Bangladesh. A negative association is commonly found between a mother’s educational level and infant and child mortality (Cleland and van Ginneken 1988; Galway et al. 1987; DaVanzo and Habicht 1986; Visaria 1988). Higher female education leads to improved child-care skills and preventive care (Das Gupta 1989), better child-feeding patterns (Caldwell and McDonald 1981), women’s ability to make their own decisions and understand the importance of hygiene and sanitation (Ware 1984), reduced fatalism and enhanced focus on child quality (Caldwell 1979), and the preference of modern health-care practices that improve children’s survival (Mosley and Chen 1984).

Sathar (1987) argues that in Pakistan, maternal education improves infants’ survival chances regardless of the availability of health services because it leads mothers to provide better nutrition and care for their children. Alam and Cleland (1984) suggest that mortality could be reduced more effectively by encouraging proper child-care practices than by increasing the general economic standard of poor parents. DaVanzo and Habicht (1986) have found evidence suggesting that the influence of maternal education on child mortality increases after mortality begins to decline. Typically, a mother’s education has a stronger association with infant mortality than does the father’s education (Caldwell and McDonald 1981; Alam and Cleland 1984).

Data and Method
To analyze the factors that affect infant mortality in a particular context, it is desirable to obtain direct
information on each birth, the nutrition and health care of each child, and the mother's health before, during, and after each pregnancy. The Pakistan Contraceptive Prevalence Survey of 1984–85 (hereafter referred to as the PCPS) used a structured questionnaire to collect information on fertility and infant mortality from a randomly selected sample of 7,405 currently married women between the ages of 15 and 49. Women who reported having given birth within three years of the interview were asked direct questions about their infant-mortality experience, breast-feeding patterns, infant food supplementation, and desired fertility. Upon examination, however, the partial birth histories obtained from the survey were found to be inadequate for purposes of analyzing child survival.

For this analysis, therefore, I have employed indirect estimation of infant and child mortality based upon the number of children ever born and of children surviving reported by respondents. Gubhaju et al. (1987) conclude from their analysis of infant mortality in Nepal that child-survivorship information yields better estimates of infant and child mortality than do partial birth histories because the latter tend to omit infant deaths.

The indirect estimation method, first developed by Brass (Brass 1964; United Nations 1983), uses information on the cumulative number of children ever born and surviving at the time of a survey, classified by respondents' duration of marriage or age. The proportion of deceased children is adjusted by a multiplier, appropriate for the given maternal age or marriage duration, to yield estimates of cumulative probability of child mortality at selected ages. The multiplier depends upon the age (or marriage-duration) pattern of fertility and the age pattern of mortality.

I used the multipliers estimated by Trussell (1975). For the age pattern of mortality, I used the Coale-Demeny West model life table (Coale and Demeny 1983) because it closely models Pakistan's mortality pattern. The computation of indirect estimates of infant mortality was done with a computer program (MORTPAK: procedure CEBCS) developed by the United Nations (1988).

For the multivariate analysis of the factors associated with child survival, I used the Mortality Index (United Nations 1985). The index, which can be computed for each woman in the group under consideration (in this case those women in the PCPS who had given birth during the three-year period before the survey), is based on the proportion of children who have died among all children born. It is a ratio of the actual proportion of deceased children to the proportion expected for women having the same marital duration and is based on the estimated age distribution of children and an assumed standard age pattern of mortality.

The index is computed as follows:

$$MI = \frac{G(D/B)}{q_a(a)}$$

where $B$ and $D$ represent respectively the number of births a woman has had and the number of deaths among them, $G$ is the appropriate multiplier, and $q_a(a)$ is the probability of dying before reaching exact age $(a)$ in a standard population.

Although the Pakistani government has attempted to improve children's survival by expanding medical facilities, launching a child immunization program, and communicating with the public about health issues, child mortality remains high. Poverty coupled with early and rapid childbearing are among the causes.

The multiplier and the value of $(a)$ are determined by the duration of marriage and the associated age distribution of children according to the Coale-Trussell model fertility pattern (United Nations 1985). The standard age pattern of mortality, $q_a(a)$, is assumed to conform to the Coale-Demeny West model life table (Coale and Demeny 1983), with the infant mortality rate equaling 108 deaths per 1,000 live births. The in-
dex thus created is a standardized ratio of observed to expected deaths.

Several types of error may have been introduced into the data. Information on births and surviving children was obtained retrospectively, and it is possible that some women, misunderstanding the survey questions, neglected to report the births (and deaths) of children who died in infancy, grown children, and children who had moved away from the parents’ home for a long period. Such omissions would have affected the accuracy of our mortality estimates. Age misreporting, which is common in Pakistan (Retherford and Mirza 1982) also would affect the estimates. Booth and Shah (1984) report that older and illiterate Pakistani women are more likely than others to underreport the births of deceased children who died in the distant past. To minimize the problem of under-reporting of deceased children, I have based the analysis on women who had been married between five and 24 years at the time of the survey.

Results

Indirect estimation of infant mortality rates. Results from the indirect estimation (Table 2) indicate much lower infant mortality over the period of 1975–81 than the estimates (145 deaths per 1,000 live births) obtained by the Pakistan Fertility Survey for the period 1970–74, but higher than the indirect estimates reported by the Population Growth Survey for the years 1976–79 (shown in Table 1). Given the disparate rates among the three sources, it is difficult to determine whether infant mortality has been falling in Pakistan. One can conclude from the present analysis that the infant mortality rate was quite high in the early 1980s, probably in the range of 110–120 infant deaths per 1,000 live births. But there is definitely a need to verify these estimates using other data sources.

My estimates of infant mortality are likely to be lower than the true rates because of underreporting of deceased infants. I conclude therefore that any decline in Pakistan’s infant mortality between 1965 and 1980 was modest at best. This result is contrary to expectation because Pakistan’s child immunization program underwent a major expansion in the late 1970s and early 1980s, the government has attempted to make Pakistani women more aware of health issues through mass communication, and access to medical facilities has improved in recent years, especially in urban areas.

The conclusion that Pakistan’s infant mortality declined only modestly between 1965 and 1980 is surprising because the government has expanded its child immunization program, mass communication efforts, and access to medical facilities in rural areas.

Multivariate analysis. To assess various factors affecting infant and child mortality, I used the ordinary least squares (OLS) method, with the Mortality Index (MI) as our dependent variable. The independent variables were classified by category and coded as sets of dummy variables. Unfortunately, the PCPS collected information on only some of the variables assumed to affect infant and child mortality. Background variables are wife’s education, husband’s education, wife’s work status, province, and urban versus rural residence. Demographic variables include children’s gender, mother’s age at last birth, and whether she ever used any con-

(continued on page 53)

Table 2. Estimated infant and child mortality based on reported proportion of surviving children: Pakistan Contraceptive Prevalence Survey, 1984–85

<table>
<thead>
<tr>
<th>Age (x)</th>
<th>Probability of dying before age x</th>
<th>Equivalent infant mortality</th>
<th>Estimated date</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>.181</td>
<td>130</td>
<td>February 1981</td>
</tr>
<tr>
<td>5</td>
<td>.165</td>
<td>109</td>
<td>December 1978</td>
</tr>
<tr>
<td>10</td>
<td>.188</td>
<td>112</td>
<td>April 1977</td>
</tr>
<tr>
<td>15</td>
<td>.195</td>
<td>109</td>
<td>August 1975</td>
</tr>
</tbody>
</table>

1. The Pakistan Demographic and Health Survey conducted in 1990–91 found an estimated infant mortality rate of 91 deaths per 1,000 live births for the period 1986–91. This estimate is based on birth-history information, whereas the current analysis focuses on living and ever-born children to Pakistani women. The difference in estimates is a question that requires detailed analysis of the new data. (See National Institute of Population Studies and IRD/Macro International 1992.)
Census-based Approaches for Studying Aggregate Changes in Characteristics of the Elderly

Census data and methods of analysis associated with them are an underutilized resource for studying changes in the social and economic characteristics of the elderly in developing countries. The social and economic characteristics typically measured in a census can be divided into those that are relatively invariant for older individuals, such as educational attainment, and those that are subject to change, such as employment status. In the case of relatively invariant characteristics, cohort analysis can be applied to a single census, combined with a mortality schedule, to project changes in the composition of future elderly populations. In the case of characteristics that vary over the lifetime, the research focus is on the net movement of older cohorts between states of a social characteristic, such as movement out of the labor force. In the latter instance, cohort analysis is applied to a series of two or more censuses to describe the level of net transitions, which may then be compared for various groups. This article illustrates these techniques and discusses their limitations, which result from the underlying assumptions and from measurement error. The policy implications of the projections are also discussed.

by Albert I. Hermalin and Bruce A. Christenson

NOW THAT fertility has declined in a number of developing countries, government and business leaders in those countries have started to be concerned about both the relative and the absolute numbers of elderly in their aging populations. In most cases these countries are in the initial stages of experiencing an aging population structure; hence concern centers on longer-term development. One response to this concern has been to conduct surveys of the elderly population, for three purposes: to describe, on a cross-sectional basis, some of the key characteristics of the elderly, such as their living arrangements, economic well-being, social support, and health status; to provide an opportunity for causal modeling and studies of association among those characteristics; and to permit comparative analyses when surveys from other countries with similar data are available (e.g., Martin 1989).

These surveys, however, do not provide much understanding about social change in the condition of the elderly over time. How do the social status and condition of a cohort change over the life course? How do cohorts differ in their levels and rates of change of key characteristics? How will a population change over time as a result of differences in the size and characteristics of successive cohorts? Although census data from a number of developing countries provide a partial answer to some of these questions, their potential has not been systematically explored in aging-related research. This article illustrates a few simple techniques and approaches for using census data on the elderly more completely.

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Elements in a Strategy to Analyze the Life Course

The foregoing observations suggest that three elements are involved in an analytic strategy to study macro-level changes in the status of the elderly. They are (1) the birth cohort as the unit of analysis, (2) a repeated cross-sectional design for tracing cohorts, and (3) a distinction between relatively fixed and variable status measures.

Relying on the birth cohort as a unit of analysis directs attention to distinctive types of change (Ryder 1965). Intracohort change, on the one hand, occurs throughout the life cycle as members of a single cohort experience various life-course transitions. Widowhood and labor force retirement are two examples of transitions that will change the composition of a given cohort, affecting marital status and labor force status, respectively.

Social change, on the other hand, is often reflected by the compositional differences between cohorts. When successive cohorts differ in their educational or occupational composition, or in their probabilities of marriage or divorce at certain ages, we tend to refer to these as social-structural changes.

Effective use of cohort analysis requires that the research be designed with temporal depth. A repeated cross-sectional design is one means of meeting this requirement (e.g., Duncan 1968, 1975). Demographers have long considered the potential uses and practical problems of applying cohort analysis to a repeated cross-sectional design afforded by two or more censuses to measure such population processes as mortality and migration (Hamilton 1966; United States, Department of Commerce, 1972; Shryock and Siegel 1976; United Nations 1983:chap. IX).

The nature of the characteristic is the third element in this research strategy. Status measures may be conveniently divided into those that are, or at least tend to be, invariant for older individuals and those that are subject to change. Some obvious fixed characteristics include gender, race, and national origin or place of birth. In the case of older adults it is also reasonable to assume that other characteristics, such as literacy, education, and number of children ever born to women will also be invariant. Variable characteristics, in contrast, can include economic activity and occupation, marital status, current residence (e.g., urban versus rural or region), and living arrangements.

Analytic Potential of Census Data

The implications of the distinction between fixed and variable characteristics for the substantive focus of research become clearer when they are considered in relation to the available time points of data. Table 1, which cross-classifies the number of time points, or censuses, by the type of measure, identifies the types of cohort change that might be studied with census data.

In this section we briefly describe the types of cohort analyses, focusing in particular on the projection of compositional change, net transi-

<table>
<thead>
<tr>
<th>Table 1. Census data and their relationship to aging research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of time points or censuses</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>1a. Single census</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1b. Single census plus projected mortality schedule</td>
</tr>
<tr>
<td>2. Two censuses</td>
</tr>
<tr>
<td>3. Three censuses</td>
</tr>
</tbody>
</table>

Net transition rates (i.e., intracohort) Structural change in the aging process (i.e., intercohort differences in net transition rates)
tion rates within cohorts, and structural (intercohort) change in the aging process (the characteristics shown in boldface type in Table 1).

