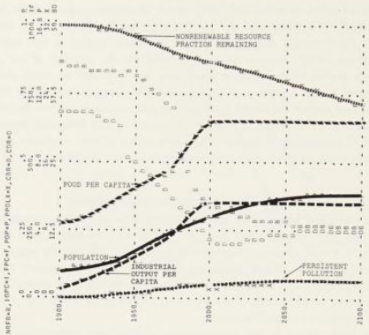

Figure 7-38 Run 7-28: equilibrium through discrete policy changes

To obtain one example of a sustainable state of equilibrium, this run combines discrete policy changes in both technology and social values. To stabilize the population POP, the desired completed family size is reduced to 2 children per family in 1975. The growth in industrial capital is reduced in 1990 by reinvesting only enough industrial output to keep industrial output per capita IOPC at a constant level. In addition, new recycling and pollution control technologies are developed, capital lifetimes are increased, and social choices of output forms are shifted toward a preference for food and services. Population POP stabilizes in 2050 at 5 billion people, industrial output per capita IOPC levels off in 1990 at 350 dollars per person-year, and food per capita FPC stabilizes by the year 2000 at three times the subsistence level. The index of persistent pollution PPOLX is kept at very low levels, and the rate of resource depletion is slow enough to permit technology and industrial processes to adjust to changes in the availability of resources.

4. The preferences of society for the mix of output of the economic system are shifted toward food and services in 1975. This policy is accomplished by increasing the indicated food output per capita and indicated service output per capita tables IFPC2T and ISOPC2T by 50 percent.
5. In 1975, pollution generation per unit of industrial and agricultural output is reduced to one-fourth of its 1970 value.
6. To minimize the amount of industrial throughput necessary to sustain the capital stock, the average lifetime of industrial capital ALIC and the average lifetime of service capital ALSC are increased by 50 percent in 1975.

This combination of technological and social policies enables the model system to move into a sustainable stable state. The rate of growth of population declines gradually after 1975, and population POP slowly levels off at 5 billion people by the year 2050. Industrial output per capita IOPC levels off in 1990 at 350 dollars per person-year, which is 75 percent above its 1970 value. Food per capita FPC reaches a value over 50 percent higher than the 1970 world average. Advances in pollution control technologies allow the index of persistent pollution PPOLX to remain below its 1970 level even though industrial output per capita IOPC and population POP continue to grow beyond their 1970 levels. Advances in resource recycling technologies, combined with the slower rate of growth of population POP and industrial output per capita IOPC, greatly reduce the rate of usage of nonrenewable resources. Resources are still slowly depleted over time (as they must be according to the second law of thermodynamics), but the rate of depletion is slow enough to enable technology and industrial processes to adjust to changes in resource availability.

The exact set of policies tested here is just one of many possible combinations of technological and social policies that could lead to a stable equilibrium state. The individual policies suggested in this run represent only hypothetical examples of the general types of policies needed to reach such a state. Two types of policies are necessary: technological policies that reduce the limitations to growth, and social policies that reduce the pressures toward growth. The next run gives an example of a stable equilibrium reached through a combination of adaptive technological and social policies.

Equilibrium through Adaptive Policies Run 7-29 (Figure 7-39) illustrates the second example of a set of policies that could result in a stable long-term model behavior. In this case the stable state is reached through an adaptive process; policies are initiated in response to a perceived need for them, measured in the model by a discrepancy between a desired system state and the actual system state. Figure 7-40 illustrates the structural changes assumed for this run. The technological policies included in this run are the same as in Run 7-22: advances in resource recycling, pollution control, and land yield technologies are developed as resource usage, persistent pollutants, and food per capita deviate from their desired levels. Figure 7-40 shows that these advances are not immediately effective because of a 10-year delay in technological development and implementation. The new technologies are also not free; their development and implementation require additional capital, which in turn raises the industrial capital-output ratio. As in Run-22, additional resource exploration and development technologies, air pollution technologies, and land erosion control technologies are assumed to be implemented in 1975. These additional technologies are modeled as discrete policies only to simplify the presentation—they could be represented adaptively, as the other technological policies were.

In addition to the preceding technological policies, Run 7-29 includes social policies that tend to stabilize population POP and industrial output per capita IOPC near their 1975 levels. Population POP is stabilized by setting the desired completed family size to 2 children in 1975. Figure 7-40 shows the structural additions included