

Durable Goods
LECTURE 9
C4D2 TRAINING

1

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

C4D2 TRAINING

2

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?

C4D2 TRAINING

3

1. What is a durable good?

4

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

5

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

6

2. Why do durable goods require a special treatment?

7

Why do durable goods require a special treatment?

- A figure worth a thousands words:



- 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

8

The problem with durable goods

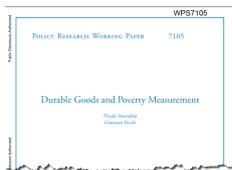
- It is not the purchase of a good that contributes to welfare, but its use.
- This creates a wedge between household expenditure (which we can easily measure) and household consumption (we rarely observe usage directly).
- For non-durable (perishable) goods, it is safe to ignore this wedge: expenditure 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 a durable goods during a given year?

9

3. How to deal with durable goods, analytically?

10

Useful reference Amendola and Vecchi (2014)



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

11

Three approaches

- 1. Acquisition Approach**
- 2. Rental Equivalence**
- 3. User Cost**

When the good is purchased its entire value is attributed to the household welfare aggregate

If a complete set of markets for the services of durables exists, we can use the market rental value of the goods

The annual opportunity cost of holding each durable.

12

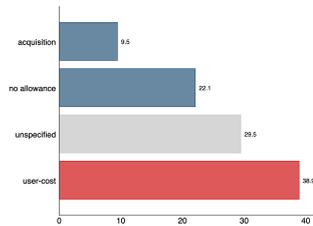


Definition: Opportunity cost

- Opportunity cost = the value of the next-best alternative you give up
 - Choice A has value X, choice B has value Y
 - You can only pick one
 - Opportunity cost of choice A is Y, opportunity cost of choice B is X
- In this case, opportunity cost of holding a durable is the income one would make by selling it and investing the money

13

Durable goods in selected World Bank poverty reports Amendola and Vecchi (2020)



14

Consider your car:
how to calculate its contribution to your standard of living?



15

Some notation first

- Let us focus on **one durable good**, e.g. cars
- Let **t** denote the survey year
- If we write **CF**, 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**)
- if **s=v=0** then the hh has purchased a new car during the survey year.

16

Three approaches, one formula

- The **consumption flow** to be included in the consumption aggregate can be calculated as follows:

$$CF_t = k_{v,t}^s \times p_{v,t}$$

- **Interpretation:** the consumption flow CF_t for a **v**-year old durable good purchased **s** years back in time is a fraction $k_{v,t}^s$ of the current market value of the good, $p_{v,t}$.
- The coefficient **k** is typically less than one.
- This **equation** should be **memorized**.

17

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.

18

The acquisition approach in practice

$$CF_t = k_{v,t}^s \times p_{v,t}$$

$$k_{v,t}^s = \begin{cases} 1 & \text{if } s = 0 \\ 0 & \text{if } s > 0 \end{cases}$$

- If the good is purchased before the survey year ($s > 0$), then $k = 0$, and $CF_t = 0$, that is, it does not contribute to the household's well-being.
- Does it make economic sense?
 - No
- If the good is purchased during the survey year ($s = 0$), then $k = 1$, and $CF_t = p_{v,t}$, that is, it contributes to the household's well-being for its full value.
- Does it make economic sense?
 - No

19

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

20

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 t (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.

22

The user cost approach – I/II

sell	use
<p>If the household sells the durable good, and invest the revenue on the financial market, at the end of the year, the household receives</p> <p style="text-align: center;">$p_t(1+i_t)$</p> <p>where i_t is the market nominal interest rate.</p>	<p>If the household uses the durable good and sells it at the end of the year, the household obtains</p> <p style="text-align: center;">$p_t(1+\pi_t)(1-\delta_t)$</p> <p>where π_t is the inflation rate during the year t and δ_t is the annual depreciation rate (due to both physical deterioration and loss of market value).</p>



23

The user cost approach – II/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:

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

CF is the **consumption flow** from durables



24

The consumption flow, interpreted

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

▪ Two cost components:

- Opportunity cost**
 $p_t r_t$ 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.
- 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?



25

The user cost approach in practice

- Using our formula:

$$CF_t = k_{v,t}^s \times p_{v,t}^s$$

- Note that if

$$k_{v,t}^s(u) = r_t + \delta_t$$

- then

$$CF_t = (r_t + \delta_t)p_{v,t}$$

which is what we have derived through the conceptual experiment seen before.

26

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 δ_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 δ_t ?

Do bicycles depreciate at the same rate as refrigerators?

