Demography, Vol. 30, No. 4, November 1993

Demography: The Past 30 Years, the Present, and the Future

Eileen M. Crimmins
Andrus Gerontology Center
University of Southern California
Los Angeles, CA 90089–0191

Demography is a multidisciplinary and multifaceted field within a discipline; therefore any attempt to describe its past and project its future depends on which disciplines and which facets are emphasized. Of necessity, this essay represents one view of the field, influenced by the author's areas of study and research; this view may not be shared by others looking at the field from other viewpoints or even from the same viewpoint. The task at hand is to celebrate 30 years of *Demography* by assessing past changes and their implications for the future of the field.

Standard demographic projection techniques require that one assess past trends, determine the factors causing change, and then assess how these factors are likely to operate in the future. Such a procedure is appropriate for projecting trends in demographic analysis as well as demographic events. For this reason I will begin with an assessment of past changes. Then I will discuss what the present indicates for the future, keeping in mind that projecting the future of demographic research is probably even riskier than predicting future population characteristics. To do this, I will address four facets of the field: how and where demography is done, the type of data employed, the methods used, and finally the theoretical approach and the questions addressed. Perhaps this order proceeds from the mundane to the significant, but I see it as proceeding from what has changed most to what has changed least.

HOW AND WHERE DEMOGRAPHY IS DONE

Because almost all areas of demography rest on empirical work, changes in demographic analysis over the past 30 years have been related closely to changes in the technology available for information processing; this factor has been largely exogenous, and probably was unpredictable by demographers looking toward the future 30 years ago. I address this topic first because it may have been the necessary condition that allowed many of the other major changes in the field to take place.

The world of information processing in 1994 differs dramatically from that of 1964. Change has been so rapid that for the past 30 years one probably could place the year of entry into a graduate program within three years by asking demographers to describe the hardware and software used in their basic methods and demography courses. In 1964 most would have used Friedan calculators to perform basic arithmetic operations. By today's standards these can be described most accurately as grotesquely large, noisy, complicated, cumbersome, and extremely limited in capability. Within a few years computers routinely entered the world of demographic training and research, but their potential was largely unrealized by most until the development of appropriate and easily applied software for the

social sciences. By the early 1970s, graduate students in universities were routinely using mainframe computers with relatively sophisticated analysis programs oriented toward social science. By the 1980s, working demographers and students were beginning to migrate away from mainframe computing as the power of desktop and local computing environments increased. In the 1990s virtually all institutions, except perhaps government agencies, will eliminate mainframe computing as we now know it and will move to more decentralized data processing environments.

These changes have had and will have major effects on how demography as a field changes. The increasing ability to process large amounts of data and to use more sophisticated statistical and analytical techniques was the necessary condition that allowed and encouraged the development of more complicated methods, data collection, and theoretical models.

Changes in the availability of the tools of the demographic trade also affect the organization of the field. In the 1970s and 1980s, the changes served to broaden and perhaps democratize the field. In the 1970s almost anyone at a major institution in the United States could find the know-how and the resources to perform state-of-the-art demographic research. Because the appropriate software was distributed widely and because demographers' needs were similar to those of researchers in other social, biomedical, and natural sciences, institutions tended to supply very adequate computer environments for demographic research. In the 1980s, because of the worldwide diffusion of desktop computing and of social science and demographic software, much demographic analysis could be performed almost anywhere in the world with a relatively small initial investment.

In the 1990s the computing needs of demographers and of those in many other fields have begun to diverge. Scholars in less data-intensive fields can operate in self-contained environments, a situation that has led to the decentralization of computing. Demographers with a seemingly ever-growing need to analyze larger and more complex data sets will have a harder time adjusting to this decentralization than scholars in other fields. Demographers will need more colleagues and more support staff to develop and maintain adequate computing environments in the 1990s; therefore, the changes in computer technology will cause an increasing concentration of cutting-edge demographic research in institutions that have strong support for the development of local computer facilities. These will be institutions that have a critical mass of researchers in the relevant fields, centers of research, and formal training programs. By the early 2000s, technology most likely will have improved so far that desktop systems will be available to all; these will be capable of reading and processing large and complex data sets with relative ease. By that time, however, the work of demography may be concentrated in a relatively small number of centers.

This centralization of demographic research also will be encouraged by an increasing emphasis on multi-investigator research. As the problems studied and the methods and data employed become more complex, the need to involve multiple experts in a field on projects is resulting in an increasing grouping of demographers by specialization. Thirty years ago, a Noah's ark approach to building a set of demographers was common. Today, because developing the expertise to cover an area requires more bodies than in the past, institutions often want to emphasize only one or two substantive areas. This development seems to point to a model of growth for the field which will produce demographic centers that operate like natural scientists' laboratories—large collections of equipment with a staff of junior faculty members, and predoctoral and postdoctoral students concentrating on a limited set of substantive issues.