**Single-census analysis.** The data from a single census lend themselves to the study of population structure. Unless the census includes retrospective questions, however, a single census is not very useful for studying population change. Using the basic counts of persons by age and gender, one can create population pyramids or otherwise describe the population structure. Whether the characteristics are fixed or variable is of limited relevance as an analytic distinction. In either instance, one can examine differences among age groups with respect to a characteristics (e.g., educational level by age) or, alternatively, the age composition of those with a given characteristic (e.g., the age distribution of college graduates).

**Single census combined with a projected mortality schedule.** The combination of a census and a projected mortality schedule introduces the possibility of projecting certain types of compositional change. Projections of the future number of elderly in a population demonstrate the implications of cohort succession for a changing population structure. Typically, the mortality schedules are provided separately for males and females, so that it is also possible to project changes in sex ratios of the elderly.

Other types of compositional change in fixed characteristics can also be examined if one is willing to assume that there are no, or only slight, differentials in survival across statuses. We consider examples of this type of analysis later in the article. Extending such analysis to variable characteristics becomes, by the very nature of their variability, problematic and less informative.

**Two-census analysis.** Comparing two consecutive censuses introduces the possibility of studying intracohort change, since a given cohort can be traced from one census to another as it ages. Of interest in this case is the degree of change among cohort members in such characteristics as marital status and employment status, which tend to change with age. This involves a simple extension of techniques used to study internal migration, in which it is standardly assumed that mortality rates do not vary across the categories being analyzed. The expected mortality can come from a life table or from a census survival ratio (CSR).

For a closed population, the CSR is the ratio of the total number of people in an age group of the second census to the total number 10 years younger in the first census. (For further details see Shryock and Siegel 1976:379–384.) It should be noted that this technique produces a measure of change for each cohort over the same period, but these changes refer to different life-cycle stages for each cohort. We will discuss an example of this technique when we turn to the topic of measuring net transition rates.

Table 1 indicates that, in principle, one might calculate from two censuses the relative survival of subgroups having a fixed characteristic, such as the expected survival at a specific age of one educational group compared with another. In reality, however, these estimates are highly sensitive to assumptions about the completeness of census coverage. Such comparisons may prove useful for assessing the relative coverage of consecutive censuses, but at present they are of limited use for more substantive analysis.

**Three-census analysis.** A sequence of three or more censuses will, in principle, permit an analysis of cohort differences in aging experiences. From a practical standpoint, the most promising area is in the study of variable characteristics. When considering variable statuses, one can examine intercohort stability or change in net transition rates. The latter provides the third example for our more extended discussion.

Cohort differences in mortality at similar ages might be evaluated using census survival ratios. Once again, however, the practical application is often more useful for clarifying the relative completeness of coverage among censuses than for reflecting real survival differences. Analyzing cohort differences in survival with respect to fixed characteristics, such as gender or literacy, also presents practical problems that are beyond the scope of this article.

The availability of three or more censuses introduces other obvious possibilities for describing changes in the makeup of an elderly population that are not included in Table 1. For instance, historical trends in the proportion of the population at older ages or the proportion of elderly who are literate, employed, or widowed, can be described with a series of three or more censuses.
The distinction between fixed and variable characteristics is not germane to these descriptions, and therefore such uses of census data will not require further comment here.

**Projecting Compositional Change**

Next, we illustrate the technique for developing projections of the elderly population by fixed characteristics, the first of the three topics highlighted in Table 1. The projection of fixed characteristics is demonstrated for both interval measures (e.g., mean number of children ever born) and categorical measures (e.g., proportion of a cohort completing a given level of schooling), and it is further extended to an analysis of future status differences between older and younger cohorts.

To carry out this projection requires data on the age structure of the population (preferably by sex) at a given time, which are most usually obtained from a census; a projection of survival rates for each age-sex group for some future period, which are usually derived from current and recent life tables and from assumptions of future trends; and, for each age and sex group (i.e., cohort), a measure of the fixed or relatively fixed status, such as the percentage literate among persons aged 25 and older or the number of children ever born to women above age 40 or 45. Large-scale, nationally representative household surveys may provide an alternate source of data for age-sex distributions or measures of fixed characteristics by age and sex groups.

With these ingredients in hand, it is a simple matter to project the existing population forward in time, to establish the age structure at each date, to assign each cohort its "fixed" characteristic at each time point, and to combine cohorts in order to measure the change in composition of all the cohorts under study. Often one can work with an existing population projection so that all that is required is to assign each cohort its status measure at each time point. Population projections are routinely made by government agencies within countries and by international organizations, such as the United Nations! (The techniques of population projection are described in Shryock and Siegel 1976:443–453 and in Pollard et al. 1974:101–113.)

It will be seen from this description that the driving force behind change in a population's composition is the degree to which successive cohorts differ from one another in the characteristic in question and in their relative size. Projecting compositional change requires two important assumptions. The first is that the population is relatively closed to in- and out-migration. In the case of older adults, this is usually a reasonable assumption for a national population. For smaller geographic entities such as provinces and local areas, however, it is typically an untenable assumption for projecting the status of the elderly. The second assumption is that within a cohort the differentials in survival probabilities by characteristic are slight or nonexistent, or that differentials in survival probabilities are much smaller than the effects of intercohort differentials in status and relative size. An evaluation of this assumption follows some examples of the technique for projecting compositional characteristics.

**Projecting the number of children ever born among older cohorts of women.** Tables 2 and 3 give two examples of the projection technique as applied to Taiwanese data. In the case of interval variables, a summary measure, such as the mean, is projected. Table 2, showing the projected average number of children ever born (CEB) to women in the age categories of 60 and over at five-year intervals from 1985 to 2020, is based on data from the 1980 census, which reported the CEB for each age group of ever-married women. Such women represent more than 98% of all women in the age groups of 35 and over. Assuming that for women in 1980 no significant number of births would occur after ages 35–39, and further assuming no differential mortality among women of different parities, one can project the average number of children ever born among each older age group for the years 1985 to 2005. With the addition of forecasts of the completed fertility of cohorts still in the reproductive age span, the projection can be extended to the
year 2020. By combining these data with a recently calculated projection of the population by age and sex, one can estimate the average number of children ever born to various subgroups of the elderly, as shown in the last three rows of Table 2.

The top panel of Table 2 shows how the decline in CEB begins with the 60–64 age group and spreads to older five-year age groups as a consequence of the succession of cohorts. The number of children born to women of ages 60–64 begins declining with the cohort that reaches that age group in 1990 (the birth cohort of 1926–30). Women in this cohort were 40–44 years of age in 1970 and had spent a significant part of their reproductive span subject to the declining fertility that started in the late 1950s and continued with the rapid expansion of contraceptive availability in the 1960s.

In each of the five-year intervals from 1990 to 2010, the 60–64 age group of women will experience a decline in the number of children ever born amounting to about one-half a child per woman. This decline occurs over successive cohorts, reflecting the increasing adoption of contraception and the decreasing desired family size that have characterized Taiwan’s rapid demographic transition (Freedman et al. 1987). If the forecast data are correct, women 60–64 in 2015 will have had half the number of children of those 60–64 in 1990.

The bottom panel of Table 2 shows the implications for all the elderly and for the younger old (those 60–69) and the older old (70 and over), by combining the age groups weighted by cohort size. For all women 60 and over, there is a noticeable decline in the number of children ever born from 1990 on, which accelerates over time until about 2015. In 2015 this age group will have had two fewer children on average than the same age group had had in 1990. The average CEB for all the elderly masks two different trends, however. Women 60–69 will show an even steeper fertility decline, having two fewer children on average between 1990 and 2010; whereas the fertility of those 70 and over will decline much more slowly, decreasing by less than one child between 1990 and 2010 and remaining at an average of four children as late as 2015.

Projected declines in Taiwanese fertility signal the possible need for alternate forms of support for the elderly. Knowledge that the most vulnerable elderly age group (those 70 and over) will not experience a sharp drop in their total fertility until after 2010 or 2015 gives planners time to shape new policies.

The policy implications of these trends are obvious. The number of grown children available to older people reflects the potential for coresidence and other forms of support. Sharp reductions in fertility signal the possible need for alternate forms of financial, emotional, and physical support for which governments need to plan. The impact of the fertility decline may be moderated somewhat by the fact that secular declines in mortality will result in larger proportions of surviving offspring to elderly women. Knowledge that the most vulnerable of the elderly—those 70 and over—will not experience a sharp reduction in CEB until after 2010 or 2015 provides planners with a period of time within which to shape new policies.

Table 2 tells only part of the story, but together with the patterns of

| Table 2. Projected number of children ever born among women 60+: Taiwan, 1985–2020 |
|---------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 5-year age groups |        |        |        |        |        |        |        |        |        |
| 60–64             | 5.5    | 5.4    | 5.1    | 4.6    | 4.1    | 3.6    | 2.9a   | 2.6a   | 2.4a   |
| 65–69             | 5.4    | 5.5    | 5.4    | 5.1    | 4.6    | 4.1    | 3.6    | 2.9a   | 2.6a   |
| 70–74             | 5.3    | 5.4    | 5.5    | 5.4    | 5.1    | 4.6    | 4.1    | 3.6    | 2.9a   |
| 75–79             | 5.3    | 5.3    | 5.4    | 5.5    | 5.4    | 5.1    | 4.6    | 4.1    | 3.6    |
| 80+               | 5.3    | 5.3    | 5.3    | 5.4    | 5.5    | 5.4    | 5.1    | 4.6    | 4.1    |
| Broader age groups |       |        |        |        |        |        |        |        |        |
| 60–69             | 5.45   | 5.44   | 5.23   | 4.82   | 4.33   | 3.84   | 3.20   | 2.71   | 2.49   |
| 70+               | 5.35   | 5.35   | 5.42   | 5.41   | 5.28   | 4.96   | 4.55   | 4.07   | 3.48   |
| 60+               | 5.41   | 5.40   | 5.31   | 5.06   | 4.73   | 4.36   | 3.83   | 3.29   | 2.89   |

Sources: ROC (1982); ROC, Executive Yuan (n.d.).

a. Includes forecasts of completed fertility.
actual and desired support revealed by appropriate surveys, it can provide the groundwork for sound policy. In addition, it uses data that are readily available in many places.²

The use of CEB as a fixed characteristic throws into sharp relief the question of consistency of reporting by a cohort as it ages. It has been demonstrated that in some populations older women tend to underreport the number of children ever born, particularly omitting children who died shortly after birth. The expectation of this recall error was one impetus for the development of indirect methods of fertility estimation by Brass and others (Brass 1975; Brass et al. 1968; United Nations 1983:chap. I and II).

Whether the reporting of a "fixed" characteristic—be it education or childbearing—tends to change over time must be assessed with respect to both the characteristic and the setting before one can accept a projection at face value. In the case of Taiwan and the number of children ever born, analyses now under way (not reported here) demonstrate little tendency for older women to omit the reporting of children they have borne, and the magnitude of any change in the completeness of such reporting among cohorts of older women certainly does not mask the declines in actual fertility and their impact on the future elderly.

Projecting educational distributions characteristics of the elderly. As an example of categorical measures, Table 3 indicates that it is also easy to project forward the proportion of elderly with a given characteristic. The table projects the proportion of elderly Taiwanese males with less than a primary education and the proportion of elderly males with at least a senior high school education for the years 1985–2020. As demonstrated in these examples of educational attainment, one simply advances each cohort's proportion at each level of education and then combines these levels across cohorts, weighted by size, to obtain the distribution of all the elderly or particular subgroups. (The assumption that survival probabilities do not differ greatly across educational statuses is assessed in the shaded inset beginning on page 63.)

Most of the projected gain in educational levels of Taiwan's elderly will initially reflect improvement in minimum schooling. Around 2010, however, the proportion of elderly who have completed senior high school and higher levels of education will begin to grow rapidly.

The pace of change in the educational composition of the elderly male population slows down in the last decade of the twentieth century but resumes in the first decade of the next century. This temporary slowdown reflects the interruption that the onset of World War II caused in the trend toward increased opportunity for formal education in Taiwan, an interruption that directly affected the schooling experiences of the Taiwanese birth cohorts of the 1930s.³ As these cohorts enter their 60s at the close of

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² Note should also be taken of several alternate approaches for estimating indicators of the potential support of the elderly in the future that differ in methodology, assumptions, inputs required, and output measures from the projection technique presented here. Tu et al. (1992), for example, use an micro-simulation (KINSIM) of Taiwan based on 1985 period rates of fertility and mortality to generate kin distributions that would eventuate from a stable population. For each age group of women in this hypothetical population one can obtain, among other outputs, the number of children and the number of siblings of each sex. Lee and Palloni (1992) make use of a family status life table model to estimate, for various cohorts of women, the prevalence of widowhood by age and the number of children by age and marital status, among other indicators.

