Measuring Welfare Change

Mari Lymysalo & Miikka Taponen

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What is consumers’ surplus?

\[ CS = \int_{p^0}^{p'} x(t) dt \]

- Consumers’ surplus (CS) is a classical measure of welfare change
- It is an exact measure only in special circumstances
- \( \Rightarrow \) More general measures are needed

An ideal measure

- Welfare change involved in moving from \((p^0, m^0)\) to \((p', m')\) is the difference in indirect utility:
  \[ v(p^0, m^0) - v(p', m') \]
- The utility theory is purely ordinal in nature, and therefore; a monetary measure to quantify these utility changes would be convenient

A monetary measure for welfare change

- If we adopt the indirect money metric utility function as the measure of utility, the utility difference becomes:
  \[ \mu(q; p', m') - \mu(q; p^0, m^0) \]
- Choosing the base prices \( q \) equal to \( p^0 \) or to \( p' \) leads to the following two measures:

Compensating and equivalent variations

\[ EV = \mu(p^0, p', m') - \mu(p^0, m') = \mu(p', m') - m' \]
\[ CV = \mu(p^0, p', m') - \mu(p', m') = m' - \mu(p^0, p', m') \]

EV: “What income change at the current prices would be equivalent to the proposed change?”
CV: “What income change would be necessary to compensate for the occurred price change?”
Equivalent and compensating variations

- EV and CV are not generally equal because the value of money depends on what the prices are
- The sign of EV and CV is the always the same because they measure the same utility differences
- Which is the most suitable measure?

Measuring Welfare

- Paper by Ebert suggests axiomatic approach
- 4 properties required from welfare approach
  - indicates welfare increase reliably
  - ranks different situations appropriately
  - evaluates changes in money
  - can be derived from observable data
- Let’s examine a measure of the change in welfare, W

Property I (exactness)

- Sign of W must reflect the type of welfare change correctly
  \[ W(p^0, p^1) > 0 \Rightarrow v(p^0, m) < v(p^1, m) \]
  \[ W(p^0, p^1) = 0 \Rightarrow v(p^0, m) = v(p^1, m) \]
  \[ W(p^0, p^1) < 0 \Rightarrow v(p^0, m) > v(p^1, m) \]

Property II (correct ranking)

- If the individual is better off facing prices \( p^2 \) than prices \( p^1 \) then welfare change with respect to a common status quo should register this fact
  \[ W(p^*, p^2) \leq W(p^*, p^1) \Leftrightarrow v(p^1, m) \leq v(p^2, m) \]

Property III (normalisation)

- W should be measured in money
- One possible measure could be
  \[ W(p^0, \alpha p^0) = \left( \frac{1}{\alpha} - 1 \right) m \]

A measure fulfilling I-III

- There is only one measure that fulfils all the properties I-III, namely Hicksian equivalent variation
  \[ W(p^*, p^0) = EV(p^*, p^0) - EV(p^0, p^0) \]
  \[ = \alpha p^0, s(p^1, m) - \alpha p^0, s(p^2, m) \]
- Proved in the paper
- This W exists for all v, it is well-defined, and it is computable
Other welfare measures

- In some cases the compensating variation (CV) is better measure than EV
  - CV does not fulfil property II, but there is a similar property that CV does fulfil
- Consumer’s surplus CS is a popular welfare measure
  - It is an acceptable approximation of EV
  - CS is easy to compute, it can be derived from market demand

Quasilinear utility

\[ v(p,m) = v(p) + m \]

- Quasilinear utility is independent of income (if the income is not too small)
- Example: toilet paper
- Consumers’ surplus is an exact measure of welfare change if and only if the utility is quasilinear
- Then: EV = CV = CS. Why?

Integral of Hicksian demand

- Equivalent and compensating variations can be written as: \( EV = \int h(p,u) \, dp \)
- \( CV = \int h(p,u) \, dp \)
- The integral of Hicksian demand curve is the correct measure of welfare

Consumers’ surplus as an approximation?

