would be too high. It should not be surprising that the model cannot fit real-world data exactly, since it is not intended to. The model's economic driving functions ignore known irregularities in the real system, such as the depression of the 1930s that lowered birth rates, and the world wars that both lowered birth rates and increased death rates. From a long-term view, such temporary discontinuities act as "noise" that interrupts and sometimes obscures the long-term dynamic behavior modes of the system. They affect the quantitative outcome of the behavior modes, but not their qualitative characteristics.

To gain a better understanding of the interplay of variables that generated the outcome of Run 2-1, in Run 2-2 (Figure 2-85) we plotted all the population sector variables that determine the death rate calculation, and in Run 2-3 (Figure 2-86) the variables that underlie the birth rate. Run 2-2 shows that increases in the lifetime multipliers from health services and from food are responsible for the decline in the death rate in all three models. Crowding and pollution have little or no effect in this run. The outputs of the four- and fifteen-level models in Run 2-2 also show the calculated fractions of the population in different age groups. The four-level model somewhat underestimates the proportion of the population in the reproductive ages and overestimates the proportion in older age groups; otherwise, the shift in age structure during the run is similar in the two age-disaggregated models.

In Run 2-3 the development of the inputs to the calculated fertility are almost identical in the three models. In year 0 maximum total fertility MTF is low (at about 6.5), and desired total fertility DTF is relatively high (at about 4.5 children), because of high perceived child mortality and a social structure that reinforces a large-family norm. The compensatory multiplier from perceived life expectancy CMPLE falls steadily in response to decreasing mortality, and the social family size norm SFSN decreases from about 1.15 (4.6 children) to 1.0 (4.0 children) as a delayed result of industrialization. The family response to social norm FRSN fluctuates slightly about the value 0.78.

As industrialization proceeds in the model, the maximum number of births increases with improving health conditions; desired total fertility decreases as a result of the changing social norm and the perception of decreasing child mortality; and fertility control effectiveness (plotted in Run 2-1) increases rapidly enough to keep actual total fertility close to desired total fertility, in spite of the increasing gap between desired fertility and that maximally possible.

Constant Income per Capita In the model runs that follow, there is no recourse to global data to verify the behavior of the model, because they show the effects of using driving functions to push the population system into unrealistic extremes of behavior. These apparently artificial runs were carried out for two reasons. The first was to be sure that the model would be robust under as many behavior modes as we could imagine. Since a model is usually constructed with historical conditions in mind, modeling errors most often become apparent when conditions begin to vary from those considered "normal." We can often locate such errors by driving the model into different behavior modes and looking for anomalous responses. The second reason was to gain a better understanding of the model system. Although the

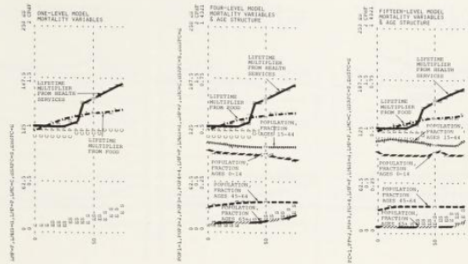

Figure 2-85 Run 2-2: historical behavior, 1900–1975, mortality variables

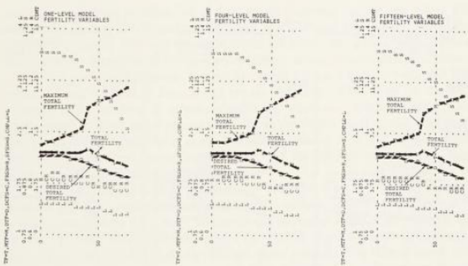

Figure 2-86 Run 2-3: historical behavior, 1900–1975, fertility variables

whole world population has not undergone any of these extreme economic conditions, some smaller segments of the human population have experienced conditions closely resembling the ones represented here. Our knowledge of their behavior under those conditions gives us some expectation of how the model population "should" behave.