³ For estimating the status of the elderly in the future, which requires demographic data beyond 1985, marriage and birth patterns of 1985 are assumed to remain in force, and certain patterns of improved mortality are adopted. Where the outputs from these alternative methods overlap, future research might be aimed at a comparative evaluation of the projections resulting from these techniques.
the century, the proportion of males 60–69 years old with less than primary schooling and the proportion with a high school or greater level of education remain fairly constant.

The interruption caused by World War II also has implications for assessing trends in differentiation between the younger old and the older old. If one were to examine the projections only to the year 2000, it would appear that the differences between 60–69 year olds and those aged 70 and older with respect to attainment of a senior high or greater level of education had disappeared and that differentiation of the younger old and older old with respect to the attainment of less than a primary education was also on a continuous decline. Further inspection of the projection to the year 2020, however, indicates a re-emergence of age differentiation at both levels of schooling in the midst of a general trend toward increasing education for all age groups. Thus the imprint of historical events on the fixed characteristics of a birth cohort has implications for the pace of change in the composition of the elderly population as well as for the degree of heterogeneity or homogeneity of the elderly.

The trends toward increasing education have implications for policy because educational level is often associated with a population’s health status, types of demands

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Sources: Same as in Table 2.
made on health and pension systems, modes of communication, and quality of life in general. In addition, the particular pace of changes in education may have implications for the timing of policy changes or initiatives.

The educational status of elderly persons relative to that of the younger persons with whom they interact also has potential social implications for family relationships and labor force behavior. Projecting educational levels of the adult population for various age groups introduces the possibility of simulating age differences in specific levels of educational attainment.

One simple method, for example, is to use the data from Table 3 on the projected proportion of males in each five-year age group with a senior high or higher level of education to calculate the probability of a difference in schooling in an encounter between an older and a younger individual drawn randomly from their respective cohorts. Such an encounter would include four alternatives: only the older person has a senior high school education, only the younger person has a senior high school education, neither individual has a senior high school education, or both of them have attained this level of schooling.

Table 4 shows, to the extent possible, trends in the probability of these alternative outcomes when persons in the 65–69 year age group are compared with those at younger ages. The 40–44 age group was selected to simulate roughly the educational level of the sons of the older males, whereas the 50–54 age group might be taken to represent the educational level of the senior work force. The characteristics of 50–54 year olds relative to 65–69 year olds are relevant from an employment perspective because the younger group will likely be competing for the jobs of the older group. Large discrepancies in education may serve to push the older cohorts out of the labor market more rapidly.

Throughout the final decades of the twentieth century, the most likely alternative in a random encounter between a 65–69 year old man and one 40–44 years old is that neither will have a senior high school education. The probability of this alternative, however, is diminishing, while the probability that only the younger male will have this much education is on the increase and becomes the most likely alternative by the year 2000. The probability that only the older male has such an education remains small but fairly stable until the end of the century, when a decline in this outcome becomes evident. The probability that both men have at least a senior high school education tends to increase gradually during this period but is still less than 10% by the end of the century.

Although family interactions are far from random encounters, this simple simulation does suggest that intergenerational tension created by educational status differences between elderly and younger males can be expected to increase over the next several decades. The final outcomes will depend, of course, on the degree to which the educational system has expanded higher levels of schooling to social classes or groups that previously had limited access to advanced education. It (continued on page 58)

Table 4. Projected outcomes in the likelihood of completing senior high school in randomly selected pairs of older and younger Taiwanese males

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<td>Both</td>
<td>0.027</td>
<td>0.030</td>
<td>0.040</td>
<td>0.057</td>
<td>0.064</td>
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<td>0.140</td>
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4. Since this analysis focuses on variation between close-ended age groups as presented in the published data, this projection of age differences can be done without a population projection. The assumptions of a population closed to migration and of little or no survival differential relative to the fixed characteristic still apply.

This volume arose from a research program of the U.S.-based National Bureau of Economic Research (NBER) on immigration, trade, foreign investment, and the labor market. It includes 15 papers selected from those presented to a conference held in Cambridge, Massachusetts, in September 1987.

The book is organized into three parts. The first looks at the characteristics of the flows of people, goods, and capital to the United States. The second examines the effects of these flows on the U.S. labor market. The third reviews the comparative experience of Canada and Australia.

The project is distinctive in its approach of combining the study of migration with that of trade and investment, particularly at a detailed empirical level. Such an attempt at integrating factor flows is only to be lauded. A glance at any standard textbook on international economics shows how mainstream economists, in their modeling, neglect the movement of people and even investment, relying overwhelmingly instead on a traded-goods interpretation of the world economy. This book focuses on immigration, but as conditioned by complementary investment and trade perspectives.

The project is also provocative in its conclusions since, contrary to common presumption, it finds that "immigrants have been absorbed into the American labor market with little adverse effect on natives" (p. 22).

It also finds that "notwithstanding all the attention given to Japanese firms, the bulk of direct foreign-owned enterprises in the United States are European" (p. 23). At the same time foreign firms are at least as favorable to U.S. workers in employment conditions as are domestically owned companies. The volume concludes, however, that in contrast to people and capital flows, trade flows have harmed American labor. The impact of import increases on wages and employment has been severe.

Why should this be so? The answer is actually straightforward. People and capital flows have been smaller and induce offsetting consequences, in ways that trade in goods does not. For example, migrants spend on jobs as well as take them, and foreign equity leads to U.S. resource claims only when that foreign investment is profitable. Imports have no such significant direct counter-balancing benefits.

The benign result for immigration may explain why U.S. politicians have been emboldened to expand U.S. immigration under the congressional immigration-law reform package of late 1990.

The comparisons in the book with Canada and Australia, which show the higher levels of skilled international migration tapped by those countries, may also explain why the recent U.S. initiatives have sought a much sharper economic focus. Less clearcut is why such results have not muted concern over foreign investment, at least as opposed to foreign imports.

The volume, then, is interesting, productive, and pertinent. But it is also narrow, superficial, and outdated.

Its narrowness derives from a strongly short-term focus on economic impacts. Even in strictly economic terms the decision of the project organizers to look only at first-round impacts, rather than full equilibrium adjustments, and to put aside questions of how things may work out for the economy as a whole in the long run, seems limited. Much of the subtlety in economics lies in the indirect effects. Much of the interest in the economic role of immigration and investment lies in their historical contribution to the growth process. But that contribution is ignored in this volume.

The book is superficial in its treatment of policy, particularly immigration policy. The authors are mostly labor and trade economists with no particular specialty in immigration issues. This has the advantage of bringing bright, well-trained minds to bear on pertinent issues from a fresh perspective. The disadvantage is a limited basis from which to address policy development and its associated political and institutional processes. It may have been too much to expect economists to deal creatively with those social and cultural issues.
where much of the real action on immigration lies. But a greater leavening of policy experience in the field could have helped.

Finally, the book is outdated both literally and figuratively. For papers from a conference that was held in 1987 to appear in print only in late 1991 seems a rather unfortunate delay in a rapidly evolving policy area. Indeed, the impact of the book may have come and gone. The earlier informal circulation of its ideas may well have been part of the climate of opinion leading to the now-achieved reform of U.S. immigration law.

But it is also outdated in a broader sense, that is, in its focus on settler migration. Certainly it grapples with the issue of illegal migration and certainly it talks of the internationalization of the U.S. economy. But it slights other people flows that are of equal importance to settler movements.

Other, far greater dimensions of modern globalization include business, tourist, and student movements of very large magnitudes, as well as the complex refugee and humanitarian movements. The latter pose problems for economic interpretations of causes and the former pose problems for economic interpretations of impact that seek to distinguish people flows from trade. In a world where international tourist expenditures often exceed the value of manufactured exports and where the export of educational services is expanding in leaps and bounds, flows of trade and people are as much joint as separate.

Even in its own economic terms the NBER volume needs to be supplemented by longer-run analyses, policy analyses, and examination of broader international population flows. For a fully comprehensive view of immigration, more focus is needed on impacts on source countries and on social and cultural dimensions.

We are still awaiting the project that can provide that blend. And we are still awaiting studies for countries other than those of North America and Australasia. In the meantime the Abowd and Freeman book makes a helpful contribution upon which others can build, and it certainly innovates in centrally linking people flows to investment and trade.

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Although controlling the movement of people across borders is one way for governments to influence population size (the other acceptable way being to adopt pronatalist or antinatalist policies), demographic concerns have not, as a rule, been central to national migration policies. Insufficient knowledge about the complex links between migration and demographic growth has hampered the consideration of policy choices.

In November 1988 a Working Party on Migration brought together OECD member country experts on migration to address this research issue. The current monograph contains their contributions to the meeting, together with an OECD Secretariat paper synthesizing the main conclusions of the workshop participants. The chief message from the discussions is that unless countries are willing to admit substantially larger numbers of migrants each year than they have during recent decades, migration “cannot be expected...to compensate for the slowing down of demographic growth and the ageing of populations of OECD countries” (p. 3). Future migration policies are expected to have a more pronounced demographic dimension to offset the negative economic effects of aging in those nations.

The introductory chapter sets forth the demographic challenges that declining populations present to European countries, describes the contributions of the succeeding chapters, and summarizes the conclusions drawn from the papers and the workshop discussions. A main conclusion is that “the seemingly simple proposition of increasing the intake of young migrants to com-
pendate for the slowdown of population growth and \ldots aging'' faces formidable technical and political obstacles. ``In fact, many countries clearly reject the migration option as a means of countering unfavourable demographic shifts'' (p. 13).

In chapter II Hervé La Bras estimates the effect of post–World War II migration on the population growth of seven OECD countries (Australia, Belgium, Canada, France, Germany, Italy, and Sweden), and finds that whereas its effect on total population growth has been substantial (accounting, for example, for 38% of Australia's growth since 1945), its effect on the age structure has been modest. ``Le Bras argues that migration waves are triggered by economic upswings but then persist as a result of their own inherent dynamics, such as family reunion,'' with the result that over several decades structure of the population with migrant origins begins to resemble that of the host population.

Using data for 11 OECD countries since 1965, the OECD Secretariat analyzes the fertility of nationals and foreigners over time (Chapter III). The findings indicate, on one hand, that the fertility of immigrants is usually higher than that of the native population and the effect of foreign births on family size is considerable; on the other hand, the higher foreign fertility affects total fertility only modestly because it represents a generally small share of total fertility.

In Chapter IV, Hania Zlotnik discusses the methods used to make official population projections for nine OECD countries, finding much variation, particularly in data availability, among them. Although the projections make similar assumptions of a small decline in mortality, a modest increase in life expectancy, and narrow fluctuations in fertility, the assumptions about future migration tend to reflect current migration policies rather than statistical analysis of past migration trends. Zlotnik concludes that ``The tendency to develop assumptions about future migration without taking account of undocumented movements—both existing or potential—or those of asylum-seekers and refugees is detrimental for the realistic assessment of future prospects'' (p. 54).

One way to approach the relationship between population size and migration is to ask what migration flows would be required to achieve certain demographic objectives, for example, to have a steady flow of workers. In Chapter V Christine Watteler and Guido Roumans present various simulations of fertility, mortality, and migration to the year 2050 for four countries with different age structures and migration histories (Austria, Belgium, Canada, and Spain).

Their results: (1) In the absence of migration, at current fertility levels the populations of all four countries would begin to shrink by 2025; even if total fertility were to rise to 2.1 children per woman, deaths would outnumber births in all those countries by 2040. (2) If migration is to be used to prevent population declines, this will have to start as early as 1990 in Belgium and Austria, by 2000 in Spain, and by 2010 in Canada. The volume of immigration into Belgium and Canada would have to double. (3) The ratio of the economically active population (ages 20–64) to the retired population (ages 65 and over) in the absence of immigration would fall to below 3 by 2020 except in Spain.

Watteler and Roumans next consider three possible scenarios for migration. First, immigration is used to maintain an active/retired ratio of 3. In this scenario, migration would occur in great and fluctuating numbers, eventually creating a ``population explosion.''' Second, the size of the active population is held constant, while the active/retired ratio is allowed to fluctuate. This scenario results in fewer migrants being needed and smaller fluctuations in their numbers. In the last scenario, immigration would be constant to assure an active/retired ratio equal to 3 in the year 2050. This would result in more immigration than in the second scenario. If life expectancy rises, retirement age would also have to rise to maintain an active/retired ratio of 3.

