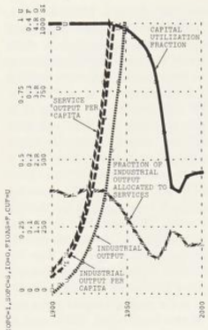

Figure 3-39 Run 3-3: behavior of the capital sector when the capital-output ratio is decreased from 3 to 2 years with standard inputs

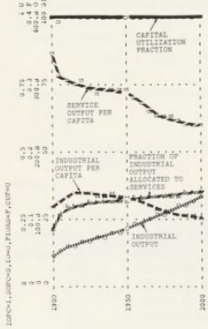

Figure 3-40 Run 3-4: behavior of the capital sector when the industrial capital-output ratio is increased from 3 to 4 years with standard inputs.
Note: Scales for IOPC, SOPC, and IO have been changed from their normal values.

run. With this higher capital-output ratio, IOPC increases very little beyond its initial value in 1900. If ICOR were raised to 4.6, the growth of the capital investment loop would be zero, IO would remain constant, and IOPC would decline. Run 3-5 (Figure 3-41) portrays the effects of decreasing the growth in industrial capital below zero by increasing FCAOR to 0.35, an increase of 700 percent. Notice that the IOPC scale has been altered in Runs 3-4 and 3-5 to provide more detail. In Run 3-5 the industrial output per capita IOPC declines from 25 to 12 dollars per person-year between 1900 and 1970.

It should be clear that all the variables in the service capital sector have indirect effects on the growth rate of capital. Suppose, for example, that productivity in the service sector were only 50 percent of the original estimate and the service capital-output ratio SCOR equaled 2 years rather than 1 year. Run 3-6 (Figure 3-42) illustrates the resulting behavior when this change is made; a higher level of investment is needed in the service sector to generate the indicated service output per capita ISOPC. The fraction of industrial output allocated to services FIOAS increases from 0.12 in the standard run to 0.18, thus effectively decreasing the investment in the industrial sector. The result is that industrial output IO barely grows from 1900 to 1970. The annual industrial output per capita IOPC is only about 70 dollars per person-year in 1970.

While it appears that the parameter values chosen for the standard run produce a behavior that is consistent with the few historical data cited, it is also clear that small changes in parameter values can cause the sector to generate entirely different behavior modes. Since the precision of our data is so low, there is need for additional study of the minor subloops that could be incorporated in future versions of the world model to make its behavior less sensitive to reasonable changes in coefficients.

Alternative Behavior Modes of the Capital Sector

Growth, equilibrium, and decay are the three long-term endogenous behavior modes of the capital sector. In the runs just discussed, the constants and exogenous inputs were chosen to exhibit each of these modes from the beginning of the simulation. When the capital sector is enmeshed in World3, population POP, fraction of industrial output allocated to agriculture FIOAA, fraction of capital allocated to obtaining resources FCAOR, arable land AL, agricultural inputs per hectare AIPH, and service capital investment rate SCIR will all change over time. Although changes in these parameters cannot force the capital sector into any behavior mode not already seen, changes in the inputs could lead the capital sector to shift from one behavior mode to another during the run. Several additional simulations will be presented here to illustrate typical ways in which this shift might occur.

By altering the driving functions for POP, FCAOR, and FIOAA, we determined the reaction of the capital sector to alternative conditions outside the sector. For example, if resources were suddenly to become severely depleted midway through the simulation run, FCAOR would increase markedly. The inputs necessary to represent this change are shown in Figure 3-43. AL and AIPH retain their standard values.