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Introduction

Perhaps when the history of population projecting or forecasting in the twentieth century is written, it will fall into three parts. The first, which began early in the nineteenth century, was characterized by concern for patterns of growth and only with the total population. A number of interesting attempts to fit curves to recorded changes have been chronicled culminating in the work of Pearl and Reed in 1920. Critics of this school claimed that the curves fit as well as they did only because they were used at a unique time in demographic history and that their success in describing what happened did not promise a corresponding success in describing what would or what might happen.

Starting in 1928 with the work of P. K. Whelpton, more analytic methods came into vogue. The cohort-survival or cohort/component technique initiated by Whelpton and developed by him with the aid of Warren S. Thompson and by a host of others is still widely used. I do not know to what extent its supremacy in the production of population projections for relatively short periods, 10 years to 20 years where the data are available would be challenged. For states and for the nation, detailed information is available, at least in the form of sophisticated estimates. For longer periods, for the look 25 and more years into the future that has become essential to major planning efforts, there is disagreement. This session is a demonstration of this.

The third period is that on the threshold of which we now stand. To an increasing extent, attempts will be made to forecast population or migration as a dependent variable, dependent upon some other and presumably independent variable, such as a quantified measure of economic activity.

We in California face several technical problems, which are not unique to us but nevertheless severely restrict the nature of our projection technique. One of these is our unusually high rate of migration and the inherent uncertainties in its composition; the other is the demand for small area detail resulting from our position in the state bureaucracy. The latter sometimes generates requests for more detail for smaller areas than prudent estimating would permit, so the work to be described represents one solution to the dilemna of insufficient data on the one hand and excessive demand for geographic detail on the other. Unfortunately we have been so busy mending holes in the data that we have not yet been able to set sail for the promised land of econometric models. It must be admitted that an area of relatively small population, high migration and insufficient demographic data might be amenable to an econometric model. I suspect that such an area might present problems whatever method were selected; certainly even an intercensal test of the method would be suspect.

The projection effort of the California Department of Finance has so far been restricted to the cohort-survival approach using the typical demographic inputs rather than attempting to depend upon non-demographic variables. There is a widespread practice in the literature to distinguish between forecasts and projections. The former term seems to refer to efforts which include judgment while the latter, presumably, are rigidly empirical. The distinction is more apparent than real. The present efforts may be regarded as projections since this is the word most commonly used in the demographic literature. No effort was made to gaze into the future beyond that required to select one of several possible patterns of change. For example, only two of many possible migration assumptions were selected and only two patterns of fertility and one of mortality were chosen. These selections were based upon a judgmental process, but no special claim of prescience is implied.

The preparation of projections is always a hazardous enterprise and anyone who claims to predict the future is, to quote Philip M. Hauser,

"either a fool or a charlatan. Yet the projections of the demographers are more than exercises in arithmetic: they make it possible for us to see the implications of observed rates of growth."

The experienced user of population projections knows that they are neither a firm prediction of things to come nor a mere game played with the computer. Rather, they are a useful planning device to show us where we are going if our assumptions are correct. For this reason, projections are only as valid as their underlying assumptions and the user is urged to scrutinize such foundations with the greatest care.

The projections discussed in this paper, some of which are already completed and others of which are yet to be published, fall into three parts. First, a set of statewide civilian projections by age and sex was prepared, using the methods and assumptions described below. Next, a set of county total population projections was prepared using crude death rates, crude birth rates and numbers of net migrants with the addition of an assumed future military population for each county. In counties where State institutions were located, it was possible to remove the institutional population before establishment of the vital rates and to replace it in the final product. Better data on other special populations would permit the elaboration of this refinement. Each county's net migration was based upon its share of the State's net migrants within recent years with adjustments, by judgment, for local conditions. The totals of births, deaths, and net migrants for the counties were controlled to the totals for the state of these components, projected. A discussion of the final disaggregation of the age groups into geographical areas, the third and final effort, concludes the paper.

Projection Assumptions, the State

Assumptions used in projecting fall into two groups, the general and the specific. Almost invariably the general assumptions underlying population projections take the following form: it is assumed that

- 1. our democratic institutions and system of government will remain, and with them the right of every person to migrate where his whims or social or economic advantage dictate.
- 2. no major natural catastrophes will befall the State or the nation.
- no major or world-wide war will break out.