Canada and Australia have gone further than the other OECD countries in considering migration as a means to achieve demographic goals. Discussing Canada's population structure (Chapter VI), David Foot argues that, as that country has already created a points system for immigration criteria, a mechanism is in place to smooth out Canada's demographic profile over time—a profile currently bulging in the 34–53 age group consisting of postwar baby boomers. New immigrants could be selected on the basis of age and admissible ages adjusted over time, depending upon demographic and labor market conditions.

(continued on page 68)
Both Continuity and Change Are Goals of East-West Center's President

In a mid-July speech to Friends of the East-West Center (EWC), President Michel Oksenberg described his vision of the Center’s future and outlined organizational changes he has begun making to realize that vision. Among those changes are the replacement of the Center’s institutes with research programs; a Center-wide system of student recruitment and education; the development of a core curriculum for all EWC graduate students that will lead to an EWC certificate; and the establishment of a conference program on issues of contemporary regional significance that will be overseen by an international committee of scholars and policy analysts. Central elements of Oksenberg’s vision are strengthening the Center’s ties to the U.S. mainland and the Hawaiian community and diversifying the Center’s funding.

The East-West Center, officially known as the Center for Cultural and Technical Interchange Between East and West, Inc., is a public, nonprofit, education and research institution established by the U.S. Congress in 1960 to promote better relations and understanding between the United States and the nations of Asia and the Pacific through cooperative study, training, and research. Oksenberg, who became its fourth president in January 1992 (see APPE Vol. 5, No. 4, p. 107), believes that the Center’s mission is as relevant as ever and that many of its valuable traditions must be preserved. He hopes, however, to make the Center more responsive to changes that are occurring throughout the Asia-Pacific region, and in particular to Asia and the Pacific’s changing relationship to the United States. The United States, having ceased to be an overwhelmingly dominant economic power in the region, “can no longer be the benevolent patron of Asia-Pacific countries,” he told the Friends organization. “Instead, it must learn to act as a mature partner, an equal.”

Flexible agenda needed

The Center’s intellectual agenda must be able to respond flexibly and swiftly to new issues as they arise in the region, stated Oksenberg. “We must not forever identify with issues of the 1970s and 1980s, some of which are no longer of pressing concern.” The Center, he noted, is well positioned to study interface issues, such as “how changing demographic profiles affect economic growth, how growth affects energy consumption, how energy consumption affects the environment, how environmental degradation affects security, how environmental change affects health, or how telecommunications change culture.”

Creating a single intellectual community, particularly among the Center’s researchers, is one of the president’s first objectives. That is why research programs have replaced the operationally more autonomous institutes. Another priority is to diversify the student program by increasing the proportion of EWC scholarships to students from the Pacific islands and the least developed countries of Asia, by enrolling students from the former Soviet Union for the first time, and by developing curricula specifically for Pacific islanders and Indochinese students. The Asian Studies Development Program, established several years ago to make Americans more aware of the Asia-Pacific region by bringing faculty from U.S. mainland colleges and universities to the Center for short periods of study, will place new emphasis on reaching institutions with substantial numbers of minority-group students.

Oksenberg plans to improve the Center’s outreach through the creation of a speaker’s bureau and the development of a more visible publication program, and by offering special seminars about the region to rising leaders in government, business, the military, communications, and the humanities. A Humanities Forum will enable artists and scholars to spend six to 12 months at the Center pursuing their work and interacting with one another.

New Research and Education Division

As part of the Center’s reorganization, a Research and Education Division has been created that incorporates the former institutes, now called programs. The division is headed by Vice President Bruce Koppel, former interim director of the Institute for Economic Develop-
ment and Policy. Besides population, the research-oriented programs focus on cultural studies, communications and journalism, international economics and politics, the environment, resources (energy and minerals), and Pacific islands development. The division also oversees the Center’s students, teacher training, short-term training programs, and conferences.

Another new division, Program Development, has the goal of launching a new program focusing on economic development and cooperation in Northeast Asia with support from governments and private organizations in that region. Lee-Jay Cho, former director of the Population Institute, is the division’s vice president (see APPE, Vol. 6, No. 1, p. 19).

The Center’s public affairs and public education activities have been merged into a single office, called Public Programs. Headed by Webster Nolan, it has responsibility for publications, news and information, alumni activities, community relations, the new speakers’ bureau, and exhibitions and films.

Andrew Mason Is Named Director of the East-West Center’s Program on Population

Andrew Mason has been appointed director of the East-West Center’s Program on Population (formerly called the Population Institute), replacing Lee-Jay Cho, who recently assumed the post of vice president for program development.

Mason, 44, joined the Center in 1975 after earning his Ph.D. from the University of Michigan. An economist by training, he also holds a joint appointment as professor of economics at the University of Hawaii. Between 1984 and 1989 he served as the institute’s assistant director for professional education. During 1983–84, while on leave from the Center, he was a visiting scholar at the Sloan School of Management Science, Massachusetts Institute of Technology.

Andrew Mason has been appointed director of the Program on Population, East-West Center.

In collaboration with other economists and demographers from the region, Mason has developed a model for projecting the number and demographic characteristics of households and assessing the likely impact on important social and economic features of the household and its members. The model, known as the HOMES model, is being used by a number of Asian governments in their economic planning efforts and has also attracted the attention of the popular press. A coauthored monograph that includes a detailed analysis of household changes in Japan during the last two decades has just been published by the Japan Statistical Association in cooperation with Nihon University, and a coedited volume describing the application of HOMES to Thailand is due to be published in early 1993 by the East-West Center.

Japan’s Statistics Bureau Pulls Out All Stops for the Fourteenth Population Census Conference

Representatives of census organizations in 23 Asian and Pacific countries, including for the first time Brunei and Mongolia, and from several international agencies gathered in Tokyo during May 26–28 for the Fourteenth Population Census Conference, hosted by the Statistics Bureau of Japan and cosponsored by the East-West Center’s Population Institute (now the Program on Population). The meeting was the latest in a series begun by the Population Institute in 1971 to facilitate the comparable collection, tabulation, and analysis of census data in the region and to encourage cooperation between statistical agencies and researchers who rely upon census data. Hosting the event were Mitsuru Ide, director-general of the Statistics Bureau, and Lee-Jay Cho, director of the Population Institute and vice president for development of the East-West Center. Griffith Fenney, East-West Center research associate, and Takanobu Negi, director of the
General Affairs Division, Statistics Bureau of Japan, were the conference coordinators.

Conference participants, many of whom head the bureaus they represent, spent the three days exchanging information about their countries' census operations during the 1990 round of censuses, summarizing the census results, and describing their plans for future population surveys and censuses. The meeting had special significance because the 1990 census round was the last decennial round of the twentieth century.

The conference also provided an opportunity for founding directors of the Association of National Census and Statistics Directors of Asia and the Pacific (ANCSADAP) to approve a document formally establishing the association, which is an outgrowth of the cooperation that has existed among the census organizations of the region for many years. The nonprofit association, which has been incorporated in the state of Hawaii, will support future conferences and networking activities of the region's census bureaus, including publication support for selected issues of the Asian and Pacific Population Forum.

Founding association directors are Barbara Everitt Bryant, director of the U.S. Bureau of the Census; Mitsuru Ide; Telk Huat Khoo, chief statistician of the Department of Statistics, Indonesia; Tai-Hyung Min, administrator of the National Statistical Office, Republic of Korea; Amulya Ratna Nanda, registrar-general and census commissioner of India; and Azwar Rasjid, director-general of the Central Bureau of Statistics, Indonesia. Other census organizations are expected to join the association in the near future.

On the last day of the conference, participants were invited to visit the Statistics Bureau and observe a demonstration of its census mapping system (CMS) and its online statistical data-base system called SISMAC (statistical information system of management and coordination). CMS uses high-powered computers to map characteristics of Japan's census enumeration districts. It has greatly improved the mapping that must be done before a census is conducted, and it can be used to display census results, such as population density, by geographic area with a high degree of sophistication. SISMAC links 19 user ministries to the Statistics Bureau's data base, giving them direct access to census and survey data. The two systems have enabled the bureau to expedite the release of census results and to make the data easier for other agencies to use.

Census conferees enjoyed the exceptional hospitality of their hosts, who held several receptions in their honor and, on the day after the conference ended, arranged for them to tour the Fanuc robotics factory in Fuji prefecture and afterward to visit Mt. Fuji. To members of the conference secretariat, who worked tirelessly to ensure that conference ran smoothly, the participants were especially appreciative.

A list of conference presentations and participants appears in the shaded box beginning on page 49.

(continued on page 51)
Presentations and Participants at Fourteenth Population Census Conference

Readers wishing to obtain copies of the conference papers, which are designated with an asterisk (*) in the list of presentations below, should direct requests to the authors, whose addresses are included in the list of participants.

PAPERS AND PRESENTATIONS

Opening Ceremony
Opening Remarks, by Mitsuru Ide and Lee-Jay Cho

Status Reports on Recent Censuses
Lee-Jay Cho, Barbara Everett Bryant, and Teik Huat Kho, Chairs
*A Brief Note on Preliminary Results of the 1990 Population Census of Indonesia, by Azwar Rachid
*Current Status of Census Operations and Processing of the 1991 Population and Housing Censuses of Malaysia, by Teik Huat Kho
*Some Topics Concerning the Accuracy of the 1990 Population Census of Japan, by Nobuyuki Urate
*Co-ordination of 1990 Census Activities and Problems Encountered in the Census from Provincial Perspectives in Papua New Guinea, by Kit Rongga
*The Use of a Population Census in a Changing Society: The Case of Mongolia, by B. Tsend-Ajush
*The Mexican Population and Housing Census of 1990 and Other National Demographic Surveys During this Decade, by Francisco Javier Gutierrez and Eduardo Rios Mingrum
*Measuring and Correcting for Census Coverage Errors, by Howard R. Hogan and J. Gregory Robinson

Census Data Processing
Maree Curran, Chair
*Developments in Data Processing and Utilization of the 1990 Population and Housing Census in the Republic of Korea, by Min-Kyung Kim
*The Philippine Experience with Decentralized Processing During the 1990 Census of Population and Housing, by Neila R. Marquez

Sample Surveys and Censuses
Azwar Rachid, Chair
*How Surveys are Changing at the U.S. Bureau of the Census, by Barbara Everett Bryant, Sherry L. Courtland, and Preston Jay Waite
*Survey Design for the Bangladesh Sample Census, 1991, by Mohammad Hamidul Hoque Bhuban
*Monitoring Emerging Trends through Inter-censal Surveys - Singapore's Plans and Experience, by Paul Cheung

Planning for Future Operations
Phensri Suwansingha, Chair
*Planning for the Post 1991 Inter-censal Surveys and Studies in India, by Amulya Ratna Nanda
*Planning for the 1996 Fiji Census of Population, by Sakti Bala Bilekai
*Emerging Needs in the Population and Housing Censuses: 1990 Round and Beyond, by Yuen-chung Yu

Analysis of Census Results
Neila R. Marquez, Chair
*Applications of Census Data in Projections of Demographic and Socio-economic Aggregates and Implication of these Projections for Planning, by Chi Ming Luk
*Small Area Statistics of the Population Census of Japan, by Takinosuke Dateki

Dissemination and Utilization
Zhang Weiming, Chair
*Dissemination and Utilization of Vietnam's 1989 Census Data, by Le Van Toan
*Promoting the 1991 Australian Census and Marketing Its Products and Services, by Maree Curran

*The Utilization of the 1990 Census Data of Thailand, by Chintana Pejaranonda

Future Plans and Activities
Lee-Jay Cho and Mitsuru Ide, Chairs

Closing Ceremony

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Activities and Announcements
(continued from page 48)

The next item in this section presents highlights from the report on the 1990 census of China presented by Zhang Weimin. The fall issue of the Forum will contain an article by Barbara Bryson on how surveys at the changing at the U.S. Census Bureau, based on her conference paper, and highlights of several other presentations. Readers interested in obtaining copies of any of the conference papers should request them directly from the participants.

