Modeling Energy Efficiency:
The Impact of Preferences, Behavior and Changing Elasticities

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Underpinning This Quick Overview:
A Selected Bibliography on Behavior and Technology Characterization

Would this be true. . . .

Where the “Masked Spider” = standard economic policy models. . .

and

“Bob” = policymakers who have just learned that such models reflect only fixed and limited behavioral responses in their assessments?

Hey, Bob. . . did I scare you or what?

Economics Science Has Not Solved. . . .

• Its first problem – namely, what determines the price of a commodity? (Robinson 1947)

• Among things that can influence commodity prices:
  – Belief
  – Value
  – Habit
  – Alternatives
  – Necessity
  – Income

• All of which can be shaped by changed perceptions, clear and persistent policy signals, as well as new or expanding programs (Brown 2001).
An Admittedly Simple Heuristic Inquiry

- Starting from today’s prices of ~$3.00 per gallon of gasoline equivalent, suppose we need to reduce energy by 25 percent.
- Let us further assume in our policy model that there is a price elasticity of -0.24. So if . . .
  \[
  \text{Energy Index} = \left( \frac{P}{\$3} \right)^{-0.24} = 0.75
  \]
- Then the new energy price will need to be just over $10 per gallon equivalent, or about 3.35 times higher than today.
- Clearly this is not good for the economy; and most economic policy models indicate exactly that – to the detriment of smart energy and climate policy.
- And while prices matter, they are not all that matter!

A very small difference in assumptions can have a huge impact in the eventual outcome.

"Ha ha ha, Bill. Guess what? After we go to the drugstore and the post office, I'm going to the vet's to get tutored."
Suppose, Instead, We Have an Integrated Technology-Behavior Model

- That instead of a simple (perhaps invariant) price elasticity, we employ a substitution elasticity which allows a more productive use of capital to displace the inefficient use of energy; and
- That combines shifts in awareness, preferences, and norms as they motivate the production and the adoption of improved technology – all in response to some changed circumstance, or some combination of prices and other policy signals.

An Isoquant of Energy Services Showing Relationship Between Capital, Energy, Price Ratio

- A Production Isoquant with an elasticity of substitution where $\sigma = 0.70$
  (where $K \sim 0.28$ and $E \sim 0.42$)
- Double the Price-Preference Ratio
- Shift in Values to 0.88 for Capital and 0.75 for Energy
- Initial Values of 8.12 for Capital and 1.00 for Energy
- Today’s Tangent of Price-Preference Ratio
Changes in Capital and Energy as a Result of Doubling the Price-Preference Ratio

- Under the assumption that, either:
  - energy prices double, or
  - allowing a shift in preferences that might decrease hurdle rates from 33% to 20% so that prices increase by ~21%
- Then the “price-preference ratio” will double
  - from $3.00 / 0.33 which equals 9.09
  - to $3.63 / 0.20 which equals 18.18
- In this case
  - Capital investment will increase from 8.12 to 9.88 (22%)
  - Annual energy flow will decrease from 1.00 to 0.75 (-25%)
- The technology payback will be
  - \((9.88 - 8.12) / (0.25 \times 1.21) = 5.8\) years at the new energy prices, reflecting roughly a 17% return

So We Now Integrate 3 Critical Differences in Our “Policy Model”

- First, we enable a more productive technology to substitute for energy use
- Second, we allow for a shift in preferences and behavior which motivate the development, production, and adoption of that technology
- Finally, rather than an assumed inflationary cost we now have a return on investment
- All of which provides for a more satisfying modeling result that, in turn, might encourage the adoption of a smart energy and/or climate change policy
Comparing Hardware and Energy Costs with “Soft” Search and Transaction Costs

Impacted by policies, programs, awareness, and by shifting preferences – all roughly approximated by the “hurdle rate” or the “implicit discount rate”

All areas that can benefit from further inquiry within the social sciences

Impacted by policies, R&D programs, experience, growing expectations, and new innovations

“if we pull this off, we’ll eat like kings.”
The difficulty lies not with the new ideas, but in escaping the old ones

John Maynard Keynes

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