The framing of specific assumptions requires, first of all, the selection of a basic orientation toward one or the other of two ideologies of projection. One assumes that employment or wages and salaries is the independent variable with respect to migration and that this variable is, in turn, dependent upon a host of other economic variables. The opposing view acknowledges the importance of economic parameters but argues that their bearing on migration is not yet sufficiently understood and, furthermore, that they cannot explain all migration. The prospect of an econometric model on which to base future population or migration is an attractive one. However, without ready access to the projected parameters needed as inputs to the model, no improvements in the validity of the projection are likely. An underlying article of faith is that whatever the level of migration assumed, the economic activity within the state will be adequate to support the population with tolerable levels of unemployment. None of the assumptions formulated envisions sustained migration as high as that of the average of the past decade.

From the standpoint of the policymaker who is to consider the various alternatives it would seem that the demographic projection would be preferable to the economic since it is easier to understand and the underlying assumptions are fewer and more clearly spelled out. The demographic projection has fewer hidden policy assumptions built into it. Furthermore, there seems to be a greater probability that the economic organization of society will differ from that which is now expected, than that the demographic events of births, deaths and migration will differ from those anticipated.

Similar considerations face the projector in examining the probable future courses of births and deaths. Changes in eating, smoking, or recreational habits or of major medical discoveries may cause changes in mortality, yet the actual level of mortality is more readily projected than changes in the determinants cited. Demographers seem to agree that, barring a major medical breakthrough, changes in mortality by age will not be critical.

This is <u>not</u> true of future additions to the population by births. The determinants of future fertility are many and complex and include such things as: availability of contraceptives and the religious and moral questions concerning their use; the types of housing to be produced in the future; the costs of education; future fundamental social values as they are reflected in styles of life, and a host of others.

To keep the projection problem to manageable proportions, the complexity of the determinants of future fertility, mortality and migration may be sidestepped in favor of summary assumptions concerning their level, formulated as specifically as possible. The user is urged to evaluate the plausibility of the assumptions and impose his own insights on them. The choice of assumptions is offered to enable him to do this.

Mortality There has been little change in mortality by age since 1955, therefore it is assumed that age-specific mortality rates will continue at their present level for all age groups. Fertility The decline in fertility of American women since 1957 has dramatized the need for new projection assumptions. In the four series of population projections published by the United States Bureau of the Census in 1967¹, four different assumptions were used. The Bureau used a "cohort" measure of fertility, rather than the "period" or "calendar year" age-specific method. Briefly, this approach examines a birth cohort or group of women born in a specified period and projects what their future fertility will be in the light of age at marriage, children already born, age, and related factors. A group of agespecific birth rates for the projection period has been derived from the assumed cohort fertilities used in the Bureau of the Census' latest United States projections.

The differing United States fertility assumptions resulted in four projection series designated A, B, C and D. Series A assumes that future cohorts will experience, during their major childbearing years, the high fertility of the post World War II period, while series B assumes a somewhat diminished level. Series C and D assume that completed fertility will resemble that observed during the five decades preceding the postwar rise and it is to these two series that future California rates are tied. It is worthy of mention that of the four series offered as models of future fertility by the Census Bureau only a few years ago and first published in 1964, the two lowest are now considered as alternatives in the light of recent observed vital rates. The actual performance of the past several years for the United States suggests a recent level between C and D. Although this decline may merely reflect temporarily delayed births, a further diffusion of the small-family pattern, particularly among groups heretofore responsible for the larger families, will result in lower age-specific birth rates. The pyramid below compares the theoretical future age and sex structures of the State's population under fertility assumptions I-D and I-C.

(Figure 1)

Admittedly, a sociological judgment has been added to the projections, namely that the recent decline in fertility represents a return to a long-established historical trend. There is at least presumptive evidence that this is the case in the United States and in other countries with advanced technologies. The course of the birth rates for women of various ages under the assumptions of series C and D are presented graphically below.

