

Clearly, the benefits to consumers will be delayed by that one year. However, it is not simply a matter of transferring \$200 from the consumers to the patentee. Consumers and society also miss out each year on the area ABD or \$20. The total consumers' benefit that is foregone each year is \$220. Recall that as the patent term is increased from year zero toward 20 years, the prospect of capturing rents for a longer period induces innovators to incur additional R&D expenditures. As R&D undertaken rises, the resulting innovations will initially achieve larger and larger overall cost reductions. Eventually, however, the new incremental cost reductions will get smaller and smaller as diminishing returns to the innovative activity set in. Though the amount of the cost reduction rises overall in each year as the patent term is extended, consumers and society must wait longer and longer to appropriate the welfare triangle ABD. Each additional year's wait brings about less and less incremental cost reduction. Moreover, because rents from later years are discounted more heavily than those in early years³, beyond a certain number of years the increase in the gain to the patent holder from a longer patent term is relatively modest. Sooner or later, these diminishing-return effects overpower society's interest in stimulating additional cost reduction by extending the patent life.

Intuitively,⁴ it will be efficient to cut off patent protection the year the value of cost reductions (in today's dollars) achieved by additional R&D, due to a longer patent term, falls below the value (in today's dollars) of the welfare loss of triangle ABD or \$20. Optimal patent duration is reached when incremental costs are offset by incremental benefits of innovations. Returning to our example, if the patent term extension by one year stimulates innovations that bring about a cost reduction of \$19, whereas the welfare loss is \$20, then the optimal patent term is 20 years and extending it to 21 years will be inefficient. Going beyond this point, too many resources will be used up in the innovative industry; below this point too few resources are being allocated to innovations in the economy.

The example also suggests that if the cost-benefit calculus is done for each industry, we will come up with different optimal patent terms in the economy. Depending on the nature of innovations, the size of investment required to produce them will vary across industries and so would the optimal patent term that would enable companies to capture profits to off-set the R&D costs. In some industries, innovations are "easy"; they can be

³ This is so because most of the R&D expenditures are in current dollars, whereas the rents accrue over the life of the patent. Discounting converts future period dollar rents into present value dollars. The rent in each year is divided by one plus the interest rate or the discount rate. For instance, \$200 you may get next year amount to \$190.50 in today's dollars if the interest rate is 5 percent. A dollar today is worth more than the one dollar 20 years hence.

⁴ The formal analysis and determination of the optimal patent term is in Annex A.