Rationale and Research Questions

- **Rationale**
  - Clean air vital for a healthy environment
  - Economy depends on polluting activities
  - Diesel engines play a key role in the economy, yet cause environmental degradation
  - Policy-makers have focused on using biodiesel as a way to reduce emissions
  - However, implementing a project to produce and use more biodiesel would be costly.

- **Research questions**
  - Would citizen consumers be willing to partake the cost?
  - How much would they be willing to contribute?
  - What are the determinants of willingness to pay (WTP)?

Why Biodiesel?

Background

- **Approaches for benefit estimation**
  - Indirect or behavioral methods
  - Direct or stated preference methods

- **Behavioral methods**
  - Behaviors are observed
  - Value of changes in public goods is inferred

- **Stated preference methods**
  - Respondents are asked contingent or hypothetical questions
  - Responses trading off improvements in public goods for money are induced
  - From responses, value of changes in public goods is inferred

Objectives and Hypotheses

- **Objectives**
  1. Design and implement a contingent valuation survey to measure individuals’ WTP for air quality improvements arising from using blended biodiesel in Ohio’s on-road and off-road diesel engines
  2. Determine factors affecting WTP
  3. Estimate aggregate WTP dollar value representing an upper bound estimate of environmental benefits of using blended biodiesel in diesel engines.

- **Hypotheses**
  1. Strong background on air pollution and health implication is likely to influence WTP
  2. People’s WTP depends on their residential location
  3. Individuals’ socio-economic situation affects WTP
Theoretical Framework

- Constrained utility maximization
- Theoretically, welfare change is measured by a change in indirect utility function or expenditure function
- CVM can be viewed as a direct measure of welfare change
- WTP = Amount of income that compensates an individual for a welfare change

\[ V(y-WTP, P, Z, Q_1) = V(y, P, Z, Q_0) \quad (1) \]
\[ WTP = F(Y, P, Z, Q_0, Q_1) \quad (2) \]

Methods and Procedures

- Survey Methods and Elicitation format
  - Mail survey
  - Half of the sample received questionnaires with the conventional double-bounded format (Two consecutive yes/no questions)
  - The other half received questionnaires with a stochastic double-bounded format
    - A first yes/no question
    - A second likelihood question with answer choices being: Definitely no (DN), Probably No (PN), Not sure (NS), Probably Yes (PY), and Definitely Yes (DY)
  - Payment vehicle: Money contribution to a trust fund

- Estimation Procedures
  - Single bounded models (Probit and Logit)
  - Conventional double-bounded model (Bivariate probit)
  - Stochastic Double-bounded models (Bivariate probit)

Recoding procedures

- Model 1:
  - Answers to the two yes/no questions are used to estimate the conventional double bounded model
- Model 2:
  - DN and PN recoded as “no”
  - NS, PY, and DY recoded as “yes”
- Model 3:
  - DN, PN and NS (if Y1="no") recoded as “no”
  - NS (if Y1="yes”), PY, and DY recoded as “yes”

Distribution of First and Second Responses (stochastic follow-up)

Reasons for Zero or Positive WTP

Bus Running on Biodiesel
Determinants of WTP

• Probability of a yes decreases when:
  • Bid price higher
  • Respondent older
  • Respondent air pollution knowledgeable

• Probability of a yes increases when the respondent:
  • Concerned about air pollution in her area
  • Views pollution as causes of many lung diseases
  • Belongs to at least one environmental group
  • Married or living together
  • Has high schooling and income levels
  • Finds information in survey useful and is comfortable with the survey materials

Levels of WTP

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Conventional</th>
<th>Stochastic</th>
<th>Krinsky-Robb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>0.089</td>
<td>0.197</td>
<td>0.066</td>
</tr>
<tr>
<td>Model 2</td>
<td>0.311</td>
<td>0.261</td>
<td>0.110</td>
</tr>
<tr>
<td>Model 3</td>
<td>0.401</td>
<td>0.263</td>
<td>0.222</td>
</tr>
</tbody>
</table>

Implications of the Results

• For energy policy
  – Citizen-consumers seem to be ready to contribute to a policy to reduce diesel related emissions
  – A premium charged to the price of biodiesel would not be protested.
  – Compensation or subsidy to biodiesel producers would be justified

• Issues and arena for further research
  – Biodiesel vs. Ultra Low Sulfur Diesel
  – Supply of biodiesel
  – Impact of producing more biodiesel on livestock sector