More Results from China's 1990 Census Are Being Released

The Chinese government has significantly improved the design and formats of its computerized cross-tabulations of data from the 1990
census, according to Zheng Jiaheng and Zhang Weimin of the State Statistical Bureau, who reported on the status of China's census operations at the Fourteenth Population Census Conference held in Tokyo in May. Because all of the cross-tabulations for national, provincial, prefectural, and county levels, if printed, would fill 9.85 million pages, the government is selecting only the most commonly used ones for publication. The State Statistical Bureau will begin releasing the cross-tabulations at the beginning of 1993.

In addition to the published tabulations, data from the census will be made available to users for detailed analysis in a series of computerized data bases. These will be:

- A micro data base of sample households, called the 1% household data base, containing national and provincial-level data. It will allow statisticians to tabulate the data in any format they wish.
- A subject-specific data base that includes data on the industrial and occupational structure of the employed population, on nationality characteristics of the minority population, on the fertility of women of childbearing ages, and on mortality.
- A macro data base (also called the aggregation data base), with each county as a recording unit, that will include such aggregated data as the total population, population by sex, population by large age groups (children, persons of labor-force age, the elderly), birth rate, death rate, number of women of childbearing ages, total fertility rate, general fertility rate, infant mortality rate, average life expectancy, and population by industry, occupation, and educational attainment. Offering easy retrieval, this data base should be particularly useful for government leaders and other decision makers who need timely information about the Chinese population.

Experiments with the data bases have been under way since last spring, and work on building them will begin in 1993.

By July 1992 the bureau planned to issue population census maps illustrating China's population growth, population density, and the urban–rural distribution of the population for 2,852 counties. A year before it released a volume containing 124 tables based on the 10% advance sample tabulations from the census.


United Nations Forms Inter-Agency Technical Support Team for Region's Population Programs

The United Nations announced in mid-August the formation in Bangkok of an Inter-Agency Country Programme Technical Support Team (CPTST) for East and Southeast Asia, under the aegis of the United Nations Population Fund (UNFPA). The team, headed by Dr. Ghazi Farooq, will include 13 population advisers from the Economic and Social Commission for Asia and the Pacific (ESCAP), the Food and Agriculture Organization (FAO), the International Labour Organisation (ILO), the UN Educational, Scientific, and Cultural Organization (UNESCO), and the World Health Organization (WHO). Their task will be to provide high-level technical support to national population programs in such areas as basic data collection; population policy formulation, implementation, and evaluation; maternal and child health and family planning; population education; and rural development planning.

According to the UN, "the new arrangements will ensure a unified and multi-disciplinary team approach that will promote better co-ordination and cross fertilization of ideas among the advisers." With backing from specialized services at the UN agencies' headquarters, the team is expected to bring "both greater expertise and increased flexibility to ensure more rapid response to country needs."

The advisers will share technical knowledge and skills developed within the UN system. They will also organize and conduct training activities at the regional and country level to upgrade competencies of project personnel. Their expertise ranges from social science research and management information systems to nonformal population education.

Before assuming his new post as team leader for CPTST, Farooq served as senior population economist and head of the Population and Human Resource Planning Unit of the ILO in Geneva and more recently as coordinator of the ILO's population activities.
Factors Associated with Child Mortality . . .
(continued from page 34)

tracement. Proximate variables related to the health of the mother and the child are available only for the last child born during the three years preceding the survey. They include prenatal care, place of delivery, type of attendant at the delivery, whether the child was immunized, whether the child had visited a physician or clinic when ill, and the mother’s knowledge and experience of using an oral rehydration solution.

Several of the variables are indicators of other factors that may directly affect child survival. For instance, only a small proportion of women in Pakistan use contraception, and for a majority of those who do so the purpose is to limit family size rather than to space births. Evidence from prior research indicates that some women who use contraception may prolong their birth intervals (Ahmed 1989), but because they use contraception inefficiently, they end up having more births than planned. Nevertheless, women who report that they have used contraceptives probably wish to control their reproduction. I assume that for that reason they are likely to be less fatalistic than other women and to be more likely to make conscious efforts to improve their children’s survival chances.

For the multivariate regression analysis I selected the maternal age group below 20 to determine whether younger women had experienced higher than average mortality, which might be assumed from their physical immaturity and inexperience in providing child care. For the family-composition variable, I chose a dummy variable reflecting whether a woman had borne more daughters or sons to assess sex differentials in infant and child mortality. Son preference is known to be strong in Pakistan, which has a patriarchal lineage system. I expected to find that women who had borne more daughters had experienced a higher incidence of infant mortality than other women.

I estimated the effects of these variables for rural and urban women separately because the availability of, access to, and use of health services are generally assumed to be much greater in urban than in rural areas of Pakistan. By analyzing urban and rural residents separately I hoped to identify the population most in need of health services.

Table 3 presents the estimated regression coefficients for urban and rural women, with statistical significance indicated by asterisks. In urban areas, children born to mothers with some formal education were found to have experienced less mortality than those whose mothers had no formal education. However, the estimated coefficients for children whose mothers had six years or more of formal education was not statistically significant. This finding is possibly due to the fact that only a tiny proportion of Pakistani women have six years or more of education. (Among currently married women between ages 15 and 19 in the PCPS, fewer than 8% had completed six or more years of schooling.)

![Environmental contamination, such as this open latrine next to a river used for bathing and drinking water, poses a special threat to children's survival.](image)
In rural areas the relationship between a mother’s education and child mortality was not statistically significant, probably because of the negligible proportion of women with formal education in rural Pakistan. It is also possible that in rural areas the mortality transition has not progressed to the stage where significant socioeconomic differentials in child mortality can be observed. A study in Malaysia found that the effect of parental education on child mortality increases after mortality has begun to decline (DaVanzo and Habicht 1986).

Among urban fathers, a high level of education (11 years or more) was associated with lower child mortality, but an intermediate educational level was associated with higher child mortality, compared with the level of mortality among children whose fathers had no formal education. This finding is surprising but not totally implausible.

It is possible that lower middle-class families in urban areas are exposed to unfavorable conditions for child survival, such as crowded and unsanitary housing and a low prevalence of breast-feeding, whereas families in which fathers have little or no formal education may practice traditional customs that include extensive breast-feeding and limited exposure to some environmental health risks associated with initial stages of development.

Exposure to child mortality is likely to be lowest in families headed by fathers with a high level of education because such families tend to have better nutrition, living conditions, and medical care than those in which the father has no formal education.

Both urban and rural women in Balochistan reported significantly higher infant mortality than those in the Northwest Frontier Provinces. Among rural women, those from Punjab also experienced higher child mortality. These results are consistent with findings from prior surveys, and their causes need more study.

Contrary to expectation, in rural areas children of mothers under age 20 seem to have lower mortality than those of older mothers. Part (possibly a large part) of this relationship, however, may be due to the way the dependent variable was defined. Although I adjusted the dependent variable (the Mortality Index) for marriage duration by grouping marriage duration into five-year intervals, some variation in

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
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<tbody>
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<td>Urban</td>
<td>Rural</td>
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<tr>
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<td>-0.204*</td>
<td>-0.183</td>
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<td>-0.163</td>
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<tr>
<td>Father’s education (≤ 5 years is reference)</td>
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<td>-0.038</td>
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<tr>
<td>11+ years</td>
<td>-0.289*</td>
<td></td>
<td>-0.070</td>
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<tr>
<td>Mother’s work status (not working is reference)</td>
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<tr>
<td>Currently working</td>
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<tr>
<td>Residence (Northwest Frontier Provinces are reference)</td>
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<tr>
<td>Punjab</td>
<td>0.062</td>
<td>0.171*</td>
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<tr>
<td>Sind</td>
<td>-0.089</td>
<td>0.045</td>
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<tr>
<td>Balochistan</td>
<td>0.258*</td>
<td>0.335*</td>
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<tr>
<td>Mother’s age at last birth &lt; 20</td>
<td>-0.058</td>
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<td>-0.563*</td>
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<tr>
<td>Sex composition (reference is M = F)</td>
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<tr>
<td>F &gt; M</td>
<td>-0.164*</td>
<td></td>
<td>-0.128</td>
</tr>
<tr>
<td>F &lt; M</td>
<td>-0.190*</td>
<td></td>
<td>-0.128</td>
</tr>
<tr>
<td>Used contraception</td>
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<td>-0.046</td>
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<tr>
<td>Received prenatal care</td>
<td>0.066</td>
<td>0.238*</td>
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<td>Delivered at hospital/clinic</td>
<td>0.045</td>
<td>0.041</td>
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<tr>
<td>Doctor or nurse attended</td>
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<td>0.053</td>
</tr>
<tr>
<td>Child received immunizations</td>
<td>-0.070</td>
<td></td>
<td>-0.085</td>
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<td>Child visited doctor</td>
<td>-0.018</td>
<td></td>
<td>-0.114*</td>
</tr>
<tr>
<td>Mother knows or used oral rehydration solution</td>
<td>-0.017</td>
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<td>0.043</td>
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<tr>
<td>$R^2$</td>
<td>0.036</td>
<td>0.036</td>
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<tr>
<td>Number of mothers</td>
<td>1,672</td>
<td>2,748</td>
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</table>

* $p < .05$. 

Table 3. Estimated regression coefficients of child mortality in Pakistan: Pakistan Contraceptive Prevalence Survey, 1984–85
child mortality remains in the number and age distributions of deceased children among women with similar marriage durations. This variation may be associated with the characteristics of mothers. For instance, children born to mothers who had delayed marriage were more likely to be younger and therefore to have had shorter periods of exposure to death than children of young mothers. In other words, mother’s age provided a partial control for the number of child deaths and their age distributions. The results for the sex combination of children indicate that children from urban families in which either boys or girls outnumbered children of the opposite sex experienced lower mortality than did children from families with balanced sex ratios. Why this should be so is not clear.

Among the variables representing maternal health, only prenatal care proved to be a significant—and surprisingly, positive—factor. Contrary to results from earlier studies, children born to rural women who had received prenatal care experienced higher rather than lower mortality. I interpret this result as due to the likelihood that only women who had had pregnancy complications or who had previously suffered the loss of a child sought prenatal care in rural areas.

Among the child-care variables, only visiting a doctor when a child was ill proved to be significant, and it was so only in rural areas. Because of the government’s recent efforts to provide health services in remote areas, I had expected that immunization would show a significantly positive effect on child survival. The result does not support this hypothesis, however. The immunization program may be inadequate, perhaps because it does not reach children at appropriate ages or because the vaccines are ineffective.

It is noteworthy that none of the variables related to mothers’ or children’s health care appeared to affect child mortality significantly in urban areas. However, when a reduced model with only variables related to health care was estimated (result not shown here), immunization was found to be a statistically significant factor. Further examination revealed a strong positive correlation between mothers’ education and child immunization. Thus one of the reasons why immunization was found not to be a significant factor in urban areas is that the model included a variable that is highly correlated with immunization.

This was not the case for rural areas. There, immunization proved not to be a significant factor whether education was included in the model or not. This result suggests that prenatal care and immunization programs in rural Pakistan have not achieved their full potential in improving child survival. As for curative health care, the visits to clinics or hospitals were significant factors in reducing mortality in rural areas.

In summary, the multivariate analysis indicates that the factors affecting infant mortality are different in urban and rural areas. In urban areas socioeconomic conditions seem to affect child mortality more than other factors, whereas in rural areas child mortality seems to be influenced more by curative health care.

In urban areas social and economic conditions seem to have the greatest effect on child mortality, whereas in rural areas curative health care seems to be more influential.

Discussion

Other studies (e.g., Mosley and Chen 1984) have found that major improvement in child survival is achieved through women’s use of both preventive and curative health services. Education provides women with decision-making power, reducing their fatalism, making them more aware of children’s welfare, and increasing their knowledge about childhood diseases and their scientific understanding of illness (Cleland and van Ginneken 1988). More-educated women tend to seek medical services for their children even if they have to travel long distances and make unexpected expenditures.

The need for medical services starts at pregnancy. Prenatal care, the conditions surrounding delivery, and the competence of the person attending a delivery are all associated with risks to maternal and child health and survival. Medically unqualified birth attendants and unsanitary deliveries can result in injuries to the newborn that are commonly reported reasons for high infant mortality at the neonatal stage.

This study has found that in urban areas, the better were parents educated, the more likely were their children to have been immunized against childhood diseases. Table 4 shows strong positive associations
in both urban and rural areas between women's educational level and three health variables—whether they had received prenatal care, whether their children were immunized, and whether they had taken ill children to see a doctor. The small difference in the prevalence of child immunization between urban and rural areas may be associated with the provision of outreach services in rural areas of Pakistan in recent years. Immunization, however, proved not to be a significant factor in the survival of rural children, a finding that suggests that the immunization program may not have been effective in rural areas in the early 1980s.

