Rebound Effects and Attic Insulation

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Over the past several decades, homeowners have chosen to invest in energy-saving home improvements much less frequently than might be expected given the apparent costs and benefits. According to engineering estimates, many of these home improvements could pay for themselves in a short period through energy-savings. The persistent observation that home owners appear to apply very high discount rates to these investment opportunities is paradoxical. (Hausman, 1979)

Gilbert E. Metcalf and I proposed one hypothesis for a resolution in a 1999 paper (Metcalf and Hassett, 1999). We noticed that if energy-saving investments were over-estimated, then the discounts rates in earlier studies would also, reflexively, be over-estimated. This scenario seemed likely since earlier researchers used the engineering rates of return as key inputs for estimating consumer discount rates. If consumers do not expect to receive the engineering return upon their own adoption of the home improvement, the estimated discount rates would seem high. It is not farfetched to see this happening if consumers assume engineering estimates of potential energy savings—which are often provided by the manufacturer of the relevant product—to misrepresent savings. This consumer expectation would not be without foundation; the engineering estimates are based on highly controlled studies that may not directly apply to actual realized savings in a representative house.

While virtually every home improvement product on the market comes with an engineering-based estimate of the potential energy savings from the use of that product, when we were writing our paper there had been relatively few studies documenting the actual returns received by individuals who pursue home improvement strategies. One paper that motivated our hypothesis was written by Sebold and Fox (1985). They studied the San Diego Gas and Electric Company's audit program, and compared the realized returns by individuals to that predicted by engineering studies. They found that, on average, total returns came in somewhat below those predicted by engineering studies. Hirst (1986) also found that actual savings from retrofit programs fall short of savings predicted by energy auditors by 22% to 53%. The Sebold and Fox results along with the Hirst results lent support for our hypothesis that engineering or other ''professional'' estimates of returns are biased upwards.

For our study, we decided to focus on the returns to attic insulation. Attic insulation was measured well in our data, and the reported potential benefits were very high. Blasnik (1990) wrote that the returns could easily be on the order of 50% per year. These returns are large enough that one would expect any reasonable methodology to detect them.

To assess the energy savings from attic insulation, we combined monthly energy billing data with the annual Residential Energy Conservation Survey (RECS) and controlled for heterogeneities.

The result? Our data provide little evidence of an energy paradox. The median rate of return in this analysis for attic insulation is 9.7%, This is certainly well below the engineering estimates of 50%. These rates put an upper bound on the implied discount rate for the energy investments analyzed in this paper and are consistent with plausible discount rates suggested by a CAPM analysis.

Having data on monthly energy billing and home improvements proved to be useful for another reason besides assessing the energy paradox. It allowed us to investigate whether households turn up their thermostats after adding insulation. We analyzed whether households turn up their thermostats after adding insulation. If there were such a ‘‘rebound’’ effect, then energy-consumption reductions would understate the benefits of the improvement, so our runs controlled for this in a linear fashion through the inclusion of the thermostat setting in the set of control variables. There was no evidence of a significant rebound effect. For single family homes, for example, the difference between the change in thermostat settings for those who added new attic insulation and those who didn’t was 0.24 deg., which was not statistically distinguishable from zero.

Does our result on the energy paradox mean that subsidies for home improvement are necessarily bad? No, consumers might rationally account for the costs and benefits that would accrue to themselves from the purchase of attic insulation or other home improvement technologies, but, even without the rebound effect, there could be externalities. Social costs, particularly the higher pollution associated with on energy-consumption choice over another, should factor into a governments decision to subsidize energy-saving home improvement technologies.

References

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