Durable Goods

LECTURE 9

A fundamental presumption

- Long-lived goods (automobiles, appliances, furniture, etc.) have a positive and significant impact on living standards.
- These goods are special: measuring the increment in living standards derived from them is not as straightforward as for other goods.
- This whole lecture is dedicated to durable goods.

Today’s four questions

1. What is a durable good?
2. Why do durable goods require special treatment?
3. How to deal with durable goods, analytically?
4. How to design a dedicated module in the questionnaire?
1. What is a durable good?

What is a durable good? – I/II
Diewert (2009: 447)

- A durable good is a consumption good that can "deliver useful services to a consumer through repeated use over an extended period of time":
  - useful services: utility, or consumption, which is what welfare analysts are after
  - extended period of time: a durable good's distinctive characteristic is that the period of time during which it delivers utility to the consumer exceeds the survey period (one year)
  - a durable good is a stock that yields a return to its owner over multiple years; this return is the value of using the good

What is a durable good? – II/II
Diewert (2009: 447)

- Housing is a durable good.
- Due to its importance, it is customary for analysts to deal with it separately from other durable goods.
- Accordingly, in this lecture we focus on consumer durable goods other than housing.
2. Why do durable goods require a special treatment?

Why do durable goods require a special treatment?

- A figure worth a thousands words:

<table>
<thead>
<tr>
<th>Durable’s Life</th>
<th>Reference Period</th>
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<tbody>
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- The durables’ service flow exceeds the reference period of the welfare aggregate
- The purchasing price reflects the value of the durable for its entire life
- Need to capture the value of the flow of the service during the reference period

The problem with durable goods

- It is not the purchase of a good that contributes to welfare, but its use.
- This creates a wedge between household expenditure (which we can easily measure) and household consumption (we rarely observe usage directly).
- For non-durable (perishable) goods, it is safe to ignore this wedge: expenditure is a good estimate of consumption expenditure
- But for durable goods, we need to estimate the value of using the good for one year (service flow), and add this value to household consumption expenditure
- How do we estimate the value of owning or having access to durable goods during a given year?
3. How to deal with durable goods, analytically?

Useful reference
Amendola and Vecchi (2014)

- Review of methods and current practice
- Mathematical notation used in the presentation is consistent with this paper

Three approaches

<table>
<thead>
<tr>
<th>1. Acquisition Approach</th>
<th>2. Rental Equivalence</th>
<th>3. User Cost</th>
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</thead>
<tbody>
<tr>
<td>When the good is purchased its entire value is attributed to the household welfare aggregate</td>
<td>If a complete set of markets for the services of durables exists, we can use the market rental value of the goods</td>
<td>The annual cost of holding the stock of each durable.</td>
</tr>
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</table>
Consider your car: how to calculate its contribution to your standard of living?

Some notation first:

- Let us focus on one durable good, e.g. cars
- Let $t$ denote the survey year
- If we write $CF_t$, we mean the consumption flow of the car owned by household during the survey period
- $v$ is the "vintage" or age of the car, the number of years since it was manufactured
  (if $v=3$ this means that the car was produced three years ago)
- $s$ is the number of years since the household owns the car
  (if $s=1$ it means that the car was purchased 1 year ago)
- $s$ must be lower than or equal to $v$
- If $s=v=0$ then the hh has purchased a new car during the survey year.
Three approaches, one formula

- The consumption flow to be included in the consumption aggregate can be calculated by means of a simple formula:

\[ CF_t = k_{v,t} \cdot p_{v,t} \]

- Interpretation: The consumption flow for a generic \( v \)-year old durable good purchased \( s \) years back in time is a fraction \( k \) of the current market value of the good, \( p_{v,t} \) (how much the \( v \)-year old good is worth on the market at the beginning of the survey period)

- The coefficient \( k \) is typically less than one.

- This equation should be memorized.

Method 1 – Acquisition approach

- A first option consists in adding up reported purchases on durable goods (purchase values) and include them in the consumption aggregate

- This would be a mistake

- Why?

- Because it would amount to assuming that households that purchased a durable good in the survey period use it all up by the end of the year.

- On the other hand, households that own durable goods purchased before the survey period would be considered “as well off as” households that do not own any durables

- This is in stark contrast with the very definition of durable good: a good that delivers utility for a period longer than the survey year.

The acquisition approach in practice

- If \( s < 0 \), then \( k=0 \) and \( CF=0 \)

- Interpretation: items purchased before the survey year \( (s<0) \) do not contribute to the household’s well-being.

- Does it make economic sense?

- No

- If \( s=0 \), then \( k=1 \), and \( CF_{v,t} = p_{v,t} \)

- Interpretation: items purchased during the survey year \( (s=0) \) contribute to the household’s well-being for their full value \( (\text{no} \text{ captures the present value of all services provided by the durable over its entire economic life}) \)

- Does it make economic sense?