Such developments will continue the trend toward increased specialization within the field and the adoption of a biomedical model for the training of specialists. In the 1990s demographers will routinely include a postdoctoral stint in their course of training. In this

decade, being a "demographer" will be regarded as being a generalist; one will have to specialize and become a "historical demographer," an "economic demographer," a "business demographer," a "medical demographer," and so on. It is likely that the next 10 years will witness an increasing number of formalized special interest groups within the professional associations in the field and an increasing number of specialized journals to cater to these interests.

THE DATA OF DEMOGRAPHY

Along with the computing environment, the data of demography have changed remarkably in the past 30 years. Most analysis of 30 years ago was conducted at the aggregate level; most of the methodological articles in the early issues of *Demography* dealt with issues of analysis of group-level data (e.g., Cho 1964; Schmid and Tagashira 1964). Many early articles represent analyses of unpublished two- or three-variable cross-tabulations compiled by census bureaus, statistical offices, or the United Nations at the request of, or made available to, individual researchers.

In the first issue of Demography only three of 31 articles represented analysis of individual-level records available to the researchers. Often the source of early articles based on individual-level data was one of the relatively recent fertility studies conducted in the United States: the Indianapolis studies, the Princeton studies, or the Detroit Area Study.

These studies represent the beginning of a relatively new approach to data in demographic analysis—the use of large-scale sample surveys to address a specific demographic outcome. Although the idea of the sample survey was not new in the 1960s, the collection and availability of nationally representative individual-level data was an innovation. Also introduced at that time was the idea that sample surveys could be used to produce more accurate estimates of vital rates than those produced using deficient registration and census data.

In the 1950s and 1960s the demographic issue of importance in the United States was the unexpectedly high fertility of the post-World War II era. Early fertility surveys were undertaken because researchers had exhausted the limits of available data. They had described fertility differences sufficiently to be able to develop fuller explanatory models of observed differences; these models incorporated variables not available in census or vital statistics data, such as religious background, psychological characteristics, and social mobility. Testing of these models required the collection of specialized data and spawned the era of fertility and family and household surveys. In the 1960s, as a result of the importance of determining solutions to the problem of rapid population growth in the Third World, survey data were collected from women of childbearing age in a large number of countries. As in the case of domestic issues in the United States, existing census and vital registration data were regarded as inadequate for designing policies to reduce population growth because they did not provide information on knowledge, attitudes, and practices of family planning.

A fuller understanding of fertility processes in the developing world was promoted by two monumental undertakings: the collection of the World Fertility Surveys in the 1970s and the Demographic and Health Surveys of the 1980s. These massive international data collection projects provided a wealth of comparable data designed to test a variety of theoretical perspectives. They also served to rapidly diffuse theoretical and methodological developments, as well as survey technology, worldwide.

At the end of the 1960s, a number of important longitudinal surveys were initiated in the United States. These were begun because researchers found that existing cross-sectional surveys did not furnish the needed answers to questions about change or provide the appropriate timing of the measurement of relevant variables. Only repeated measurement,

over time, of individuals' characteristics and behaviors could adequately address the process of change.

Early longitudinal surveys in the area of labor force and economic status have proved useful for an array of demographic issues. These include the National Longitudinal Surveys, the Retirement History Survey, and the Panel Survey of Income Dynamics. In the late 1970s, growing emphasis on the appropriateness of longitudinal data caused an increase in the number of panel data sets. High School and Beyond, the Survey of Income and Program Participation, the Longitudinal Survey on Aging, the National Long Term Care Survey, and the National Survey of Families and Households, among others, were begun over the next 10 years. In addition, methods for gathering data indicating change over time from cross-sectional surveys were developed in the United States and in other countries.

In the 1980s, the demographic community in the United States argued for the need to replicate longitudinal studies of one cohort with those involving additional cohorts in order to study demographic processes in different periods. Because of these arguments, data from a new Retirement History Survey and a new Longitudinal Survey of the Aged will become available in the next few years.

Over the past 30 years, demographic analysis has been based increasingly on individual-level data and (in recent years) on longitudinal data collected for individuals. Until now, changes in demographic data structures have been dictated by theoretical and analytic requirements. Data have grown increasingly complex to correspond to increasing complexity in the causal models underlying the demographic behavior we wish to understand. In the future, data analysis will continue to increase in complexity along with theoretical models. We will begin to employ the growing bodies of data from repeated cross-sectional surveys and from longitudinal data on multiple cohorts not only to address questions of change in demographic behavior across and within individuals, but also to examine how demographic processes are affected by change in the context of the time and the place in which individuals live.

THE METHODS EMPLOYED

Any examination of the past and the future of demographic methods must divide the field into the two very different approaches of formal demography and social demography (Lorimer 1959; Winsborough 1992). Formal demography, with roots in mathematics and statistics, is composed of the set of analytic techniques and methods that relate population composition to the forces of demographic change—mortality, fertility, and migration—to describe, estimate, and project the population and the forces of population change. Social demography relates social circumstances or social change to the composition of populations or the components of population change. Because the history of these two subfields has differed over the past 30 years, their futures are likely to differ as well.