(Figure 2)

For California, it was assumed that the difference between the State age-specific rates and the national rates observed in 1960 would tend to converge within 50 years.

Net Migration A satisfactory study of migration including the gross streams in and out of individual states has not been made since the Census of 1960, which asked, nationwide, a question on residence in 1955 of all persons five years of age and older within a sample population. The estimation of net migration, the excess of in-migrants over out-migrants, is a vital part of the population estimating process, especially in California. Since 1950 California's net civilian migration has varied from an annual estimated 268,000 in fiscal 1951 to 388,000 in fiscal 1957; since 1960, annual estimates of net civilian migration have varied between 369,000 in fiscal 1963 and a provisional estimate of 240,000 in fiscal 1966. International migrants to California, immigrants, are a significant element in population change and in the last ten years have varied between the 49,673 of 1959 and the 79,090 of 1963². For the projections, annual immigration at a level of 65,000 has been assumed, and this element is included in the projections of net migration. It is as yet too soon to assess the effects of recent changes in the immigration laws, but this variable may increase in the years ahead.

Military migration is assumed to be zero

unless a buildup or contraction of troop strength in California is underway. The dependents of military personnel are civilians, and for certain areas rapid changes in net civilian migration have been caused by military shifts. For projection purposes, and because no change in the military population of California after 1970 can be foreseen, net civilian migration and net total migration need not be distinguished. "Loss to military," that component of civilian population change measuring the net movement into and out of the armed forces, is projected at zero or it may be considered a part of the net migration to and from the State.

The determinants of net migration are certainly manifold, complex, interrelated and not completely understood. While attempts have been made to construct models which tie migration to other projected variables, these population projections make no attempt to isolate or separately to project the motivations underlying migration. In the familiar fashion they attempt to show the future population of the State, at various times and for various age and sex groups, implied by their underlying assumptions. The present "state of the art" imposes its limitations.

In the framing of assumptions concerning the future level of net migration one salient fact cannot be ignored. There are no concrete up-to-date data on the age and sex composition of the migrant population of all ages to California, neither in-, nor out-, nor net. However, using birth, death, school enrollment and social security data it is possible to estimate age groups annually. Any change in these age groups beyond the effects of births and deaths are assumed to be attributable to migration. Using this method, an average annual rate of migration by age from 1960 to 1965 was developed and applied throughout the projection period to obtain an age "mix" of migrants.

The decision to use this device to establish merely a migration mix and not a magnitude is attributable to a property inherent in the assumption. If a constant rate of net migration were applied to a growing population it would imply an ever-increasing number of migrants due only to the larger population. For this reason net migration is controlled to a previously assumed level.

In Series I, net migration is assumed to level at 300,000 per year. As an alternative, Series II is presented. In this series the level of immigration from foreign countries is assumed stable at 65,000 per year, while the domestic net migration of 235,000 is assumed to be declining at the rate of 4,700 per year. In effect, Series II assumes that although international migration will continue, and the high level of U. S. migration in and out of all states will also continue, in 50 years all interstate disequilibriums will have vanished; California (and all other states) will attract and repel migrants in equal measure. Series I represents the effects, conservatively stated, of the continuation of recent migration experience of the State. Series II measures the effects of a moderate decline in net migration. These two options are comparable to those used in population projections produced by the Bureau of the Census. The effect of these differing assumptions on the possible age structure of the State is shown by Figure 3.

Although Series I-D and I-C on the one hand and II-D and II-C on the other, differ only in their underlying fertility assumptions, some differences appear in age groups outside those affected by the differing births. This is attributable to the fact that net migration is held at a constant level as are net migration rates by age. The differing composition of the population under the differing fertility assumptions generate slightly differing "mixes" of the migrant population.

(Figure 3)

Summary, Statewide Projections

If the assumptions underlying Series I-D are realized, the civilian population of California will attain a level of about 26,100,000 in 1980 and 38,700,000 by the year 2000. Series II-D suggests a population of 25,600,000 in 1980 and 35,500,000 in 2000. By the year 2000 Series I-C and II-C suggest civilian populations of 41,600,000 and 38,200,000 respectively³. It is worth noting that the effects of varying assumptions became more pronounced with the passage of time. A short-term projection can be made with a single set of assumptions and yield information in which the user may have a fair degree of confidence, but a projection carried beyond a decade or two should be interpreted in terms of ranges. However, even such ranges should not be regarded as upper and lower limits to the possible future course of population.