- No
Method 2 – Rental equivalence

• Ideally, one could try to estimate the utility that derives from owning (or using) a durable good by collecting information on how much it would cost to rent it for a year.

• In principle, this is doable - in practice, it is not.

• Most countries have no markets for renting most durable goods, and when markets exist it is difficult (impossible?) to control for quality.

• Not recommended

*The rental approach in practice

- Assume that consumers can rent a car
- Let \( R_v \) denote the current market rental value of the \( v \)-year-old durable good
- If \( k \) is specified as in the formula here (it can be interpreted as the share of the good’s value that is consumed in the current period), then \( CF_t = R_v \)
- Interpretation - the CF equals the market rental value of the durable owned by the household

- Does it make economic sense?
  - Yes

- Is it empirically viable?
  - Most likely, no.

Method 3 – User Cost

• We introduce the user cost approach through a conceptual experiment

• Consider a household that owns a durable good.

• Notation: let \( p_t \) denote the market value of a particular good at the beginning of the survey year 1 (we forget about the age of the good for a second)

• The household faces two options:
  1. to sell the durable good;
  2. to use the durable good.
The user cost approach – I

<table>
<thead>
<tr>
<th>sell</th>
<th>use</th>
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<td>If the household <strong>sells</strong> the durable good and invests the revenue on the financial market, at the end of the year, the household receives: $p_t (1 + i_t)$, where $i_t$ is the market nominal interest rate.</td>
<td>If the household <strong>uses</strong> the durable good and sells it at the end of the year, the household obtains: $p_t (1 + \pi_t) (1 - \delta_t)$, where $\pi_t$ is the inflation rate during the year $t$ and $\delta_t$ is the annual depreciation rate (due to both physical deterioration and loss of market value).</td>
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The user cost approach – II

- The **consumption flow** is the difference between the value of the two options at the end of the year: this is the cost that the household is willing to pay for using the durable good for one year:
  $CF_t = p_t (1 + i_t) - p_t (1 + \pi_t)(1 - \delta_t)$

  which can be approximated by:
  $CF_t = p_t (i_t - \pi_t + \delta_t) = p_t (i_t + \delta_t)$

  $CF_t$ is the **consumption flow** from durables.

The consumption flow, interpreted

$CF_t = p_t (i_t - \pi_t + \delta_t) = p_t (i_t + \delta_t)$

- **Two cost components**:
  1. **Opportunity cost** $p_t i_t$ is the foregone real interest, i.e., the interest one could have earned if one had invested the money in a bank account instead of the consumer good.
  2. **Depreciation** $p_t \delta_t$ is the drop in value of the good during the course of the year.

- Problem: how to estimate the depreciation rate (delta) in practice?
The user cost approach in practice

- Using our formula:
  \[ CF_t = k^2_t 	imes p^2_t \]
- Note that if
  \[ k^2_t (u) = n_t + \delta_t \]
- then
  \[ CF_t = (r_t + \delta_t)p_{u,t} \]
- which is what we have derived through the conceptual experiment seen before.

Estimating \( CF_t \) based on the user cost approach

\[ CF_t = p_t(r_t + \delta_t) \]
- Of the two "ingredients" needed to compute \( CF_t \), \( r_t \) is the easiest to obtain: it comes from sources external to the survey.
- Instead, the depreciation rate \( \delta_t \), which measures the loss (or gain) in value that durable goods experience with age due to physical deterioration and market value change, must be estimated.
- How to estimate \( \delta_t \)? Can bicycles depreciate at the same rate as refrigerators?

Estimating the depreciation rate — I/II

- We can write:
  \[ p_{t,1} = (1 - \delta_1)p_{0,1} \]
- And similarly:
  \[ p_{t,2} = (1 - \delta_2)p_{1,1} \]
- Then:
  \[ p_{t,2} = (1 - \delta_2)(1 - \delta_1)p_{0,2} \]
- Proceeding iteratively gives:
  \[ p_{t,n} = \prod_{i=1}^{n}(1 - \delta_i)p_{0,n} \]
Estimating the depreciation rate — II/II

• Given:

\[ p_{n+1} = \prod_{i=1}^{n} (1 - \delta_i) p_{0,i} \]

• The "secret" consists in modelling \( \delta_i \). Many options:
  1) the geometric depreciation model
  2) the straight line depreciation
  3) others not covered here...

The geometric model

• Depreciation rate constant over time: \( \delta_i = \delta \)

• Market value of age \( v \) durable simplifies to:

\[ p_{n+1} = (1 - \delta)^v p_{0,i} \]

• Depreciation rate given by:

\[ \delta = 1 - \left( \frac{p_{0,i}}{p_{n+1}} \right)^\frac{1}{v} \]

• Bottom line: \( \delta \) can be easily estimated, at least in theory; it only requires information on the market values of homogeneous durable goods of different age, \( p_{0,i} \) and \( p_{n+1} \).

