
Suppression of Inventions

J. Hirshleifer

University of California at Los Angeles

Question.—You are a monopolist of light bulbs, which now have a service life of 1,000 hours. Your engineers discover a way of doubling the service life, without any change in the cost of producing bulbs. If you, as a monopolist, fail to suppress the invention, what will be the price-quantity solution (assuming that consumers are fully informed about the improved quality) at the new equilibrium, ignoring transient states? Will it pay to suppress the invention?

Answer.—The demand curve for bulbs shifts in rather a tricky way. One's first impression might be that the demand price for a bulb generating twice the number of light-hours would be everywhere twice as high as for an unimproved bulb. But this ignores the declining marginal value in use of light-hours associated with the doubling of their quantity. The demand curve for improved bulbs *is* twice as high, but at halved quantities (in the steady-state solution); the curve shifts upward, but also twists so as to become more vertical.

The solution is simpler to obtain if the analysis runs in terms of quantities of *light-hours* rather than of bulbs, and if total rather than average magnitudes are employed. Since the demand function for *light-hours* remains unchanged, so will the total-revenue function $R(L)$. The total-cost function of bulbs $C(B)$ is unchanged, which means that the total-cost function of *light-hours* $C(L)$ is stretched (doubled) in the horizontal direction. (At a given cost, the same number of bulbs and hence twice the number of light-hours can be produced.) We can assume that marginal cost is positive, $C'(L) > 0$, and that marginal revenue is declining, $R''(L) < 0$. If marginal cost is rising or constant, the horizontal stretching of $C(L)$ clearly lowers $C'(L)$ evaluated at the original output of light-hours (now representing half the original quantity of bulbs). Since $R'(L)$ is unchanged, this dictates an increased output of light-hours, that is, the optimum output of new bulbs must be at least half the previous profit-maximizing output of unimproved bulbs. The profit-maximizing output of new bulbs may even exceed the previous output of unimproved bulbs if $R'(L)$ is falling very slowly; in that case, the output of light-hours will more than double. (The corresponding implications for the price of light-hours and the price of bulbs are quite clear, and need not be

spelled out.) If marginal cost is a declining function of bulbs produced, however, the horizontal stretching of $C(L)$ may have the effect of raising $C'(L)$ at the original output of light-hours. In this exceptional case, the output of light-hours will contract—the new output of bulbs will be less than half the old output.

Suppression of the invention is never rational, as may be shown by quite general considerations. With the new bulbs, but at the old output of light-hours, the total revenue is just as great while the total cost is less (since only half as many bulbs are being produced). The monopolist's optimum with the new bulbs must be at least as profitable as this solution, and will in general be better. Even if consumers are less than fully informed, so long as some superiority of the new bulbs is recognized, there will be a gain in profit in producing the new bulbs instead of the old.