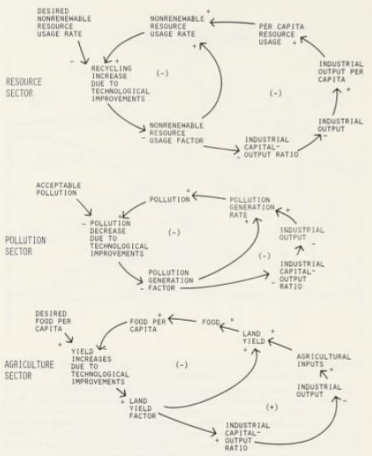

Figure 7-28 Structural additions for adaptive technological policies with development and implementation costs

implementation of the new technologies involved in reducing resource usage, reducing pollution, or increasing land yields all require additional capital; thus more capital is required to produce each unit of industrial output. The additional capital required might be termed "protective" capital, for it serves the purpose of offsetting the negative effects of increased industrial production. It should be noted that a more thorough treatment of these costs should detail each factor of production (such as capital, resources, energy, or land) that must be diverted from the other sectors of the model and into the development and implementation of these new technologies.

Figure 7-29 shows the assumed relationships between the effectiveness of the technologies developed and the costs of those technologies. When the nonrenewable resource usage factor NRUF equals 1.0, no new resource recycling technologies are developed, so the industrial capital-output ratio ICOR remains at its normal value of 3.0. As recycling technologies are developed, the nonrenewable resource usage factor

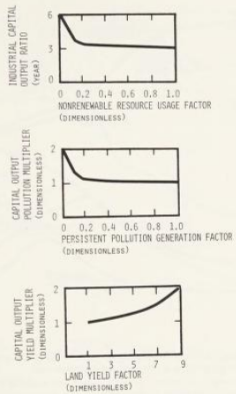

Figure 7-29 Assumed costs of technological development and implementation for adaptive technological policies

NRUF is reduced, and the cost is reflected as a rise in the industrial capital-output ratio ICOR. Similarly, in the pollution sector, the industrial capital-output ratio rises as a result of a decrease in the persistent pollution generation factor PPGF, or level of pollution per unit of industrial and agricultural output. In the agriculture sector, the industrial capital-output ratio rises as new technologies increase the land yield factor LYF. The assumed increases in costs are quite modest—for example, a 50 percent reduction in resource usage due to increased recycling technologies is assumed to require less than 3 percent of the total capital stock.

The assumption of increasing costs of technological development and implementation implies that there is a trade-off between continued growth in population and in industrial output and the control of resource depletion, pollution generation, and land yields. Run 7-21 shows the effects of this assumption on the behavior of the model. As in Run 7-20, technological advances in recycling, pollution generation control, and land yields allow population POP and industrial output per capita IOPC to grow for a longer time than in the reference run (Figure 7-7). As population POP and industrial out-