Methods in Formal Demography

A review of some of the major works in formal demography over the past 30 years reveals that despite major methodological advances, this is a field of relative continuity and cumulation. The continuity in formal demography arises from the questions it addresses: What is and what will be the population structure? How is the structure related to the processes of fertility, mortality, and migration? Much of the major research in this area develops ideas generated at least in rough outline during the eighteenth and nineteenth centuries. The life table remains one of the most basic models in formal demography.

Current ideas, although considerably refined and elaborated, still rest on the work of Graunt (1661), Gompertz (1824), Lexis (1875), and Lotka (1907). What was written so long ago is still considered to be both correct and relevant. In stable population theory, another major component of formal demography, the intellectual heritage can be traced from Euler (1760) to Lotka (1939) to Coale (1972).

The continuity of ideas in this area is demonstrated by the reference list in Smith's (1992) new monograph on methods, *Formal Demography*, in which about 20% of the references are to sources that appeared more than 30 years ago. Many of these appeared far earlier. In a number of additional recent works in formal demography, the narrative material gives a clear picture of the steady evolution of the intellectual heritage in this area (Coale and Demeny 1983; Halli and Rao 1992; Newell 1988; Smith and Keyfitz 1977).

Certainly the years just before and just after the introduction of *Demography* were a fertile period in the development of methods to describe the empirically observed regularities of age differences in demographic events. The pace of advancements in methodological approaches increased exponentially because of the growing ease of data processing, the growing availability of data, and the expanding body of statistical techniques available to demographers. At about the time when *Demography* was initiated, the first model life tables were introduced by the United Nations (1955, 1967) and by Coale and Demeny (1966). Based on actual populations, these model life tables proved very useful for evaluating and substituting for deficient or nonexistent data and for determining the effect of changes in mortality and fertility on population composition. These approaches remain appropriate, as demonstrated by the fact that both sets of model life tables have been updated recently (Coale and Demeny 1983; United Nations 1982).

In recent decades, major advances in formal demography have included significant extensions to the original theory of stable populations, which address some of the limiting assumptions in the basic model. Preston and Coale (1982), for instance, extended the approach to nonstable populations; with the development of multistate population methods, Andrei Rogers (1974, 1975) incorporated migration into the stable population model.

Model development in demography made another major advance with the introduction of "relational" models. The growing use of a relational approach is usually attributed to Brass (1971, 1975), who argued that the existing empirically based model life tables were not flexible enough to describe observed experience. Brass proposed a two-parameter approach as an alternative to existing model life tables. How many parameters to use in modeling and forecasting mortality remains a major topic in formal demography (Alho 1992; Ewbank, de Leon, Stoto 1983; Heligman and Pollard 1980; Keyfitz 1982; Lee and Carter 1992a, 1992b; McNown 1992; McNown and Rogers 1989; Zaba 1979).

Models for describing the observed regularity in fertility were developed along lines similar to those for mortality. Coale and his colleagues developed new approaches to modeling marriage and family formation; these proved invaluable in the analysis of fertility change in both historical and contemporary countries undergoing fertility decline (Coale 1971; Coale and McNeil 1972; Coale and Trussell 1974). Brass also offered an approach to modeling fertility similar to his approach to mortality (Brass 1975, 1981).

The purpose of much of the work described above and of large bodies of related research was to deal with the fact that traditional demographic methods required relatively complete vital registration and census systems. Such systems were largely nonexistent in the part of the world with rapidly growing populations or for historical populations. In the last few decades, major intellectual resources have been expended in developing indirect techniques of demographic estimation. The purpose has been to understand more fully the current demographic conditions in countries with rapid population growth as well as the implications, for future population structures, of changes in demographic rates. This work

culminated in the production of two United Nations manuals on the topic (United Nations 1967, 1983).

In perusing the more recent manuals, we note the rapid development of multiple techniques for estimating basic demographic parameters using data collected in sample surveys or with special census questions. Because of the increasing availability of individual-level survey data such as the World Fertility Surveys from which aggregate levels of fertility and mortality can be estimated, the techniques of formal demography have become oriented increasingly to the use of individual-level data.

In the last few decades, formal demographers have incorporated a number of methods developed by statisticians, epidemiologists, and other social and natural scientists. For instance, Chiang's (1968) cause-elimination life table methodology introduced stochastic models to demography. These have become the basis of much contemporary mortality analysis (Manton and Stallard 1984).

Methodological developments in formal demography have allowed the questions addressed in this field to be broadened. Until recently, for instance, the life table model was used almost exclusively in mortality analysis. With the development of multistate methods, life table analysis could be used to address time spent and population structure in states of life as well as death (Hoem 1970; A. Rogers 1973; A. Rogers and Ledent 1976; Schoen 1975, 1988). These include states indicative of marital status (Espenshade and Braun 1982), labor force status (Hayward and Grady 1990), dependency status (R. Rogers, A. Rogers, and Belanger 1989), and family status (Bongaarts, Burch, and Wachter 1985). Life table models are also the basis for methods of survival and event history models; these have been applied to individual-level data derived from surveys to study a wide variety of demographic behaviors including the timing of births, breast-feeding, marriage, and divorce as well as mortality (Menken et al. 1981; Rodriguez and Hobcraft 1980; Teachman 1983; Trussell and Hammerslough 1983). These more recent methodological developments have changed the emphasis in formal demography from concentration on demographic structures to an interest in explaining demographic dynamics or processes. They also have broadened the substance of formal demography beyond its early concentration on mortality and fertility.