*The straight line model

• Finite economic life. After \( T \) years CF falls down to zero. Linear pattern

\[ \frac{p_{n,v}}{p_{n,T}} = \begin{cases} \frac{T - v}{T} & \text{if } v \leq T \\ 0 & \text{otherwise} \end{cases} \]

• The depreciation rate increases over time

\[ \delta_i = \begin{cases} \frac{1}{T - i} & \text{if } 1 < T \\ 1 & \text{otherwise} \end{cases} \]
Recap

- **User cost** is the more appropriate concept to evaluate the consumption flow from durables.
- In terms of data requirements, the geometric depreciation model is a good compromise.
- We need to estimate:
  1. Current market value of the durable: \( P_{t,t} \)
  2. Current real interest rate: \( r_t = l_t - \pi_t \)
  3. Depreciation rate: \( \delta \)

Data requirements: first best

- Current market value of item of vintage \( t \): \( P_{t,t} \)
- Current market value of a new item: \( P_{0,t} \)
- Age \( t \) of the durable
- Current nominal interest rate: \( l_t \)
- Current yearly inflation rate: \( \pi_t \)

\[
CF = (l_t - \pi_t + \delta)P_{t,t} \\
\delta = 1 - \left( \frac{P_{t,t}}{P_{0,t}} \right)^\frac{1}{2}
\]
Data requirements: approximating the first best

- Current market value of the item purchased year $t - S$: $p_{t-s,t}$
- Price paid in year $t - S$: $p_{t-s}$
- Current nominal interest rate: $i_t$
- Current yearly inflation rate: $\pi_t$
- Average yearly inflation rate: $\bar{\pi}

$$CF = (i_t - \pi_t + \delta)p_{t-s,t}$$
$$\delta = 1 - \frac{1}{1 + \bar{\pi}} \left(\frac{p_{t-s}}{p_{t-s,t}}\right)^\bar{\pi}$$

4. How to design a dedicated module in the questionnaire?

Tanzania, 2014/15 National Panel Survey

- 1) Current market value of item ($p_{t-s,t}$)
- 2) Price paid in year $t-s$ ($p_{t-s}$)
- Age of the durable ($v$)
- Data requirements for a (practical) first best are met
1) Current market value of item ($p_{t-s,t}$)
2) Price paid in year $t-s$ ($p_{t-s}$)
3) Years of ownership ($s$) or Age of the durable ($v$)

- We only have the current market value of the item
- Standard methods cannot be applied

Some practical considerations

- The years of ownership can be used as a substitute for the age of the durable
- It is uncommon for surveys to collect information on the current market value of item of vintage $v$, and most of the time, what we have instead is the price paid in $t-s$. In all these cases, we will need to apply an inflation rate
- When the first best criteria are not fulfilled, alternative methods may exist to achieve a reliable estimation of the durables
- But not always.

Palestine
Expenditure and Consumption Survey, PECS 2011

- Palestine is an extreme case
- We only have information about the amount of durables (number of units)
- In those cases, a wise choice is to ignore consumer durable goods and exclude them from the welfare aggregate
Lessons learned

- We are interested in the use (consumption) of a durable good, and not in its value (purchase).
- The recommended approach to estimate the value of use is called "the user cost method".
- Data requirements depend on the specific method chosen for estimating the so-called consumption flow from durable goods.
- The questionnaire should contain a specific module on ownership of durables.

References

Required readings

Suggested readings

Thank you for your attention
Homework

Exercise 1 – The durable goods module

- Comment on whether the following modules are suitable for estimating the CF, as needed by a welfare analyst.
Ghana, 2017
Ghana Living Standards Survey

1) Current market value of item ($p_{t,s,t}$)
2) Price paid in year $t$ ($p_{t-s}$)
3) Years of ownership ($s$)

- Data requirements for a (practical) first best are met even in the absence of the age of the durable
- Q2: "How long ago was [...] obtained". What happens if many durables were obtained as gifts?

Zambia, 2015
Living Conditions Monitoring Survey

- Same case as Ghana
- Here, information is collected on the "most recent" durable. How does this affect the resulting estimate (think about cases in which the household owns more than one durable good for each type)?
Nigeria, 2015/16
General Household Survey

1) Current market value of item ($p_{t-s,t}$)
2) Price paid in year $t-s$ ($p_{t-s}$)
3) Years of ownership ($s$)

Alternative methods exist when we only have the current market value of the durable and an estimation of the maximum economic life of the durable.

Malawi, 2016/17
Integrated household survey
Malawi, 2016/17
Integrated household survey

1) Current market value of item \( p_{t-s,t} \)
2) Price paid in year \( t \) \( (p_t) \)
3) Age of the durable \( (v) \)

- the questionnaire only collects information about the price paid if the durable was acquired in the last 12 months (in year \( t \)).
- We don’t have the price paid in year \( t-1 \).
- Note that, in this case, \( p_t \) and \( p_{t-1} \) will probably be very similar.
- Same case as Nigeria but a bit better because we have the vintage.