Technological Change and Public Policies

Technical change takes several forms in this model. First, technical change may reduce the unavoidable amount of mass wasted associated with the production of the transformed nonrenewable resource, or the production of capital goods, or the production of consumption goods. Second, technology may reduce the amount of mass necessarily contained within a unit of capital goods or consumption goods. Third, technology may reduce the rate of physical depreciation of capital goods or the amount of labor services necessary to convert a unit of waste into recycled product or treated and stored mass. Fourth, a technical improvement may reduce the mass necessary to add a unit to a country’s infrastructure.

Effects of Technical Change

Technical change that reduces the unavoidable amount of waste associated with the production of transformed NR, \( \varphi \). As shown in chapter 5, a reduction in \( \varphi \) either reduces the amount of waste that the nonrenewable resource industry must recycle during the period or the number of pollution allowances the sector must buy at the beginning of the period for each unit of the nonrenewable resource it transforms during the period. In either case, a fall in \( \varphi \) reduces the marginal cost of producing an extra unit of \( NR^T \), inducing the sector to increase the number of labor hours involved in processing the raw nonrenewable resource, increase current production of \( NR^T \), reduce the market price of the transformed resource, and increase current dividends paid to its shareholders during the current period.

The fall in the price of the transformed nonrenewable resource, ceteris paribus, increases the amount of that resource demanded by the capital and consumption goods industries because it reduces the marginal cost of producing a unit of physical capital or a unit of consumption goods. In addition, the fall in \( p_{NR_T} \) reduces the cost to the three government sectors of purchasing the \( NR_T \), which they use to add
to their respective infrastructures during the period. Because it is assumed that the
decisions as to how much to add to infrastructures during the current period is made
before \( p_{NRt} \) is announced, the amount of \( NR^T \) purchased during the current period
by the government sectors is not affected by the fall in price. However, the fall in
price does diminish, ceteris paribus, the amount that the government sectors need
to borrow during the current period, thereby tending to reduce the end-of-period
market supplies of bonds in all three bond markets. This in turn reduces the amount
of taxes each government will need to collect next period to provide a given amount
of general public services next period. The menus that the government sectors present
to their household sectors next period for the following period will involve both a
lower marginal cost and a lower average cost of general public services if the lower
price of the transformed nonrenewable resource were to persist. In general, a fall in
the amount of waste produced in transforming a unit of the nonrenewable resource
spreads throughout the world economy in the form of lower prices for all goods that
use \( NR^T \) and lower interest rates in all three countries due to the fall in the government
sectors’ supplies of bonds to their respective bond markets.

Technical change that reduces the mass contained in a unit of physical capital, \( \kappa \), reduces
physical depreciation, \( \delta \), or reduces the wasted \( NR \) per unit of capital produced, \( \varphi_K \). A
technical advance that reduces the mass contained in a unit of physical capital, \( \kappa \),
reduces the marginal cost of producing an extra unit of capital goods. As a result,
the capital goods sector increases the number of hours it uses its current employees,
increases its current production of physical capital, reduces the price it announces
for capital goods, and increases its end-of-period demand for physical capital to produce
capital goods next period. In addition, the sector increases the amount of labor it
demands for next period and raises the wage rate, \( W_{2t+1} \), it announces this period
in order to attract the additional employees for next period. Finally, a reduction in the
mass contained in a unit of physical capital reduces the amount of the nonrenewable
resource the capital goods industry requires to produce capital and therefore reduces
its demand for the nonrenewable resource in the current period. The amount of waste
generated by the capital goods industry through physical depreciation is also reduced
causing the sector to demand fewer pollution allowances during the period. Ceteris
paribus, this reduces the market price of pollution allowances.

A reduction in the amount of wasted \( NR \) in the production of a unit of capital
goods, \( \varphi_K \), produces essentially the same effects upon the decisions of the capital
goods industry as does a reduction in the mass embodied in a unit of physical capital.
A reduction in the rate of physical depreciation produces virtually the same effects
upon the decision making of the capital goods industry as does a reduction in the
mass embodied within a unit of capital. However, the effects of a reduction in physical
depreciation extend to the government sectors in all three countries as well as to the
\( NR \) and \( C \) industries. Because the rate of depreciation reduces the user cost of capital,
all governments and all industries that use physical capital will tend to increase their
end-of-period demands for that good.

Technical change that reduces the mass contained in a unit of consumption goods, \( \gamma \).
A technical advance that reduces the amount of the nonrenewable resource required
to produce a unit of consumption goods, \( \gamma \), reduces the marginal cost of producing
consumption goods. This induces the consumption goods industry to increase the