In the future, formal demographers will continue to build cumulatively on existing methodology to refine techniques for describing the demographic forces in a population, estimating their potential effects, and projecting the size and composition of the population. The directions of these developments will be responsive to the substantive questions that arise in the future. In the last decade, for instance, the aging of the population in many countries of the world, along with the increase in life expectancy, has led to questions about the shape of the mortality curve at the oldest ages (Coale and Kisker 1990) and about the relationship of life expectancy to active life expectancy at the oldest ages (R. Rogers et al. 1989). Little attention was paid to these issues before they became substantively important. Description of demographic structures and processes, however, will become increasingly straightforward. Projections either of fertility or mortality trends or of the resulting population structure based on simple extrapolation of past trends, even when made with complex statistical models, will be regarded increasingly as insufficient, although probably they will continue to be made by official government agencies. Formal demographers in the future will concentrate increasingly on models that incorporate the entire causal process of population change. This greater emphasis on causation, coupled with the expanding application of formal demography to new substantive areas will move the work of formal demographers increasingly closer to that of social demographers.

Methods in Social Demography

In social demography, the methodology employed today is a distant descendant of what was employed 30 years ago. An overview of this area does not present a pattern of continuity but of total change. We have moved from descriptive methods and data to analysis that is based largely on the application of causal models. The availability of certain types of data and the power to easily apply complex statistical techniques have encouraged the development of methods appropriate to this emphasis on causal models.

When *Demography* began publication, most articles presented rates, percentages, or means based on group-level data. These were compared for total populations or for subgroups of one population. Even when data on individuals first became available, the relatively primitive processing technology—punched cards and counter sorters—allowed faster and more accurate classifying of individuals but did not aid in statistical calculation. As a result, early surveys were analyzed in a manner that continued to emphasize group-level differences by using methods unchanged from those used previously with aggregate data. Consequently most of the early analysis of both the U.S. fertility surveys and the international KAP surveys was methodologically simplistic by today's standards.

When statistical software oriented toward social science needs became widely available at the end of the 1960s, the processing of demographic data and the methods and models employed changed dramatically. Within a few years, analysis using methods appropriate to individual-level differences became the standard. Multivariate techniques, primarily regression, were adopted widely. Although for some time demographic theorists had viewed such multivariate models as appropriate for analyzing demographic outcomes, they had not applied these methods widely because of the labor-intensity of calculation. Sophisticated social science software made it possible to easily incorporate many explanatory variables into an analysis, to test large numbers of alternative models, and to test alternative-variable operational definitions with little marginal cost in time or money. Analysis of demographic survey data entered the era of the independent variable. In the succeeding years, numerous articles appeared, each one introducing one more independent variable to models explaining demographic outcomes. Because of this tremendous increase in the ease with which independent variables could be added to the analysis, the emphasis on causal modeling in sociology (Blalock 1964; Duncan, Featherman, and Duncan 1972; Heise 1975), and the growing influence of economists and economic modeling in the field of demography, the theoretical models guiding demographic analysis became increasingly complex. Initially, ordinary least squares regression was regarded as an all-purpose multivariate technique. Soon, however, many variants of the model were developed to deal with the fact that reality violated many of the underlying assumptions of the technique. Most of the early refinements evolved because the demographic states or events to be explained were not continuous variables, the determinants of the outcomes were not well measured, the process was not homogeneous for the entire population, or the direction of causation was unclear. Much of the demographic literature of the 1980s reflects the development of these refinements.

Although longitudinal data became fairly widely available during the 1970s, most researchers at first did not treat it differently from cross-sectional data. Early studies often simply incorporated a time-appropriate measure or a change score for the dependent variable. Not until the 1980s did methods for dealing with change over time, as measured in longitudinal data, become part of the demographic toolbox. (Some of these now widely applied methods, such as event history analysis and survival analysis, were discussed in the previous section.) In social demography as in formal demography, these methodological developments, the availability of data, and changes in the world demographic situation led to an increasing emphasis on the process of demographic change rather than on demographic status. That is, increasing emphasis was placed on birth spacing or birth intervals rather than

on number of children; on taking and leaving jobs rather than on labor force participation per se; on starting and stopping contraceptive use rather than on years of use; on changing place of residence rather than on being a lifetime migrant; on divorce and remarriage rather than on marital status.