27

Estimating the depreciation rate – I/II

- We can write: $p_{1,t} = (1 - \delta_1)p_{0,t}$

- And similarly: $p_{2,t} = (1 - \delta_2)p_{1,t}$

- Then: $p_{2,t} = (1 - \delta_2)(1 - \delta_1)p_{0,t}$

- Proceeding iteratively gives: $p_{v,t} = \prod_{i=1}^v (1 - \delta_i)p_{0,t}$

28

Estimating the depreciation rate – II/II

▪ Given:

$$p_{v,t} = \prod_{i=1}^v (1 - \delta_i) p_{0,t}$$

▪ The “secret” consists in modelling δ_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: $p_{v,t} = (1 - \delta)^v p_{0,t}$

▪ Depreciation rate given by: $\delta = 1 - \left(\frac{p_{v,t}}{p_{0,t}}\right)^{\frac{1}{v}}$

▪ Bottom line: δ can be easily estimated, at least in theory: it only requires information on the market values of homogeneous durable goods of different age, $p_{v,t}$ and $p_{0,t}$.

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: $p_{v,t}$
- 2) Current real interest rate: $r_t = i_t - \pi_t$
- 3) Depreciation rate: δ

Data requirements: first best

- Current market value of item of vintage v : $p_{v,t}$
- Current market value of a new item: $p_{0,t}$
- Age v of the durable
- Current nominal interest rate: i_t
- Current yearly inflation rate: π_t

$$CF = (i_t - \pi_t + \delta)p_{v,t} \quad \delta = 1 - \left(\frac{p_{v,t}}{p_{0,t}}\right)^{\frac{1}{v}}$$

34

Some practical considerations

$$\delta = 1 - \left(\frac{p_{v,t}}{p_{0,t}}\right)^{\frac{1}{v}}$$

- In place of v (age of the durable): **years of ownership** can be a more practical approximation
- In place of $p_{0,t}$ (current market value of a new item): more practical to ask for the **price originally paid for the good when it was purchased**, $p_{v,t-v}$
- The analyst will use an inflation rate π in order to approximate what is needed for estimating delta: $p_{0,t} \approx (1 + \pi)^v p_{v,t-v}$

35

The consumption flow estimated: Maldives, 2016

Consumer durable	Depreciation rate	consumption flow
	δ	CF
Air conditioning	0.1188	1,441.6
Bicycle	0.2083	365.7
Car/Jeep	0.0742	12,082.7
Computer/Laptop	0.1148	1,091.0
Fan	0.2083	362.5
Mobile phone	0.1976	1,920.0
Motor cycle	0.0787	4,942.7
Refrigerator	0.1190	535.5

36

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

37

Tanzania, 2014/15 National Panel Survey

- 1) Current market value of item (**Pts-t**)
- 2) Price paid in year t-5 (**Pt-s**)
- 3) Age of the durable (**V**)
 - Data requirements for a (practical) first best are met

ITEM ID	ITEM NAME	IF YOU OWN THIS ITEM, WRITE THE PRICE	IF YOU OWN THIS ITEM, WRITE THE PRICE	IF YOU OWN THIS ITEM, WRITE THE PRICE	IF YOU OWN THIS ITEM, WRITE THE PRICE
401	Radio and Radio Cassette				
402	Telephone (landline)				
403	Telephone/mobile				
404	Multioperator or faxster				
405	Television				
406	Video, DVD				
407	Chair				
408	Sofa				
409	Fridge				
410	Washing machine				
411	Washing machine				
412	Refrigerator				
413	Refrigerator				
414	Refrigerator				
415	Refrigerator				
416	Refrigerator				
417	Refrigerator				
418	Refrigerator				
419	Refrigerator				
420	Refrigerator				
421	Refrigerator				
422	Refrigerator				
423	Refrigerator				
424	Refrigerator				
425	Refrigerator				
426	Refrigerator				
427	Refrigerator				
428	Refrigerator				
429	Refrigerator				
430	Refrigerator				
431	Refrigerator				
432	Refrigerator				
433	Refrigerator				
434	Refrigerator				
435	Refrigerator				
436	Refrigerator				
437	Refrigerator				
438	Refrigerator				
439	Refrigerator				
440	Refrigerator				
441	Refrigerator				
442	Refrigerator				
443	Refrigerator				
444	Refrigerator				
445	Refrigerator				
446	Refrigerator				
447	Refrigerator				
448	Refrigerator				
449	Refrigerator				
450	Refrigerator				
451	Refrigerator				
452	Refrigerator				
453	Refrigerator				
454	Refrigerator				
455	Refrigerator				
456	Refrigerator				
457	Refrigerator				
458	Refrigerator				
459	Refrigerator				
460	Refrigerator				
461	Refrigerator				
462	Refrigerator				
463	Refrigerator				
464	Refrigerator				
465	Refrigerator				
466	Refrigerator				
467	Refrigerator				
468	Refrigerator				
469	Refrigerator				
470	Refrigerator				