Pakistan's health facilities need to be modified to match the needs of local people. The provision of mobile health units, training for traditional midwives in modern medical practices, and supplies needed by midwives for safe deliveries would improve child survival.

This study has found a clear negative association between infant mortality and maternal educational level, one that becomes stronger as mothers' educational levels rise. But a general rise in the average level of female education, especially in rural areas, does not seem to have greatly improved children's survival chances in Pakistan. The reason, as DaVanzo and Habicht (1986) argue, is probably that not enough health facilities and resources exist to be available to the public at large.

### Summary and Conclusion

Infant mortality is still quite high in Pakistan, more than 100 deaths per 1,000 live births. It is higher in rural areas and in the provinces of Punjab and especially Balochistan. Higher levels of maternal education are associated with improved child survival in urban areas. High levels of education among fathers is also a significant factor in reducing infant mortality.

Recent efforts to provide basic health care to rural Pakistanis seem to have had limited success in improving children's survival chances. Although immunization against childhood diseases is widespread in rural areas, its impact on child mortality is not statistically significant; and in urban areas it is not a significant factor when mothers' educational level is taken into account.

The immunization program could have a much greater impact on child survival if it were administered more effectively and reached groups most in need, such as the poor and less educated. Prenatal care seems to be sought mainly by high-risk women. In rural areas more emphasis is needed on preventive services such as prenatal care for all pregnant women and immunizing children at optimal ages (0–9 months). In addition, programs to reduce leading causes of infant and child mortality, such as acute respiratory disease and gastroenteritis, need to be improved. The availability of primary health care programs, combined with public health education for rural residents, would in all likelihood lead to major improvements in child survival.

This study has been limited to indirectly estimating child mortality and its covariates because data on the survival of individual children in respondents' birth histories were inadequate. For more detailed analyses of child mortality, better survey data are required. An effort should be made to improve the design of future surveys.

### Table 4. Percentage of currently married women using various health services in Pakistan, by urban–rural residence and women's educational level: Pakistan Contraceptive Prevalence Survey, 1984–85

<table>
<thead>
<tr>
<th>Residence and education</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prenatal</td>
</tr>
<tr>
<td>Urban areas</td>
<td></td>
</tr>
<tr>
<td>No formal education</td>
<td>31.6</td>
</tr>
<tr>
<td>1–5 years</td>
<td>45.4</td>
</tr>
<tr>
<td>6+ years</td>
<td>67.0</td>
</tr>
<tr>
<td>Rural areas</td>
<td></td>
</tr>
<tr>
<td>No formal education</td>
<td>18.6</td>
</tr>
<tr>
<td>1–5 years</td>
<td>36.0</td>
</tr>
<tr>
<td>6+ years</td>
<td>48.4</td>
</tr>
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</table>

### ACKNOWLEDGMENTS

Funding for this research project was provided by the Office of Population, U.S. Agency for Interna-
tional Development, under its Demographic Data Initiative Project through a Cooperative Agreement with the Population Institute of the East-West Center. The support included a short-term research fellowship at the institute. Special thanks are due to Minja Kim Choe for her immense help on this article and her support for my work.

REFERENCES


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(continued from page 42)

is within these social classes or groups where intergenerational tension would be the greatest.

This simple simulation suggests that intergenerational tension created by differences in educational status between elderly and younger males will increase over the next several decades.

Somewhat similar outcomes are found in a random encounter between a 65–69 year old man and one 50–54 years old, as projected to 2010. Although the greatest likelihood is that neither has a senior high school education, the probability of this alternative starts to decline in 1990. The probability that only the younger male has a senior high school education begins to increase rapidly during the last decade of the twentieth century. By the year 2010 this type of random encounter is just as probable as one in which neither man has a senior high school education. The likelihood that only the older male has this level of schooling fluctuates, rather than declines, during the period from 1980 to 2010.

To the extent that educational credentials are a determinant of career outcomes, the growing tendency for only the younger males to have a senior high school education may create increased pressure on older men to step aside or withdraw from the labor force altogether. This tendency may be ameliorated somewhat by a small but growing probability over the projection period that both the younger and the older male have at least a senior high school education.

Net Transition Rates within Cohorts
When one examines characteristics, such as marital status or labor force participation, that can change with age over the life span, interest shifts to ascertaining the rate of change for a cohort as it advances from one age group to another. Ideally one would like to know the gross as well as the net shifts—for example, how many in a given cohort married and how many dissolved a marriage in a given period. Census data are rarely detailed enough to provide this information, but they can be used to estimate the net rate of change in a cohort’s status.

This application is well recognized in the development of age-specific migration rates from two censuses through the use of census survival ratios. The logic of the technique can be extended directly to other characteristics relevant to studies of the elderly.

The technique consists of applying the census survival ratios to the members of a cohort having a specific status in one census to estimate the expected number in the next census and then comparing this expected number with the actual number in the second census. The difference provides an estimate of the net change in number and allows the calculation of net rates of change (Shryock and Siegel 1976). Life table survival rates may also be used to calculate the number expected to have a particular status at the second census. In general,
however, estimates of intracohort change based on the census survival ratio will have the advantage over those based on life table survival of taking into account errors in population statistics related to census coverage (Shryock and Siegel 1976:360).

This procedure is illustrated in panels A and B of Table 5 for the economically active male population of Thailand in 1960 and 1970. As expected, the results in the last column of panel B show net movement over the decade into the economically active status among the two youngest cohorts but net movement out of economic activity thereafter, with a net “out-migration” of 260 per 1,000 for those 50 and over in 1960. One can further compare the net transition rates for the same cohort and time period among subgroups of a population.

Table 5. Use of census survival ratios to assess the mobility of economic activity: Male population of Thailand

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<td>–317.9</td>
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a. It is assumed that no one of age 10 is in the labor force because government figures report only workers of ages 11 and older.

b. Transition rate per 1,000 equals the difference between actual and expected divided by the average population of the two censuses.
defined by fixed characteristics, such as gender. The comparable data for females are shown in panels A and B of Table 6 and indicate earlier and larger net movement out of the economically active class for females.

If the data permit, the same strategy can be used to compare labor force movement among educational or literacy groups. Again, such data have direct policy relevance. Although the economic interrelationships may be complex, knowing the direction and rate of labor force change for key groups may assist governments and the private sector in planning for pension programs, labor force supply, and productivity.

The application of this "migration strategy" to examining cohort change in economic activity has a counterpart in the literature on

### Table 6. Use of census survival ratios to assess the mobility of economic activity: Female population of Thailand

#### PANEL A

<table>
<thead>
<tr>
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<td>11,871,557</td>
<td>16,985,973</td>
<td>11+ 2</td>
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<td>30-39</td>
<td>1,330,217</td>
<td>1,614,488</td>
<td>1,899,676</td>
</tr>
<tr>
<td>40-49</td>
<td>1,046,778</td>
<td>1,363,786</td>
<td>2,069,722</td>
<td>40-49</td>
<td>916,766</td>
<td>1,091,137</td>
<td>1,538,938</td>
</tr>
<tr>
<td>50-59</td>
<td>739,395</td>
<td>891,525</td>
<td>1,336,533</td>
<td>50-59</td>
<td>598,538</td>
<td>626,566</td>
<td>862,545</td>
</tr>
<tr>
<td>60-69</td>
<td>408,589</td>
<td>563,124</td>
<td>775,908</td>
<td>60+</td>
<td>261,358</td>
<td>279,539</td>
<td>359,274</td>
</tr>
<tr>
<td>70+</td>
<td>244,717</td>
<td>353,486</td>
<td>552,857</td>
<td>Unknown</td>
<td>13,100</td>
<td>2,367</td>
<td>35,274</td>
</tr>
<tr>
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#### PANEL B

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<th>1970</th>
<th>Survival ratio</th>
<th>Economically active</th>
<th>Difference, actual-exp.</th>
<th>Transition rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td>1960 actual</td>
<td>1970 expected</td>
<td>1970 actual</td>
</tr>
<tr>
<td>10-19</td>
<td>20-29</td>
<td>0.9071</td>
<td>1,639,844</td>
<td>1,487,496</td>
<td>1,972,270</td>
<td>484,774</td>
</tr>
<tr>
<td>20-29</td>
<td>30-39</td>
<td>0.9041</td>
<td>1,932,365</td>
<td>1,746,976</td>
<td>1,614,488</td>
<td>-132,488</td>
</tr>
<tr>
<td>30-39</td>
<td>40-49</td>
<td>0.8800</td>
<td>1,330,217</td>
<td>1,170,546</td>
<td>1,091,137</td>
<td>-79,409</td>
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<td>40-49</td>
<td>50-59</td>
<td>0.8517</td>
<td>916,766</td>
<td>780,796</td>
<td>626,566</td>
<td>-154,230</td>
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<td>50+</td>
<td>60+</td>
<td>0.6582</td>
<td>859,896</td>
<td>565,943</td>
<td>279,539</td>
<td>-286,404</td>
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</table>

#### PANEL C

<table>
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<th>Age group</th>
<th>1970</th>
<th>1980</th>
<th>Survival ratio</th>
<th>Economically active</th>
<th>Difference, actual-exp.</th>
<th>Transition rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1970 actual</td>
<td>1980 expected</td>
<td>1980 actual</td>
</tr>
<tr>
<td>10-19</td>
<td>20-29</td>
<td>0.9890</td>
<td>2,353,009</td>
<td>2,327,008</td>
<td>2,927,843</td>
<td>600,835</td>
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<tr>
<td>20-29</td>
<td>30-39</td>
<td>1.0175</td>
<td>1,972,270</td>
<td>2,006,693</td>
<td>1,899,676</td>
<td>-107,017</td>
</tr>
<tr>
<td>30-39</td>
<td>40-49</td>
<td>1.0172</td>
<td>1,614,488</td>
<td>1,642,281</td>
<td>1,538,938</td>
<td>-103,343</td>
</tr>
<tr>
<td>40-49</td>
<td>50-59</td>
<td>0.9800</td>
<td>1,091,137</td>
<td>1,069,332</td>
<td>862,545</td>
<td>-206,787</td>
</tr>
<tr>
<td>50+</td>
<td>60+</td>
<td>0.7349</td>
<td>906,105</td>
<td>665,880</td>
<td>359,274</td>
<td>-306,606</td>
</tr>
</tbody>
</table>

a. It is assumed that no one of age 10 is in the labor force because government figures report only workers of ages 11 and older.

b. Transition rate per 1,000 equals the difference between actual and expected divided by the average population of the two censuses.
projecting labor force entries and separations (see United Nations 1971:36–38). The emphasis in the UN’s Manual V, however, is on the net increase or decrease in the size of the labor force over the decade rather than in measuring cohort movement into or out of statuses reflecting economic activity. Moreover, the migration approach is not the only method for measuring net transition rates into and out of a status. One can, for example, calculate the percentage of change in the proportion of a cohort occupying a given status in consecutive censuses. The percentage of change, however, may produce inflated estimates of change when a large proportion of the elderly moves between categories. (The formal relationship between the two approaches is described in Hermelin 1989.5)

Net Transition Rates between Cohorts

The last example we will pursue in any detail is the additional insight possible from three or more censuses. In the discussion of Table 1 we suggested that using at least three censuses makes it possible to analyze structural change in the aging process—that is, differences among cohorts in the net transition rates occurring at the same age. Compare, for example, panels B and C of Table 5. They show that between 1970 and 1980 the net transition rates for males were less positive at the younger ages and more negative at the older ages than between 1960 and 1970. The younger cohorts were behaving differently either because they were also different in such relevant characteristics as education and occupation or because of period differences in socioeconomic conditions.

Differentials among censuses in completeness of coverage and enumeration can heighten or dampen the apparent degree of change over a period to the extent that a correlation exists between the enumeration error and the characteristic in question. For example, a comparison of the census survival ratios in Table 5 between 1960 and 1970 versus 1970 and 1980 shows that the latter were substantially higher, indicating the possibility of poorer coverage in 1970 than in the other censuses. This should not affect the observed pattern of transition rates across the two periods, though, unless the level of coverage is associated with economic activity.