The emphasis on individual-level behavior and individual change led to a period during the 1970s and 1980s when macro-level influences on demographic behavior were largely ignored. In contrast, many articles in the early issues of *Demography* were oriented to macro-level differences evident in change over time and were based on multiple censuses from one country or across many countries. Cohort change in fertility also was studied regularly under the assumption that macro-level forces affected the individuals across cohorts differently. Although we have been increasingly able to compare the results of individual-level models across time and space, especially because of the availability of large bodies of comparable data such as the World Fertility Surveys, we have yet to routinely apply techniques that allow us to measure both the micro and the macro influences at the same time. Within the last 10 years, however, methodological approaches to this problem have been developed (DiPrete and Grusky 1990; Entwistle, Mason, and Hermalin 1986; Grusky and DiPrete 1990; Wong and Mason 1985).

The next decades will be a period of further development and increasing application of these methods. Again we will include macro-level influences in our models in order to understand more clearly the time dimension of demographic processes and the micro-macro link in demographic behavior. This development, of course, will be facilitated greatly by the growing bodies of appropriate data.

On balance, the methodological developments of the past 30 years have greatly advanced our understanding of demographic behaviors and demographic processes. This is not to say that all of the methodological innovations of recent years have increased our knowledge. One need not go beyond the pages of *Demography* to find articles whose sole motivation is to apply a novel technique. Demographers must guard against the tendency to do this when there is no possible substantive outcome or to fail to clarify the substantive value of the outcome.

This problem is not recent, however. In an assessment of demography made more than 35 years ago, Vance (1959) accused us of neglecting the importance of ideas while attending to precision of measurement. He offers two colorful quotes, expressing even more disparaging sentiments, from two prominent demographers of the time. Hauser reported demography to be "a field with an extremely high ratio of techniques to ideas" (Vance 1959, p. 296). Dorothy Thomas, after reviewing the existing work in her area (migration), pronounced it "planlessly empirical and trivial in content" (Vance 1959, p. 296). Although I have heard such ideas voiced occasionally in recent years, especially by nondemographers, I would argue that the ratio of ideas to techniques in demography has improved over the past 30 years. The trivial methodological application still exists, but it does not characterize the field in general.

The Theoretical Approaches and the Questions Addressed

The first few issues of Demography show that 30 years ago demographic analysis emphasized the description of differences in natality, mortality, migration, and labor force participation, either across countries or time or among subgroups within countries. When contrasted with the present, the research of the past seems to concentrate on what would be a relatively small set of today's dependent variables. The scope of the field or the outcomes that we are interested in explaining have continued to widen as the models developed incorporate more and more variables and as the issues of the world change. Recent PAA

presidential addresses on patterns of young lives, child care, and the well-being of generations are evidence of the changes in the world; so are sessions, at the most recent PAA meetings, on divorce, women's issues, men's role in fertility decision making, refugees, and HIV and sexually transmitted diseases.

Thirty years ago the most important explanatory factors influencing demographic outcomes of interest were often included in the analysis as a means of dividing the population into subgroups. Aside from demographic transition theory, however, little formal theory was used to define the direction of the analyses, and hypotheses were not tested routinely. In the first issue of *Demography*, Judith Blake (1964) described how the scope of the field had widened recently to include social-economic and demographic interrelations. Although this was true, an accurate description of differences was still the aim of most research. In the area of fertility, for instance, much emphasis was placed on fertility differences by rural-urban background, by religious affiliation, and by race.

With the ability to apply techniques that incorporate as many variables as desired and with the availability of data to measure these variables appropriately, theories or models of demographic behavior have become increasingly more expansive in their explanatory approaches. Explanatory variables have been incorporated from sociology, psychology, economics, biology, anthropology, geography, and public health. Increasingly we have viewed the outcomes in which we are interested as complex and as influenced by a wide variety of factors. At present the mechanisms by which these factors operate are usually spelled out in models which range from informal to highly formal, but which normally result in a clear set of hypotheses to be tested.

Theoretical developments have been the engine pulling the field of demography, while computers may have provided the fuel. Theoretical ideas have promoted the collection of appropriate data to test those ideas; the data have encouraged appropriate methodological advances to test the theoretical approaches; the results have provided a new round of theoretical developments. The proximate determinants model of Davis and Blake (1956), for example, developed in the mid-1950s was not tested until data became available from the KAP surveys of the 1960s and 1970s and from the World Fertility Surveys of the 1970s (Bongaarts 1978; Easterlin and Crimmins 1985). Extensive testing of demographic transition theory had to await the data and the methodological developments of the European Fertility Project (Coale and Watkins 1986). In these examples, the lag between theoretical developments and empirical testing was quite substantial. This situation may continue as we attempt to explain demographic processes over larger courses of the life cycle and across more time and more cohorts.

Although our theoretical approaches are considerably more complex now than in the past, demography still has highly developed theories in only a few areas. Fertility behavior is the exception, but even in this area there is no agreement as to which of the highly developed theories offers the correct approach (Becker 1960; Bulatao and Lee 1983; Caldwell 1976; Easterlin, Pollack and Wachter 1980). Research in migration and labor force participation is also based on fairly refined models of behavior; these are likely to become more complex as more macro-micro links are revealed.