The median age of the civilian population at the time of the 1960 Census was 30.3. This is expected to drop to a minimum of 27.8 in 1970, from which it will rise, attaining a level of 28.7 in 1980 and 31.0 in 2000 under Series I-D. Under Series II-D a slightly more steep rise to 28.8 in 1980 and 31.4 in 2000 may be anticipated. For Series I-C and II-C the median age remains lower throughout the period due to the assumed greater number of births under both C series. In 1970 I-C and II-C imply 27.7 years and by 2000 the median age is 28.4 for Series I-C and 28.7 for Series II-C.

<u>Projections for Standard Metropolitan Statis-</u> <u>tical Areas</u>⁴

California consists of 58 counties of which 36 are non-metropolitan. The remaining 22 are divided into 14 SMSA's. On the basis of tests which revealed tolerable success in the development of 1965 composition (as measured by a composite method of estimating) from the 1960 benchmark, it was decided to attempt projections for the SMSA's and for the non-metropolitan counties, the latter treated as a unit. The non-metropolitan area of California is more statistical convenience than administrative entity since it contains counties as dissimilar as hot, dry, Imperial with its lettuce crops, Alpine (population 397 in 1960) and cool, moist Del Norte and its coastal redwoods.

The projecting task falls into two sections. The first involves the development and testing of rates, using the first benchmark, 1960, and proceeding to the second benchmark, 1965. A set of SMSA estimates has been prepared by a composite method. The second step is the projection of the rates established in the first within the framework imposed by the statewide assumptions.

The inputs required are the state age-specific birth rates, death rates and rates of net civilian migration and loss to military for the years 1960-65. Furthermore, the number of births, deaths, net migrants and loss to military, specific by age, for the 15 areas for the same period are necessary. For the test, deaths were devel-oped by application of rates from an especially prepared 1960 table of survivals for the state, by single year of age and by sex. The use of statewide rates is probably justified in the absence of evidence of critical regional differences. Completion of the test will indicate whether or not minor adjustments are warranted. Births were developed by a comparison of statewide age-specific birth rates for 1960 with those for each respective area by ratio. This ratio was applied to the derived state age-specific rates for each year between 1960 and the second benchmark year and the sum of births generated were controlled to the recorded births for the state by minor adjustments to the rates. The assumption selected implies that relative differences in age-specific birth rates among the areas will continue and that any change in the birth rates experienced by the state will be shared proportionately by its areas.

On the basis of composite estimates prepared for the areas for the years 1960-1965, unadjusted migrations were calculated by adding, age specifically and algebraically, population changes and deaths. Starting from 1960, migration rates based upon the unadjusted migrations were averaged for an annual value, specific for age, and applied, year by year, along with birth rates, death rates, and loss to military to estimate the 1965 population. Comparisons with the 1965 and earlier composite estimates were made. The net civilian migration rates were adjusted by an iterative method to produce net migrants sufficient to yield the 1965 estimates.

The projections of the SMSA's by age, not yet completed, will be produced from the benchmark year 1965 using adjusted migration rates, birth rates and death rates and assumed loss to military. In the cases of all three components, the sums of the numbers generated for the 15 respective areas are to be controlled to the previously projected state total by age.

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2

- United States Department of Justice, Annual Report of the Immigration and Naturalization Service, 1966.
- 3 The figures cited are by no means official since the final run has not been made. Those interested in the final figures and their breakdowns may request them from the Department of Finance, Sacramento 95814.

4

The contribution of Mrs. Isabel T. Hambright, who with programming help from Survey Research Center, Berkeley, made these projections possible, is acknowledged.

Bureau of the Census, Current Population Reports Series P-25 No. 359.



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Figure 2 CALIFORNIA AGE-SPECIFIC BIRTH RATES

Figure 3 CALIFORNIA'S CIVILIAN POPULATION BY AGE AND SEX

1960 - 1980 - 2000

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