In this connection, Table 6 reveals that females have the same pattern of change in the census survival ratios as males, whereas the pattern of transition rates for females across the two periods is quite different from that for males. This result suggests that the sex difference in the trend of net transitions is real and not simply an artifact of changes in the completeness of coverage. To the extent that policymakers can examine trends in cohort behavior over time, they will have a better idea of developments that can affect the well-being of the elderly and other groups within their societies.

To the extent that policymakers can examine trends in cohort behavior over time, they will have a better idea of developments that can affect the well-being of the elderly and other groups within their societies.

As is evident from the two examples shown in Tables 5 and 6, the availability of three censuses also shows the change in the net transition rates over two decades in the lifetime of each cohort. As data from the 1990 census round become available, the transition experiences of these cohorts may be traced over an even longer portion of their lives.

Conclusion

The major objective of this article has been not to introduce a new technique but rather to show how techniques familiar to demographers can be used to study issues in aging in ways not previously considered. By fully exploiting census and similar data, it is possible for analysts to gain insights about the future composition of the elderly, the changing status of the elderly in relation to younger groups, and the rate at
which key cohorts are changing in various characteristics. These approaches serve to give temporal depth to the type of data typically collected in censuses and cross-sectional surveys and provide insights often of direct relevance to policymakers. They are not meant to supplant other types of information, but they represent an important adjunct that is all too often overlooked. Given the widespread availability of the basic data and the low costs of the analysis, the techniques deserve more attention as a useful tool for setting the stage for more refined analyses.

Several steps can be taken to make this kind of analysis even more useful. Key assumptions, such as the existence of no differential mortality or no difference in coverage by level within a characteristic, need further examination. Although these assumptions represent a reasonable starting point, research to assess the extent of differential mortality and coverage and to evaluate the sensitivity of the results to these assumptions needs to be promoted. Attention also needs to be given to assessing the varying accuracy of reporting over time. At a minimum the census survival ratios for each category of fixed characteristics should be calculated for each cohort to see to what degree they are similar.  

The range of analyses can be greatly strengthened when one can move beyond published census data to sample files of individual-level census data (i.e., micro-level data). With such data, one is not constrained by the levels of aggregation and types of cross-classifications published. It is common, for example, to find in the published data 10-year age groups for certain characteristics and open-ended classifications starting at fairly young ages (e.g., 50 and over). Such tabulations greatly limit the range of analysis that can be undertaken. Similarly, it is rare to find age cross-classified by more than two other characteristics (e.g., gender and economic activity), which precludes examining more subtle relationships such as net rates of change in economic activity by gender and education. In other words, increasing the availability of micro-level data has the potential of advancing research on aggregate-level issues by freeing the analyst from data restrictions created by relying on someone else's decision about which census variables are to be cross-classified.

Another attractive feature of the types of analysis proposed here is that it is possible to combine survey data with census data in order to extend projections or obtain information not available from the census. In Table 2, for example, the furthest date for which we can project the number of children ever born from the 1980 census question, without forecasting the fertility of incomplete cohorts, is 2005 (assuming that no significant numbers of births occur after age 39). But a mid-decade survey of fertility, such as Taiwan’s 1986 KAP (family planning knowledge, attitudes, and practice) survey, could be used to provide data on the completed fertility of one additional cohort. This information could be incorporated into the projection to extend the range to the year 2010. Similarly, it is possible to combine data on the size of each cohort with survey data that might not be available in the census, such as information on the country of birth or educational level of a parent.

Many of the countries that have experienced a decline in fertility and are now facing the prospect of an older age structure have a good tradition of census-taking. Important new data will be forthcoming from the 1990 round. It is to be hoped that growing awareness of the potential of these data to address policy-relevant issues in the field of aging will spur research into the associated issues of differential mortality, coverage, and registry, lead to greater levels of detail in published data, and encourage greater provision of micro-level data so that more refined analyses can be conducted.

ACKNOWLEDGMENTS

The research reported in this article is part of a broad project sponsored by the U.S. National Institute on Aging (NIA), entitled the Comparative Study of the Elderly in Four Asian Countries. Support for the research came from NIA Grant No. AG07637 and NIA Training Grant No. T32 AG00151. An earlier draft, which was completed while the first author was a Fellow at the Center for Advanced Studies in the Behavioral Sciences, with financial support from the National Science Foundation (Grant No. BN587-00864), was presented at the spring (continued on page 67)
Assessing the Assumption of Similar Survival Probabilities across Educational Statuses

In projecting the educational composition of the elderly, it is customary to use age-by-period-specific probabilities of surviving to advance cohorts to older ages. The assumption that these probabilities are similar across educational statuses deserves further consideration along two lines of inquiry. First, how valid is the assumption of no differences in survival probabilities by educational status? Second, does the violation of this assumption significantly alter the projected trends in educational composition of the elderly population?

Validity of the assumption. On the surface, the validity of the assumption can be questioned on the general grounds that in most societies an individual’s life chances are affected by his or her social status. Empirical evidence of such a relationship as it pertains to educational status has been suggested by studies of adult mortality from the United States and developed countries in Europe (Kitagawa and Hauser 1973; Valkonen 1989). These studies demonstrate that adult mortality ratios at lower levels of education are large in relation to mortality at higher levels of education.

Since mortality is the inverse of survival, one might be tempted to infer that such a demonstration of educational differentials in mortality implies similar differences in survival chances. Although such a conclusion is appropriate where absolute differences in mortality probabilities or proportions are concerned, it is not necessarily a valid conclusion with respect to relative measures. Specifically, under conditions where mortality is generally low, relative mortality differentials appear larger than corresponding differentials in survival probabilities. Consider a hypothetical population of 30-year-old individuals evenly distributed between low- and high-status categories with annual survival probabilities of .990 and .998, respectively. The average survival probability is .994, and the survival of the high-status group relative to the low-status group is 1.008. The probability of dying, however, is five times greater for the lower-status group than for the higher-status group (.010 versus .002), even though the overall probability is low in either case.

In other words, the different impression one obtains from simple measures of relative mortality and survival in a low-mortality setting is a reflection of floor effects in the first instance and ceiling effects in the latter. In brief, if educational projections are made in settings where levels of mortality are already low, then an assumption of comparable survival probabilities across educational levels is likely to be reasonable.

The empirical validity of our assumption depends on the cumulative effect of differential survival as a cohort ages. Thus age-specific

<table>
<thead>
<tr>
<th>Age group</th>
<th>Five major cities</th>
<th>Other townships</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–24</td>
<td>0.997</td>
<td>0.994</td>
</tr>
<tr>
<td>25–29</td>
<td>0.995</td>
<td>0.991</td>
</tr>
<tr>
<td>30–34</td>
<td>0.991</td>
<td>0.983</td>
</tr>
<tr>
<td>35–39</td>
<td>0.972</td>
<td>0.948</td>
</tr>
<tr>
<td>40–44</td>
<td>0.923</td>
<td>0.869</td>
</tr>
<tr>
<td>45–49</td>
<td>0.919</td>
<td>0.863</td>
</tr>
<tr>
<td>50–54</td>
<td>0.903</td>
<td>0.831</td>
</tr>
<tr>
<td>55–59</td>
<td>0.847</td>
<td>0.724</td>
</tr>
<tr>
<td>60–64</td>
<td>0.765</td>
<td>0.606</td>
</tr>
<tr>
<td>65–69</td>
<td>0.681</td>
<td>0.503</td>
</tr>
<tr>
<td>70–74</td>
<td>0.587</td>
<td>0.386</td>
</tr>
<tr>
<td>75–79</td>
<td>0.475</td>
<td>0.261</td>
</tr>
<tr>
<td>80+</td>
<td>0.359</td>
<td>0.150</td>
</tr>
<tr>
<td>Total</td>
<td>0.928</td>
<td>0.873</td>
</tr>
</tbody>
</table>

Table A. Proportion of adult males with at least a primary education, by age group and place of residence: Taiwan 1980 census

Table B. Proportion of adult males with at least an upper secondary education, by age group and place of residence: Taiwan 1980 census

<table>
<thead>
<tr>
<th>Age group</th>
<th>Five major cities</th>
<th>Other townships</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–24</td>
<td>0.689</td>
<td>0.511</td>
</tr>
<tr>
<td>25–29</td>
<td>0.602</td>
<td>0.428</td>
</tr>
<tr>
<td>30–34</td>
<td>0.524</td>
<td>0.332</td>
</tr>
<tr>
<td>35–39</td>
<td>0.420</td>
<td>0.232</td>
</tr>
<tr>
<td>40–44</td>
<td>0.333</td>
<td>0.155</td>
</tr>
<tr>
<td>45–49</td>
<td>0.306</td>
<td>0.139</td>
</tr>
<tr>
<td>50–54</td>
<td>0.341</td>
<td>0.177</td>
</tr>
<tr>
<td>55–59</td>
<td>0.337</td>
<td>0.126</td>
</tr>
<tr>
<td>60–64</td>
<td>0.324</td>
<td>0.119</td>
</tr>
<tr>
<td>65–69</td>
<td>0.268</td>
<td>0.081</td>
</tr>
<tr>
<td>70–74</td>
<td>0.239</td>
<td>0.058</td>
</tr>
<tr>
<td>75–79</td>
<td>0.218</td>
<td>0.050</td>
</tr>
<tr>
<td>80+</td>
<td>0.181</td>
<td>0.031</td>
</tr>
<tr>
<td>Total</td>
<td>0.469</td>
<td>0.285</td>
</tr>
</tbody>
</table>
data on mortality rates by level of education are needed for a full evaluation. Unfortunately, such data are not currently available for Taiwan, nor for most other countries. For the moment, we might indirectly assess the extent of survival differences in education by comparing geographic subpopulations that differ in average educational characteristics and for which we have information on mortality.

A comparison of the five major cities of Taiwan with the other townships provides such an opportunity. (The five major cities include the Taipei and Kaohsiung metropolitan areas and Keelung, Taichung, and Tainan City.) Among the adult male population of ages 20 and older in those cities, 93% have completed at least a primary education and 47% have at least an upper secondary education. (See Tables A and B). The comparable proportions for the remaining townships are 87% and 29%, respectively. Geographic differences in educational attainment also vary by age, with larger differences appearing at older ages. At older ages the proportion of large-city male residents with a primary education is substantially greater than at comparable ages in other townships (Table A). The differences disappear, however, for younger cohorts, reflecting the establishment of compulsory primary education. A substantial difference in proportions with an upper secondary education exists by place of residence at all ages, although the difference is more dramatic among the older cohorts (Table B).

The 1980 Taiwan-Fukien Demographic Fact Book (ROC, Ministry of the Interior, 1981) provides life ta-

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Table C. Age-specific and cumulative survival probabilities for males in large cities and townships: Taiwan, 1980

<table>
<thead>
<tr>
<th>Age at N</th>
<th>N+5</th>
<th>Cities</th>
<th>Townships</th>
<th>Cumulative survival</th>
<th>Difference</th>
<th>Hypothetical townships</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>20-24</td>
<td>20-24</td>
<td>0.9934</td>
<td>0.9908</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>25-29</td>
<td>20-24</td>
<td>0.9934</td>
<td>0.9908</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0026</td>
<td>0.9746</td>
</tr>
<tr>
<td>30-34</td>
<td>20-24</td>
<td>0.9863</td>
<td>0.9795</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0068</td>
<td>0.9741</td>
</tr>
<tr>
<td>35-39</td>
<td>20-24</td>
<td>0.9763</td>
<td>0.9651</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0112</td>
<td>0.9710</td>
</tr>
<tr>
<td>40-44</td>
<td>20-24</td>
<td>0.9608</td>
<td>0.9456</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0152</td>
<td>0.9654</td>
</tr>
<tr>
<td>45-49</td>
<td>20-24</td>
<td>0.9586</td>
<td>0.9191</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0195</td>
<td>0.9584</td>
</tr>
<tr>
<td>50-54</td>
<td>20-24</td>
<td>0.9086</td>
<td>0.8830</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0255</td>
<td>0.9496</td>
</tr>
<tr>
<td>55-59</td>
<td>20-24</td>
<td>0.8658</td>
<td>0.8320</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0338</td>
<td>0.9348</td>
</tr>
<tr>
<td>60-64</td>
<td>20-24</td>
<td>0.8008</td>
<td>0.7577</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0431</td>
<td>0.9074</td>
</tr>
<tr>
<td>65-69</td>
<td>20-24</td>
<td>0.7058</td>
<td>0.6551</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0507</td>
<td>0.8647</td>
</tr>
<tr>
<td>70-74</td>
<td>20-24</td>
<td>0.5760</td>
<td>0.5258</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0502</td>
<td>0.8006</td>
</tr>
<tr>
<td>75-79</td>
<td>20-24</td>
<td>0.4168</td>
<td>0.3761</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0407</td>
<td>0.7099</td>
</tr>
<tr>
<td>80+</td>
<td>20-24</td>
<td>0.2142</td>
<td>0.1839</td>
<td>1.0000</td>
<td>1.0000</td>
<td>0.0304</td>
<td>0.5043</td>
</tr>
</tbody>
</table>