Mortality research remains largely descriptive, as was the fertility research of 30 years ago. Because no "theory" of mortality currently exists, this area is likely to undergo considerable theoretical development in the coming decade. Currently the emphasis is placed on describing differences according to race, ethnicity, and social class. New independent variables, such as social support, are suggested regularly as possible explanatory variables for mortality differences, but the mechanisms through which these variables might work often remain unspecified. To better understand the processes that lead to poor health and shortened life is a great challenge, but the process of mortality is more complicated than other demographic processes because it is more biologically determined.

In addition, for most people, age at death can be affected by events occurring over about 70 years of life. Thus the events leading to early death may be widely separated in time from the event. Current knowledge of mortality causation is limited; our methods of gathering appropriate data are even more limited.

In 30 years' time we probably will have made significant progress in understanding demographic outcomes. In the next 10 years, as mentioned earlier, we can expect to regularly incorporate context variables along with individuals' characteristics into our explanatory models. In the fertility literature, this approach has been taken by Entwistle, et al. (1986) in their analysis of the use of family planning in 15 countries, and by Billy and Moore (1992) in their analysis of marital and nonmarital fertility in the United States. In these analyses the place of residence characteristics can be seen to represent socioeconomic, normative, or service environment in which fertility decisions are made. Grusky and DiPrete (1990) have used time rather than place as context in investigating the effect of changing bureaucratic and political circumstances on race and sex groups' achievement.

The joining of context to individual factors will become more important in all areas of demographic research. This perspective certainly will broaden studies of labor force and retirement behavior, in which outcomes typically are modeled on individual characteristics. Future studies will be more likely to include characteristics of local labor markets and of policy and program environments. In the literature on living arrangements of the elderly, models increasingly will include characteristics of the formal care, housing, and real estate environments as well as those of the older individuals, their potential household members, and their neighborhoods. As theoretical development in mortality proceeds, models of health and mortality will come to incorporate disease environments of childhood, chemical environments throughout life, and health policies and health programs experienced at various points of life.

Although the field of demography has advanced substantially in all areas, we have not put ourselves out of business by providing answers to the major questions facing the field 30 years ago. How are population growth and economic development related? What policies should be emphasized to reduce population growth in parts of the world? What will be the future level of fertility in the U.S. population? These were the important questions 30 years ago, and they remain largely unanswered. Our progress has led us to conclude that the questions and answers are more complex than we once believed. Probably that will still be true 30 years from now.

SUMMARY

In a population, 30 years approximates the mean length of a generation or the time in which one generation replaces the previous one. In most areas of demographic research, one generation of research replaces the next in a considerably shorter period. A glance at what demographers were doing 30 years ago shows that in most areas, past research no more resembles what demographers do now than the Friedan calculators of that period resemble our current desktop computing environments. In these areas, current research differs from the research of 30 years ago in the theoretical approach, in the methods employed, and in the type of data used. Where great change has occurred, theory, methods, and data appear to have evolved together: each has changed in response to changes in the other areas and then has demanded further developments in those areas.

Formal demography is one area that has been characterized by continuity. The questions addressed and the basic techniques employed build on a long heritage, even while steady progress is made in the development of methodology and analytic techniques.

Analysis of the 1980s reintroduced the idea of context—the idea that behavior is

influenced not only by the characteristics of individuals but also of the environment in which the behavior takes place. In the 1990s, this approach will be incorporated more thoroughly into theoretical developments in all areas of demography as we attempt increasingly to make comparisons across cohorts and time while continuing to model individual behavior. Mortality is the theoretically underdeveloped area of demography which probably will show the greatest change in the next 30 years.

REFERENCES

Alho, Juha. 1992. "Comment." *Journal of the American Statistical Association* 87 (419):673–74.

Becker, Gary S. 1960. "An Economic Analysis of Fertility." In *Demographic and Economic Change in Developed Countries*. Universities National Bureau Conference Series No. 11. Princeton: Princeton University Press.

Billy, John G. and David E. Moore. 1992. "A Multilevel Analysis of Marital and Nonmarital Fertility in the U.S." *Social Forces* 70(4):977–1011.

Blake, Judith. 1964. "Issues in the Training and Recruitment of Demographers." *Demography* 1:258–63.

Blalock, Hubert M. 1964. *Causal Inferences in Nonexperimental Research*. Chapel Hill: University of North Carolina Press.

Bongaarts, John. 1978. "A Framework for Organizing the Proximate Determinants of Fertility." *Population and Development Review* 4(1):105–32.

Bongaarts, John, Thomas K. Burch, and K.W. Wachter, eds. 1985. *Family Demography: Methods and Their Application*. London and New York: Oxford University Press.

Brass, William. 1971. "A Critique of Methods for Estimating Population Growth in Countries with Limited Data." *Bulletin de l'Institut International de Statistique* 44:397–412.

_____. 1975. *Methods for Estimating Fertility and Mortality from Limited and Defective Data*. Chapel Hill: Population Laboratory, University of North Carolina.

