LETTERS

When Should the Gas Guzzler Go?

The interest evoked by my letter of 7 March (p. 1028) has prompted me to address the more difficult (and more interesting) question, *When* should the gas guzzler go?

By assuming that a new, high mileage car would be bought in Y years whether or not one is bought to replace the gas guzzler right now, my letter gave an upper bound (1) on the optimal length of time to keep the guzzler.

That optimal time depends on a whole slew of parameters; the most important is the discount rate, k. In my earlier letter, I assumed that the interest rate you can get on your money was a satisfactory value to use. And it should be. But the discount rate, which expresses the relative value of having a dollar now or later, must be at least as large as the inflation rate. Some investments may have a higher yield than the current inflation rate (none of mine do).

If the amount by which the discount rate exceeds the inflation rate is quite small (such as zero), and the lower maintenance costs of the new car are just balanced by its higher insurance premiums, the optimal value of Y is zero. When? Now! (Of course, if you *like* ye olde guzzler better, you may not want to base your decision on just the financial tradeoff.)

Taking into account loan financing parameters and the income tax deductibility of interest payments, as well as the discount rate and various other parameters, the optimal amount of time to keep the guzzler can be found by the following algorithm.

1) Obtain the values of k, the discount rate in percentage per month; Z, the monthly cost of insurance and repairs for the guzzler; H, the same for the high-mileage car you are considering; C, the cost of the new car; S, the trade-in value of the guzzler; P, the price of gasoline; D, the annual miles driven; M, the guzzler's mileage in miles per gallon; L, the replacement period for the new car in years; f, the trade-in value of an L-year-old high mileage car as a fraction of its purchase price; h, the amount by which the discount rate exceeds the escalation rate for repairs and insurance on the high mileage car; z, the same for the guzzler; c, the amount by which the discount rate exceeds the escalation rate of new car purchases; g, the amount by which the discount rate exceeds the fuel escalation rate (this may be negative!); s, the amount by which it exceeds the guzzler's trade-in value escalation rate; i, the same for the loan interest rate; I, the loan interest rate itself; R, the ratio of mileage of the new car to the improvement in mileage that would result from dumping the guzzler; d, the down-payment fraction on new-car loans; N, the new-car loan period in months; and finally T, your marginal income tax rate (2).

2) Calculate the monthly gasoline cost savings by

$$A = DP/12\,MR$$

3) Calculate an upper bound on the optimum time to keep the guzzler. From my earlier letter, Y_{max} = the smaller of ($C/12A$) and (years until the guzzler will drop dead).

4) The formula for the capital recovery function is

$$crf(r,n) = \begin{cases} r/[1-(1+r)^{-n}] & \text{if } r \neq 0 \\ 1/n & \text{if } r = 0 \end{cases}$$

5) Find the Y from the set $\{0, 1/12, 2/12, \ldots, Y_{max}\}$ that maximizes V. I'll leave the search procedure up to you, the reader. V, the net present value of keeping the guzzler for Y more years before replacing it with a sequence of high mileage cars instead of replacing it immediately, may be obtained as follows:

Expenses:

$$X = H/crf(h,12Y) - Z/crf(z,12Y) + A/crf(g,12Y)$$

Capital required:

$$Q = \frac{C \times c}{crf(c,12Y)}\left[1 + \frac{1-f}{(1+c)^{12L}-1}\right] - \frac{S \times s}{crf(s,12Y)}$$

Down payments:

$$D = dQ$$

Loan payments:

$$E = (1-d)\,Q\,crf\,(I,N)/crf(k,N)$$

Tax reductions:

$$B = T\left\{E - \frac{(1-d)\,Q[crf(I,N) - I]}{(1+I)\,crf(i,N)}\right\}$$

Finally,

$$V = X + D + E - B$$

If none of the values of Y produces a positive value of V, get rid of the guzzler now—unless, of course, you *like* it better.

In closing, I might point out that the trade-off considered here is that of a continuation of high operating costs versus an initial investment followed by low operating costs. Thus, with appropriate interpretation of the parameters, it can be applied not only to gas guzzlers versus

gas sippers, but to economic questions involving more money, such as installation of a solar energy system on your house to cut your gas and electric bills.

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References and Notes

1. Discussions with Doug Armstrong of the Milwaukee *Journal* have caused me to realize that I should have pointed out that all percentages have to be converted to fractions (by dividing by 100 percent) before they can be used in the second equation in my earlier letter. More important, the "improvement" obtained by using the second equation instead of the first is quite small: If $d = 10$ percent, then $i = 1.5$ percent per month (18 percent per year compounded monthly, a rather high rate) and $K = 0.25$ percent per month (3 percent per year compounded monthly, a rather low rate) and Y only increases by a factor of 1.3. Reversing the values of i and k decreases Y by the same factor. The adjustment for the gasoline inflation rate, g, is a rather weak approximation.
2. All percentages must be converted to fractions (by dividing by 100 percent) before use in equations.

Brown's Administrative Philosophy

Luther J. Carter's article "Carter and the environment" (News and Comment, 14 Mar., p. 1190) leaves the impression that I, among others, might not share the judgment of the League of Conservation Voters that, on the issues, California Governor Brown had the strongest record of any of the candidates. On the contrary, I was extensively consulted by the League in developing the material on Brown and believe that those materials fairly represent his record. His administrative weaknesses are explicitly referred to in a number of places. If, as I believe, certain programs have moved ahead more swiftly in Brown's absence, it should not be overlooked that they have been moved ahead by appointees of the Governor's choosing, as part of an explicit philosophy of public administration. Governor Brown's explicit philosophy is to appoint men and women with whom he is in agreement on priorities and values. This contrasts with President Carter's approach when he appointed James Schlesinger to head the Department of Energy and then tried to steer the Secretary down the path of presidential values. On the record, Brown's approach seems to work better for the environment than Carter's.

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Erratum: The price of *The Properties of Diamond*, J. E. Field, Ed., Academic Press, reviewed by F. P. Bundy (29 Feb., p. 974), is $75.