Source: Taiwan, Ministry of the Interior (1981:table 87, Abridged Life Table for Taiwan Area, 1980 (p. 3): Five Big Cities; table 87: Abridged Life Table for Taiwan Area, 1980 (p. 5): All Cities).

a. The source for this table presents separate life tables for chen, or urban townships, and hsiang, or rural townships. Only marginal differences exist between them for adult males aged 20 and older, and we used the life table for chen to calculate the age-specific survival probabilities. Although the differences are miniscule, the direction of the differences is in favor of higher adult survival in the rural rather than the urban townships.

b. The hypothetical age-specific survival proportions for townships in column 6 are calculated by multiplying the age-specific survival proportions of cities by 0.9810 to reflect a constant differential.
ables for the five largest cities combined and for the other townships. Five-year age-specific survival probabilities calculated from the life tables of both types of communities are presented in columns 1 and 2 of Table C. Differences in survival are indeed small at each age, even when cumulative survival levels are compared (columns 3 and 4). Column 5 shows that for any age group during the adult life span, the cumulative proportions of men surviving in the two settings differ by no more than about 5 percentage points. Thus the indirect evidence would seem to support the validity of the assumption that there is little difference in survival probabilities among educational categories. The evidence would be somewhat stronger if the amount of difference in educational characteristics of large-city and township residence found at older ages were to apply to all age groups.

In short, although the information to directly assess the validity of the assumption that little or no difference in survival probabilities by level of education is not available, consideration of the evidence from the mortality literature and the indirect evidence from the Taiwan life tables suggests that this assumption is more tenable than it first appears. In the end, the validity of the assumption is likely to depend upon the time and place and to be a matter of degree.

Thus, it is useful to consider the second question. Would projections based on moderate educational differentials in survival probabilities greatly alter our initial projections?

**Effect of violating the assumption.** Since we have concluded above that the comparison of life tables for large cities and other townships provides indirect support for our assumption that little or no educational differences exist in survival probabilities, it is obvious that a simulation based on survival differences for these two settings would result in projected educational levels quite close to our original projections.

To test the robustness of the projection technique for moderate violations of the assumption, we devised a simulation based on somewhat larger differentials in survival probabilities. The largest differentials in survival probabilities between men from cities and townships occur at older ages. To arrive at a hypothetical difference in survival that is noticeable, we assume that a cohort of men from the townships experiences survival rates that differ from those of its counterpart in the cities by a constant relative proportion.

We use the ratio of township to city survival found among men of ages 60–64 in 1980, which has a value of 0.981, to represent the relative survival of less and more educated groups of men at all ages. The new hypothetical-township survival probability for each age group is represented in column 6 of Table C, and the hypothetical situation creates noticeably greater cumulative differences in the survival probabilities between city and township males than indicated by the previous comparison. By age 60, fully 11% more of the city cohort survive than the township cohort. The difference then declines at older ages.

We applied this differential to the age-specific survival probabilities to simulate the effect that differences in survival by educational status would have on the projection of elderly educational characteristics. The same educational differential was used in projecting the proportion of the elderly male population with at least a primary education and the proportion of the population with at least an upper secondary level of education.

(To maintain comparability with our initial projections, we treated the survival ratio calculated from the original Taiwan population projections as the average survival level and used the constant relative survival differential of .9810 between low and high education for all age groups to calculate the deviations of each educational group from age-specific averages. The amount of deviation at each age depends on this constant differential and on the proportion of persons in each educational group at the start of the time interval.)

Tables D and E provide a comparison of these projections for the elderly aged 60 and over with the earlier projections, which assumed no educational differences in survival rates. The results indicate that similar projection results are obtained even when one allows for moderate differentials in sur-
vival probabilities by level of education. The maximum difference in the two projection procedures is less than 2 percentage points for primary education and less than 4 percentage points in the case of upper secondary education. Similar results are found when the elderly are divided into younger old (60–69) and older old (70 and over) age groups, as can be seen by comparing the age group summaries in Table 3 of the main text with Tables F and G.

In summary, the limited available evidence indicates that the assumption of similar survival probabilities across educational levels is reasonable at least for a low-mortality country such as Taiwan. We recognize, however, that the extent to which our assumption holds will likely vary among settings. Where moderate differences in cumulative survival probabilities exist by population characteristics, it appears that one can still make fairly accurate projections even if those differences are not taken into account. This preliminary result is encouraging because researchers typically lack direct data on educational differences in survival probabilities.

Further simulation efforts may help to establish some principles and parameters for determining how much survival probabilities can differ by educational attainment before projections become misleading. The amount of tolerance for variation in survival probabilities is likely to depend on the degree to which cohorts differ in a given characteristic. When sharp cohort differences are observed in a characteristic such as education, modest variation in survival probabilities is much less likely to result in misleading projections than in cases where observed cohort differences are small. Although efforts to achieve greater precision are desirable, the preceding simulations suggest that the current method is useful for identifying major trends and that in most cases modifying the assumptions will represent minor refinements.

Table D. Projected proportions of elderly males at ages 60 and over with less than a primary education, based on alternative assumptions about differential survival by level of education

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</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td>0.525</td>
<td>0.425</td>
<td>0.331</td>
<td>0.286</td>
<td>0.259</td>
<td>0.210</td>
<td>0.152</td>
<td>0.100</td>
<td>0.062</td>
</tr>
<tr>
<td>Differential survival&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.525</td>
<td>0.420</td>
<td>0.323</td>
<td>0.275</td>
<td>0.245</td>
<td>0.195</td>
<td>0.140</td>
<td>0.089</td>
<td>0.054</td>
</tr>
</tbody>
</table>

<sup>a</sup> Calculations in this table and Table E assume a constant relative survival probability of .9810 between low and high education from ages 20–24 onward. In Table D this refers to persons with less than a primary education versus those with at least a primary education. In Table E the hypothetical differential applies to those with less than an upper secondary education versus those with at least an upper secondary education.

Table E. Projected proportions of elderly males at ages 60 and over with at least an upper secondary education, based on alternative assumptions about differential survival by level of education

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</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td>0.135</td>
<td>0.166</td>
<td>0.186</td>
<td>0.186</td>
<td>0.190</td>
<td>0.213</td>
<td>0.265</td>
<td>0.341</td>
<td>0.410</td>
</tr>
<tr>
<td>Differential survival&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.135</td>
<td>0.168</td>
<td>0.192</td>
<td>0.195</td>
<td>0.202</td>
<td>0.229</td>
<td>0.287</td>
<td>0.371</td>
<td>0.446</td>
</tr>
</tbody>
</table>

<sup>a</sup> See note in Table D.
Table F. Projected proportion of elderly males with less than a primary education, by age group, based on simulation of differential survival by level of education

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</tr>
</thead>
<tbody>
<tr>
<td>60–69</td>
<td>0.460</td>
<td>0.344</td>
<td>0.242</td>
<td>0.210</td>
<td>0.217</td>
<td>0.151</td>
<td>0.065</td>
<td>0.034</td>
<td>0.021</td>
</tr>
<tr>
<td>70 +</td>
<td>0.681</td>
<td>0.579</td>
<td>0.486</td>
<td>0.374</td>
<td>0.276</td>
<td>0.241</td>
<td>0.225</td>
<td>0.171</td>
<td>0.107</td>
</tr>
<tr>
<td>60 +</td>
<td>0.525</td>
<td>0.420</td>
<td>0.323</td>
<td>0.275</td>
<td>0.245</td>
<td>0.195</td>
<td>0.140</td>
<td>0.089</td>
<td>0.054</td>
</tr>
</tbody>
</table>

Note: Calculations in this table and Table G assume a constant relative survival probability of .9810 between low and high education from ages 20–24 onward. In Table F this refers to persons with less than a primary education versus those with at least a primary education. In Table G the hypothetical differential applies to those with less than an upper secondary education versus those with an upper secondary education.

Table G. Projected proportion of elderly males with at least an upper secondary education, by age group, based on simulation of differential survival by level of education

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</tr>
</thead>
<tbody>
<tr>
<td>60–69</td>
<td>0.154</td>
<td>0.195</td>
<td>0.214</td>
<td>0.201</td>
<td>0.197</td>
<td>0.254</td>
<td>0.357</td>
<td>0.454</td>
<td>0.523</td>
</tr>
<tr>
<td>70 +</td>
<td>0.088</td>
<td>0.113</td>
<td>0.149</td>
<td>0.186</td>
<td>0.209</td>
<td>0.203</td>
<td>0.208</td>
<td>0.246</td>
<td>0.323</td>
</tr>
<tr>
<td>60 +</td>
<td>0.135</td>
<td>0.168</td>
<td>0.192</td>
<td>0.195</td>
<td>0.202</td>
<td>0.229</td>
<td>0.287</td>
<td>0.371</td>
<td>0.446</td>
</tr>
</tbody>
</table>

Census-Based Approaches . . .
(continued from page 62)

1990 meeting of the Population Association of America in Toronto, Canada.

REFERENCES


Republic of China (ROC) [Taiwan], Executive Yuan, Council for Economic Planning and Development. n.d. Projections of the Population of the Taiwan Area, ROC, 1988–2085. Taipei.


Reviews and Publication Notes
(continued from page 45)

Australia's large post–World War II influx of immigrants has retarded population aging in that country. As Reginald Appleyard points out in the last chapter, however, Australia now has a total fertility rate below replacement (at 1.87). Its population is projected to peak at 18 million in 40 years and then begin to decline unless immigration is used to offset the aging process. Even with substantial immigration, population aging and declining growth will not be reversed, only slowed. If Australia cannot get skilled laborers from Europe it will have to turn to developing countries. Then the question will be how willing are Australians to allow their European ethnic base to erode.

This issue is one facing European OECD members as well. There are already signs of a backlash toward guest workers and their families in several nations. Planners and researchers who regard demographically oriented migration policies as a way to prevent population aging and decline are aware of strong political opposition to such policies. In-depth studies are needed of the economic, social, cultural, and psychological implications of using migration to offset declining population growth and aging.

Migration: The Demographic Aspects suggests solutions to the problem of declining population growth and aging, but these solutions may not be greeted with enthusiasm by the citizens of OECD member countries. This work is recommended for large academic libraries and special population collections.

Alice D. Harris
former Resource Materials Specialist for the East-West Population Institute

ALSO NOTED

Microcomputer software packages for population analysis, developed by the United Nations Department of Economic and Social Development. Available from UN Department of Economic and Social Development, United Nations Plaza, New York, NY 10017, U.S.A.

The UN Department of Economic and Social Development (DESD) maintains a policy of generating computer software that requires little or no programming knowledge, allows users to use the software with minimal training, and runs on lower-end computers. Two of its demographic software packages are described here.

Abacus is a projection program for personal computers that uses the cohort component method for projecting population by sex and five-year age groups at five-year intervals up to 100 years for each run and allows the projection to continue for an unlimited number of years. It offers forward and backward projections with an option to shift the initial year, annual interpolation, single-year age group interpolation for ages 0–24, selection of survival ratios from nine families of model life tables, construction of new life tables by combining empirical and model life tables, three families of model fertility schedules, and a parametric system of model migration schedules. Users can choose from many options when they formulate assumptions for their projections. Output results and projected demographic indicators are formatted in a table presentation. Required: microcomputer with 256 K of random-access memory (RAM). Price: US $100.

QFIVE has been prepared to accompany DESD's Step-by-Step Guide to the Estimation of Child Mortality. It produces estimates of infant mortality, child mortality (probability of dying between exact ages 1 and 4, q_i), and mortality under exact age 5 by applying the two versions of the Brass method presented in the Guide: the Trussell version, which is based on the Coale–Demeny model life tables, and the Palloni–Heligman version, based on the UN model life tables for developing countries. Available on a 5.25-inch diskette with the Step-by-Step Guide. Required: 300 K of RAM. Price: US $50.