_____. 1981. "The Use of the Gompertz Relational Model to Estimate Fertility." *Proceedings of the World Population Conference, Manila* 3:345–61.

Bulatao, Rodolfo A. and Ronald D. Lee, eds. 1983. *Determinants of Fertility in Developing Countries: A Summary of Knowledge*. New York: Academic Press.

Caldwell, John C. 1976. "Toward a Restatement of Demographic Transition Theory." *Population and Development Review* 2(3–4):321–66.

Chiang, Chin L. 1968. *Introduction to Stochastic Processes in Biostatistics*. New York: Wiley.

Cho, Lee Jay. 1964. "Estimated Refined Measures of Fertility for All Major Countries of the World." *Demography* 1:359–74.

Coale, Ansley J. 1971. "Age Patterns at Marriage." *Population Studies* 25:193–214.

_____. 1972. *The Growth and Structure of Human Populations: A Mathematical Investigation*. Princeton: Princeton University Press.

Coale, Ansley J. and Paul Demeny. 1966. *Regional Model Life Tables and Stable Populations*. Princeton: Princeton University Press.

_____. 1983. *Regional Model Life Tables and Stable Populations*. 2nd ed. New York: Academic Press.

Coale, Ansley J. and Elaine E. Kisker. 1990. "Defects in Data on Old Age Mortality in the United States: New Procedures for Calculating Approximately Accurate Mortality Schedules and Life Tables at the Highest Ages." *Asian and Pacific Population Forum* 4(1):1–31.

Coale, Ansley J. and D.R. McNeil. 1972. "The Distribution by Age of the Frequency of First Marriage in a Female Cohort." *Journal of the American Statistical Association* 67:743–49.

Coale, Ansley J. and T. James Trussell. 1974. "Model Fertility Schedules: Variations in the Age Structure of Childbearing in Human Populations." *Population Index* 40(2):185–258.

Coale, Ansley J. and Susan C. Watkins, eds. 1986. *The Decline of Fertility in Europe*. Princeton: Princeton University Press.

Davis, Kingsley and Judith Blake. 1956. "Social Structure and Fertility: An Analytic Framework." *Economic Development and Cultural Change* 4(4):211–35.

DiPrete, Thomas A. and David B. Grusky. 1990. "The Multilevel Analysis of Trends with Repeated Cross-Sectional Data." Pp. 337–68 in *Sociological Methodology*, Vol. 20, edited by Clifford Clogg. Cambridge: Blackwell.

Duncan, Otis D., David L. Featherman, and Beverly Duncan. 1972. *Socioeconomic Background and Achievement*. New York: Seminar Press.

Easterlin, Richard A. and Eileen M. Crimmins. 1985. *The Fertility Revolution*. Chicago: University of Chicago Press.

Easterlin, Richard A., Robert A. Pollack and M.L. Wachter. 1980. "Toward a More General Economic Model of Fertility Determination: Endogenous Preferences and Natural Fertility." In *Population and Economic Change in Developing Countries*, edited by Richard A. Easterlin. Chicago: University of Chicago Press.

Entwistle, Barbara, William M. Mason, and Albert I. Hermalin. 1986. "Multilevel Dependence of Contraceptive Use on Socioeconomic Development and Family Planning Program Strength." *Demography* 23:199–216.

Espenshade, Thomas and Roberta Braun. 1982. "Life Course Analysis and Multistate Demography: An Application to Marriage, Divorce and Remarriage." *Journal of Marriage and the Family* 44:1025–36.

Euler, Leonhard. 1760. "Recherches Generales sur la Mortalite et la Multiplication du Genre Humain." *Histoire de l'Academie Royale des Sciences et Belles-Lettres* 16:144–64.

Ewbank, Douglas, Jose C. Gomez de Leon, and Michael Stoto. 1983. "A Reducible Four Parameter System of Model Life Tables." *Population Studies* 37(1):105–27.

Gompertz, Benjamin. 1824. "On the Nature of the Function Expressive of the Law of Human Mortality." *Philosophical Transactions of the Royal Society* 27:513–585.

Graunt, John. 1661. *Natural and Political Observations Mentioned in a Following Index, and Made Upon the Bills of Mortality*. London: John Martyn.

Grusky, David B. and Thomas A. DiPrete. 1990. "Recent Trends in the Process of Stratification." *Demography* 27:617–37.

Halli, Shiva S. and K. Vaninadha Rao. 1992. *Advanced Techniques of Population Analysis*. New York: Plenum.

Hayward, Mark D. and William R. Grady. 1990. "Work and Retirement among a Cohort of Older Men in the United States, 1966–1983." *Demography* 27:337–56.

Heise, David R. 1975. *Causal Analysis*. New York: Wiley.

Heligman, Lawrence and John H. Pollard. 1980. "The Age Pattern of Mortality." *Journal of the Institute of Actuaries* 107: 449–80.

Hoem, Jan M. 1970. "Probabilistic Fertility Models of the Life Table Type." *Theoretical Population Biology* 1:12–38.