38

Namibia, 2015/16 Household Income and Expenditure Survey (NHIES)

- 1) Current market value of item (**Pts-t**)
- 2) Price paid in year t-5 (**Pt-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

ITEM ID	ITEM NAME	IF YOU OWN THIS ITEM, WRITE THE PRICE	IF YOU OWN THIS ITEM, WRITE THE PRICE	IF YOU OWN THIS ITEM, WRITE THE PRICE	IF YOU OWN THIS ITEM, WRITE THE PRICE
401	Radio and Radio Cassette				
402	Telephone (landline)				
403	Telephone/mobile				
404	Multioperator or faxster				
405	Television				
406	Video, DVD				
407	Chair				
408	Sofa				
409	Fridge				
410	Washing machine				
411	Washing machine				
412	Refrigerator				
413	Refrigerator				
414	Refrigerator				
415	Refrigerator				
416	Refrigerator				
417	Refrigerator				
418	Refrigerator				
419	Refrigerator				
420	Refrigerator				
421	Refrigerator				
422	Refrigerator				
423	Refrigerator				
424	Refrigerator				
425	Refrigerator				
426	Refrigerator				
427	Refrigerator				
428	Refrigerator				
429	Refrigerator				
430	Refrigerator				
431	Refrigerator				
432	Refrigerator				
433	Refrigerator				
434	Refrigerator				
435	Refrigerator				
436	Refrigerator				
437	Refrigerator				
438	Refrigerator				
439	Refrigerator				
440	Refrigerator				
441	Refrigerator				
442	Refrigerator				
443	Refrigerator				
444	Refrigerator				
445	Refrigerator				
446	Refrigerator				
447	Refrigerator				
448	Refrigerator				
449	Refrigerator				
450	Refrigerator				
451	Refrigerator				
452	Refrigerator				
453	Refrigerator				
454	Refrigerator				
455	Refrigerator				
456	Refrigerator				
457	Refrigerator				
458	Refrigerator				
459	Refrigerator				
460	Refrigerator				
461	Refrigerator				
462	Refrigerator				
463	Refrigerator				
464	Refrigerator				
465	Refrigerator				
466	Refrigerator				
467	Refrigerator				
468	Refrigerator				
469	Refrigerator				
470	Refrigerator				

39

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

Durable Goods			
Group No	Description of item	Item No.	Total amount last 12 months
50	Furniture		
	Wooden bed	5001	
	Metal bed	5002	
	Wooden tables	5003	
	Wooden chairs	5004	
	Plastic tables	5005	
	Plastic chairs	5006	
	Wooden cupboard	5007	
	Dining room, complete set	5008	
	Living room, complete set	5009	
	Bed room, complete set	5010	

40



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.

41

References

Required readings

Amendola, N. and G. Vecchi (2014), "Durable goods and poverty measurement", World Bank Policy Research Working Paper no. 7105.

Deaton, A., & Zaidi, S. (2002). Guidelines for constructing consumption aggregates for welfare analysis (Vol. 135). World Bank Publications. p. 33-35

Suggested readings

Diewert, W. E. (2004), "Durables and User Costs" in ILO, Consumer Price Index Manual: Theory and Practice, chapter 23, ILO / IMF / OECD / UNECE / Eurostat / World Bank.

Diewert, W. E. (2009), "Durables and Owner-Occupied Housing in a Consumer Price Index" in W. E. Diewert, J.S. Greenlees and C.R. Hulten (eds.), Price Index Concepts and Measurements, University of Chicago Press.

42

Thank you for your attention

C4D2 TRAINING 43

43

Homework

C4D2 TRAINING

44

Exercise 1 – The durable goods module

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

C4D2 TRAINING 45

45

Malawi, 2016/17
Integrated household survey

MODULE 1: DURABLE GOODS

ENUMERATOR: RECORD START DATE & TIME
HH:MM SS:MM

	Q11	Q12	Q13	Q14	Q15	Q16
	Does your household own a [ITEM]?	How many [ITEM]s do you own?	What is the [ITEM] used for?	If you wanted to use [ITEM] today, how much would you pay for one?	Did you purchase or buy [ITEM] in the last 12 months?	How much in [ITEM] did you buy for any [ITEM] in the last 12 months?
	1	2	3	4	5	6
Mortgage (mortg)	801					
Bed	802					
Furniture	803					
Chair	804					
Fan	805					
Air conditioner	806					
Radio (wireless)	807					
Radio with flash drive/MP3 CD	808					
Table or CD/DVD player, MP3	809					
Television	810					
VCR	811					
Washing machine	812					
Kerosene/gas/other stove	813					
Electric or gas stove - not pizza	814					
Refrigerator	815					