in the model: as industrialization proceeds, per capita resource usage tends to increase.

Run 7-4 shows that the fraction of capital allocated to obtaining resources FCAOR remains constant during the period of the run. This constant fraction reflects the fact that, in the past, the tendency toward rising resource capital costs has been continually offset by advances in technology. Although resource capital costs historically have remained constant or have decreased, it is assumed in the model that this trend can continue only as long as resources are relatively abundant—that resource costs (FCAOR) will begin to rise after resources are depleted to half their initial value. Note that in Run 7-4 over 90 percent of the initial amount of nonrenewable resources remains unexploited in 1970 (nonrenewable resource fraction remaining NRFR equals 0.9 in 1970. Different assumptions about the eventual rise in resource costs will be tested later in this chapter.

Persistent Pollution Sector Variables As described in Chapter 6, the historical time trends characteristic of global persistent pollutants are:

1. Exponential growth in the global concentration of pollutants.
2. Significant delays between the generation of pollutants and their appearance.

Run 7-5 (Figure 7-6) shows the historical behavior of the persistent pollution sector. The persistent pollution generation rate PPGR increases exponentially as a result of growth in both the persistent pollutants generated from industrial output PPGIO and the persistent pollutants generated from agricultural output PPGAO. The total amount of persistent pollutants present in 1970 is used as a normalizing constant to determine the index of persistent pollutants PPOLX relative to 1970 levels. As shown in this run, PPOLX also grows through time, passing through its normalized value of 1.0 in 1970.

Run 7-5 also illustrates the effect of the delay between the generation of pollutants and their appearance as persistent pollutants. The rate of appearance of persistent pollutants PPAPR also rises exponentially in Run 7-5, but the increase in the appearance of pollutants lags behind the generation of pollutants by 20 years.

Several additional variables of interest in the pollution sector are plotted in Run 7-5. The pollution assimilation half-life AHL remains constant at a value of 1.5 years during the 70-year period, reflecting the assumption that the index of pollution PPOLX has not risen high enough to interfere with the assimilation process. The lifetime multiplier from pollution LMP also remains constant over the initial 70 years of the run, indicating that persistent pollution has had no significant effect on the life expectancy of the population.

Runs 7-1 through 7-5 were intended to illustrate the model's behavior over the period for which historical data are available for comparison, 1900–1970. As expected, some small discrepancies occur between the output of the model and the historical time-series data. These discrepancies arise from two factors. First, discrete events such as
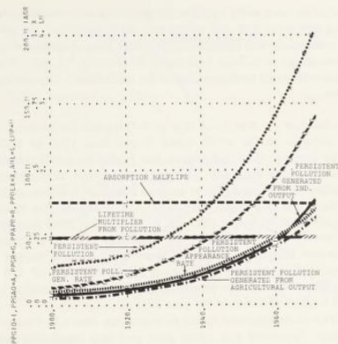
Figure 7-6 Run 7-5: persistent pollution sector behavior, 1900–1970

The rate of generation of persistent pollutants PPGR increases exponentially as its two components, persistent pollutants generated from industrial output PPGIO and persistent pollutants generated from agricultural output PPGAO, rise over the 70-year period. After a 20-year delay, the persistent pollutant appearance rate PPAPR also rises, causing the index of persistent pollutants PPOLX to rise and eventually pass through its normalized value of 1.0 in 1970.

wars and depressions that have short-term effects on world historical data are excluded from the model. Second, instead of choosing numerical parameters that would fit model-generated data to historical time-series data, the parameters were chosen individually and independently to represent each causal relationship. A comparison of the behavior of the model with that of the historical system therefore becomes a second criterion for model utility, independent of the defense of individual parameters. As mentioned earlier, the model must reproduce historical behavior modes, not replicate exact time-series data, and the model does meet that criterion.

7.3   REFERENCE BEHAVIOR OF THE WORLD3 MODEL

The historical runs of the previous section have plotted the behavior of the major sector variables for comparison with world historical behavior as the model was run from 1900 to 1970. The following global reference run, Run 7-6A (Figure 7-7), il-