Keyfitz, Nathan. 1982. "Choice of Function for Mortality Analysis: Effective Forecasting Depends on a Minimum Parameter Representation." *Theoretical Population Biology* 21:329–52.

Lee, Ronald and Lawrence R. Carter. 1992a. "Modeling and Forecasting U.S. Mortality." *Journal of the American Statistical Association* 87(419):659–71.

_____. 1992b. "Rejoinder." *Journal of the American Statistical Association* 87(419):674–75.

Lexis, W. 1875. *Einleitung in die Theorie der Bevolkerungs-Statistik*. Strasbourg: Trubner.

Lorimer, Frank. 1959. "The Development of Demography." Pp. 124–79 in *The Study of Population*, edited by Philip Hauser and Otis D. Duncan. Chicago: University of Chicago Press.

Lotka, Alfred J. 1907. "Relation between Birth and Death Rates." *Science* 26(653):21–22.

_____. 1939. *Theorie Analytique des Associations Biologiques*. Paris: Hermann.

Manton, Kenneth and Eric Stallard. 1984. *Recent Trends in Mortality Analysis*. Orlando: Academic Press.

McNown, Robert. 1992. "Comment." *Journal of the American Statistical Association* 87(419):671–72.

McNown, Robert and Andrei Rogers. 1989. "Forecasting Mortality: A Parameterized Time Series Approach." *Demography* 26(4): 645–60.

Menken, Jane, James Trussell, Debra Stempel, and Ozer Babakol. 1981. "Proportional Hazards Life Table Models: An Illustrative Analysis of Socio-Demographic Influences on Marriage Dissolution in the United States." *Demography* 18:181–200.

Newell, Colin. 1988. *Methods and Models in Demography*. New York: Guilford Press.

Preston, Samuel H. and Ansley J. Coale. 1982. "A Generalization of Stable Population Relations." *Population Index* 48:217–59.

Rodriguez, German and John Hobcraft. 1980. *Illustrative Analysis: Life Table Analysis of Birth Intervals in Colombia*. Voorburg: International Statistical Institute.

Rogers, Andrei. 1973. "The Mathematics of Multiregional Demographic Growth." *Environmental Planning* 5:3–29.

_____. 1974. "The Multiregional Net Maternity Function and Multiregional Stable Growth." *Demography* 11:473–81.

_____. 1975. *Introduction to Multiregional Mathematical Demography*. New York: Wiley.

Rogers, Andrei and Jacques Ledent. 1976. "Increment-Decrement Life Tables: A Comment." *Demography* 13:287–90.

Rogers, Richard G., Andrei Rogers, and Alain Belanger. 1989. "Active Life among the Elderly in the United States: Multistate Life-Table Estimates and Population Projections." *Milbank Quarterly* 67(3–4):370–411.

Schmid, Calvin F. and Kiyoshi Tagashira. 1964. "Ecological and Demographic Indices: A Methodological Analysis." *Demography* 1:194–211.

Schoen, Robert. 1975. "Constructing Increment-Decrement Life Tables." *Demography* 12:313–24.

_____. 1988. *Modeling Multigroup Populations*. New York: Plenum.

Smith, David P. 1992. *Formal Demography*. New York: Plenum.

Smith, David P. and Nathan Keyfitz, eds. 1977. *Mathematical Demography: Selected Papers*. Berlin: Springer-Verlag.

Teachman, Jay. 1983. "Analyzing Social Processes: Life Tables and Proportional Hazards Models." *Social Science Research* 12:263–301.

Trussell, James and Charles Hammerslough. 1983. "A Hazards-Model Analysis of the Covariates of Infant and Child Mortality in Sri Lanka." *Demography* 20(1):1–26.

United Nations. 1955. *Age and Sex Patterns of Mortality: Model Life Tables for Underdeveloped Countries*. ST/SOA/SEX A/22. New York: United Nations.

_____. 1967. *Manual IV: Methods of Estimating Basic Demographic Measures from Incomplete Data*. Population Studies No. 42. New York: United Nations.

_____. 1982. *Model Life Tables for Developing Countries*. Population Studies No. 77. New York: United Nations.

_____. 1983. *Manual X: Indirect Techniques for Demographic Estimation*. Population Studies No. 81. New York: United Nations.

Vance, Rupert B. 1959. "The Development and Status of American Demography." Pp. 286–313 in *The Study of Population*, edited by Philip Hauser and Otis D. Duncan. Chicago: University of Chicago Press.

Winsborough, Halliman H. 1992. "Demography." Pp. 451–58 in *Encyclopedia of Sociology*, edited by Edgar F. Borgatta and Marie L. Borgatta. New York: Macmillan.

Wong, George Y. and William M. Mason. 1985. "The Hierarchical Logistical Regression Model for Multivariate Analysis." *Journal of the American Statistical Association* 80:513–24.

Zaba, Basia. 1979. "The Four-Parameter Logit Life Table System." *Population Studies* 33(1): 79–100.