Back to Basics: A Price Response Approach to Estimating Lighting Freeridership

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Agenda

• Evaluation Context
• Program Description
• Upstream Net-to-Gross (NTG) Approaches
• Our Approach
• Results
• Lessons Learned
• Conclusions
Evaluation Context

• Efficiency Maine Trust (EMT) Residential Lighting Program (RLP)
  – Contracted with Cadmus in September 2011
  – Final Report: September 2012

• Freeridership analysis (impact evaluation)
RLP Program Description

• **Provides financial incentives** to encourage sale, purchase, and use of CFLs by Maine consumers

• **Primarily a markdown program**
  – Markdowns: 90% of program budget
  – In-store coupons (some smaller stores)
  – Pilot CFL giveaway with Appliance Rebate program
  – Contracts with implementer to administer the program

• **Active field staff** presence at retail stores:
  – Verify markdowns
  – Restock coupons
  – Educate retail staff and consumers
RLP Program Implementation

• Significant shift in 2011:
  – Re-purposed $500,000 from TV advertising to increase markdowns
  – Discrete, substantial change in price of program CFLs
  – Typical markdown: $1.25 per CFL

• Results:
  – Program CFL initial cost in line with (lower than) incandescent bulbs
  – Retailers motivated to invest in off-shelf merchandising (floor and end cap displays, larger signs)
Program Standard CFL Sales

Sales-Weighted Average Incentive per CFL ($)

Week

Total CFLs Sold

- $0.00
- $0.20
- $0.40
- $0.60
- $0.80
- $1.00
- $1.20
- $1.40

Standard Sales

Average Standard Incentive per CFL
Program Specialty CFL Sales

Week

Sales-Weighted Average Incentive per CFL ($)

Total CFLs Sold

- Specialty Sales
- Sales-Weighted Average Specialty Incentive per CFL

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Upstream Program Design

- Price signal is main lever
- Demand is elastic (responds to price)
- Market share or econometric methods are preferred NTG approaches, however:
  - Not been used much in the past
  - At times, data inadequate data to quantify elasticity (price response)

## Overview of NTG Approaches

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<thead>
<tr>
<th>Approach</th>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Self-Report</td>
<td>• Simple</td>
<td>• Biases: non-response bias, recall, potential specification bias (scoring freeridership values)</td>
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<td></td>
<td>• Less expensive</td>
<td>• Can underestimate spillover</td>
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<td></td>
<td>• Takes into account complexities of program-participant interaction.</td>
<td>• Sampling can be difficult</td>
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<td></td>
<td>• Can use multiple data sources (i.e., vendor interviews).</td>
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<tr>
<td>Market Share</td>
<td>• Addresses trends in entire market</td>
<td>• Difficult to obtain data</td>
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<tr>
<td></td>
<td>• Useful if participation not well defined</td>
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<tr>
<td>Econometric</td>
<td>• Provides quantitative estimates of magnitude of net impacts</td>
<td>• Sample often not randomly determined</td>
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<td></td>
<td>• Based on measured data</td>
<td>• Potential for omitted variable bias</td>
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<td></td>
<td>• Tests for bias and precision can be included</td>
<td>• Heterogeneity in customer base</td>
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<tr>
<td></td>
<td></td>
<td>• Difficult to obtain data</td>
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<td>• Often omits trade ally effects (spillover)</td>
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Price Elasticity Approach: Theory

- Consider a downward sloping demand curve:

- Assuming elastic demand (as shown), shifting price $P_0$ to $P_1$ should shift $Q_0$ to $Q_1$
Price Elasticity Approach: Theory

- If $P_0$ is the initial bulb price and $P_1$ is the price of the program bulb (with markdown), then $Q_0$ is freeridership (would have purchased at $P_0$)

- We have $P_0$, $P_1$, and $Q_1$
- If we know the slope of demand curve, we can predict $Q_0$

$$\text{Net of freeridership sales} = \frac{\text{Gross Sales} - \text{Net Sales}}{\text{Gross Sales}} = \frac{Q_1 - Q_0}{Q_1}$$
Estimating Price Elasticity: Theory

• Given variation in the markdown over time, and hence price, we can estimate the price elasticity
  – This variation across time and space (different bulbs) gives variation necessary to econometrically fit demand curve (observations of price-quantity pairs)
• Prices often changed en masse with negotiation of MOUs
  – Acts as a natural experiment
• Required data:
  – Program and non-program price
  – Variation in price (markdown) over time
  – Data on external factors that affect price (e.g., specialty/standard, wattage, manufacturer, retailer)
Estimating Price Elasticity: Model

• Use regression models to estimate slope of demand curve (elasticity)

• Typical equation:

\[
\ln(sales) = \beta_0 + \beta_1 \ln(price) + \sum \beta_\gamma \text{Fixed Effects}_\gamma + \sum \beta_\delta \text{Time Effects}_\delta
\]

• Use regression results to predict sales if price at the original retail level
Benefits of Our Approach

• Built on strong theoretical foundation
  – Basic price theory
• Produces stable, reliable estimates
  – Data driven
  – Little chance for measurement error
    • Removes subjectivity (i.e. what customer thinks would have done at different price or without program)
    – Can provide statistically valid results
• Based on actual purchasing behavior
• Assumptions clearly presented
• Able to explicitly quantify factors affecting freeridership
Limitations

• **Assumptions**
  – Price elasticity same for customers who purchase program and non-program bulbs
  – Prices remain constant over study period for competing goods (incandescents)
  – Elasticity is constant over the price range (no non-linearities)

• **Cannot capture**
  – Non-like spillover (showerheads, aerators, etc.)

• **Difficult to capture**
  – Like spillover (need, at minimum, understanding of price trends for non-participating retailers/bulbs)
  – Impact of marketing (need detailed data)

• **Potential for error in model specification**
  – Bias from unobserved variables
RLP Results

- Program Overall Freeridership: 0.34

- Program Overall NTG: 0.66
Results in Context

- Implementing contractor noted that freeridership similar to their internal analysis
Looking Forward

• Approach presents a good opportunity for cost-effective, stable freeridership results
  – May be extended to spillover, using supplementary data from nonparts & manufacturers

• Data driven methods more viable as point-of-purchase (POP) data more available
  – Cadmus implementing similar NTG approach in evaluations for several utilities
Lessons Learned: Keys to Success

• Understand program implementation and operation well; ensures model well-specified
  • For example, needed to know the program included in-store promotions and when those promotions occurred so model can account for their effect

• Understand the data
  – QA/QC critical

• Strong communication between evaluation team and program implementation team
  – Evaluator needs access to data experts to resolve questions and understand any issues/limits of data
Lessons Learned: Challenges

• Getting buy-in from non-technical stakeholders
  – Comfort with data driven approach, but “econometrics” is a black box, which leads to questions, such as:
    • Why should I believe that? How can I know if they did it correctly?
  – Can be hard to explain intricacies in “plain English”
  – Self-report/survey methods easier for non-technical audience to understand
Conclusions

• Process went well overall

• Econometric methods not easily understood or explained. Initial reactions:
  – “I need to understand the underlying methodology to remove doubts about the results.”
  – “I just don’t know how [they] did it. It may have been wonderful, but I have no way to know.”

• Ability for evaluator to work directly with implementing contractor was important
Questions?

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