- Hicksian demand is not directly observable since it depends on utility
- Could consumers’ surplus be used as a good approximation for welfare change?
- It can be shown that CS lies between equivalent and compensating variations

Aggregate consumers’ surplus

\[ V(p) = \sum_{i=1}^{n} y_i(p) - \int \sum_{i=1}^{n} x_i(t) \, dt = \int \sum_{i=1}^{n} x_i(t) \, dt \]

- Aggregate consumers’ surplus is an appropriate measure if utility functions of all consumers are quasilinear
- In general it is not an exact measure for welfare, however; it is often used as one
- This issue is discussed in next week’s presentation

Nonparametric bounds

- Nonparametric bounds on the money metric utility function can be derived without having to specify a single parametric form
- The bounds can be tightened by increasing the amount of observed choices (see 8.11)
- The overcompensation function and the undercompensation function bound the true compensation function \( m(p,x_0) \)
Social Benefits of Smoking

• Paper by Reekie
• How should the social costs and benefits of smoking be determined?
• South African officials considered government to be equal to society
• There was no attempt to assess the benefits of smoking in a society where some individuals prefer this activity

Balance Sheet

<table>
<thead>
<tr>
<th>Costs (R million)</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure 2248.0</td>
<td>Earnings of employees 195.2</td>
</tr>
<tr>
<td>Lost productivity due to early death 1051.0</td>
<td>General sales tax on tobacco 241.0</td>
</tr>
<tr>
<td>Lost productivity due to hospitalisation 49.5</td>
<td>Excise Revenue 552.0</td>
</tr>
<tr>
<td>Direct health care 289.6</td>
<td></td>
</tr>
<tr>
<td>Total 3638.1</td>
<td>Total 988.2</td>
</tr>
</tbody>
</table>

Flaws in previous numbers

• Expenditures should be about equal to taxes, revenues and earnings of employees
• Losses due to premature death are negated by not having to pay pension
• The earnings of doctors and medical personnel

What are social costs and benefits?

• Social costs are the total costs of an economic activity
• Prices reflect social costs in freely operating market
• Consumers usually get commodities cheaper than they are willing to pay, difference being benefit
• Measured by consumers' surplus

Proposed Balance Sheet

<table>
<thead>
<tr>
<th>Costs</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private expenditures</td>
<td>Private expenditures</td>
</tr>
<tr>
<td>Other private costs (borne by consumers, e.g. queuing, illness)</td>
<td>Consumers' surplus</td>
</tr>
<tr>
<td>External costs (borne by third parties, e.g. lung cancer on non-smoker, nuisance)</td>
<td>Product-specific taxes</td>
</tr>
</tbody>
</table>

Empirical Investigation

• Statistical analysis of cigarette smoking in SA was conducted
• Models \( Q = \alpha + \beta P + \gamma Y + \varepsilon \)
  \( Q = \alpha P^Y Y^\varepsilon \)
were fitted to data
• Logarithmic model statistically superior
Conclusion of Example

- Consumers’ surplus gives an estimate for the social benefits of smoking
- External costs to non-smokers have been omitted
- Nicotine addiction is not taken into account
- Freely operating market is assumed (consumers have perfect information etc.)

Advertising and Consumers’ Surplus

- Paper by Tremblay & Tremblay
- Three models of advertising
  - persuasive
  - informative
  - image-creating
- Optimal level of advertising is sought so that welfare is maximised

Persuasive Advertising

- Consumers are “deceived” to buy products they really do not need or want
- Demand curve without advertising represents the consumers’ true interests
- This is the most critical view of advertising
  \[ \Delta CS = -(c + e + g + h) \]

Informative Advertising

- Consumers are told about the product
- Demand curve after advertising represents the true preferences
- May be either positive or negative
  \[ \Delta CS = f - c - e \]

Image-creating Advertising

- Same effect as improving product quality
- Consumer tastes remain the same, but he gains the image of the product along purchase
- May be either positive or negative
  \[ \Delta CS = a + f - c \]

References