

## CONSUMER BEHAVIOR – PART 3

### PRICE INDEXES (P-R pp. 97-102)

Suppose in 2005, you receive \$200/month “midnight snacks allowance” from your parents. You spend it on pizza X or burgers Y.  $P_X = 10$ ,  $P_Y = 5$ . Your utility function is  $U(X,Y) = X Y$ . Optimal choice from Cobb-Douglas formula:  $X = \frac{1}{2} 200 / 10 = 10$ ,  $Y = \frac{1}{2} 200 / 5 = 20$ ,  $U = 200$ . In 2006, the price of burgers doubles:  $P_Y = 10$ . Your old consumption bundle costs  $10 * 10 + 10 * 20 = 300$ . You will ask for extra \$100/month, that is, an increase of 50% in your allowance.

General idea – Laspeyres price index, using initial quantities as weights

$$\text{Old cost} = P_X(2005) X(2005) + P_Y(2005) Y(2005)$$

$$\text{New cost} = P_X(2006) X(2005) + P_Y(2006) Y(2005)$$

Define Laspeyres index of 2006 prices with 2005 as base year:

$$\frac{P_X(2006) X(2005) + P_Y(2006) Y(2005)}{P_X(2005) X(2005) + P_Y(2005) Y(2005)} 100 = \frac{10 * 10 + 10 * 20}{10 * 10 + 5 * 20} 100 = \frac{300}{200} 100 = 150$$

But suppose your parents now sent you \$300/month. Would you buy the old bundle?

No. Optimal to substitute away from the good whose price has risen

New optimum: spend \$150 on each good (using Cobb-Douglas formula)

Quantities  $X(2006) = 15 > 10 = X(2005)$ ,  $Y(2006) = 15 < 20 = Y(2005)$

$$U(2006) = 15 * 15 = 225 > 200 = U(2005)$$

What should your parents actually send you to keep you exactly as well off as in 2005?

Call this allowance Z. You will then purchase  $X = \frac{1}{2} Z / 10 = Z / 20$ ,  $Y = \frac{1}{2} Z / 10 = Z / 20$

$$U = Z^2 / 400. \text{ To keep this } = 200, \text{ need } Z^2 = 400 * 200, \text{ or } Z = 20 * 10 * \sqrt{2} = 282.84 < 300$$

True index =  $(282.84/200)*100 = 141.42 < 150$ ; Laspeyres index overstates the price increase  
 This is one reason for the “upward bias in the CPI” recently much discussed in policy debates  
 (Other reasons – quality improvements, cheap outlets not properly accounted for)

An alternative, the Paasche index, uses the current or final year quantities as weights:

$$\frac{P_X(2006) X(2006) + P_Y(2006) Y(2006)}{P_X(2005) X(2006) + P_Y(2005) Y(2006)} 100$$

For our snacks price index problem, this is  $\frac{10 * 15 + 10 * 15}{10 * 15 + 5 * 15} 100 = \frac{300}{225} 100 = 133.33 < 141.42$

So the Paasche index understates the true change in the cost of living

If all prices increased in the same proportion (“pure inflation”), e.g if in 2006,  $P_X = 20$ ,  $P_Y = 10$

Laspeyres index is  $\frac{P_X(2006) X(2005) + P_Y(2006) Y(2005)}{P_X(2005) X(2005) + P_Y(2005) Y(2005)} 100 = \frac{20*10 + 10*10}{10*10 + 5*10} 100 = 200$

And calculation of the income  $Z$  needed to maintain 2005 utility is

$$X = \frac{1}{2} Z / 20 = Z / 40, Y = \frac{1}{2} Z / 10 = Z / 20, U = Z^2 / 800$$

To keep this = 200, need  $Z^2 = 800 * 200 = 400 * 400$ , or  $Z = 400$  so no bias.

Similarly Paasche index has no bias in this situation either

So “pure inflation” is the easy case; changes in RELATIVE prices cause biases in price indexes

Precisely because substitution occurs in response to changes in relative prices

That is why “CPI bias” problem was so big in recent years – big relative price changes

One solution – chaining. Each year, use last year’s quantities as weights

Relative price changes over one year are small, so errors small

## MARKET DEMAND (P-R pp. 122-7, 132-4)

Horizontal sum of individual demands.

Example: Two consumers A and B

Individual demands  $Q_A = a - c P$ ,  $Q_B = b - d P$

Market demand  $Q = Q_A + Q_B$

$= (a+b) - (c+d) P$  when  $P < a/c$

This works so long as these are independent

But may have interactive effects –

positive or negative

Consider example of positive – fashion or networks

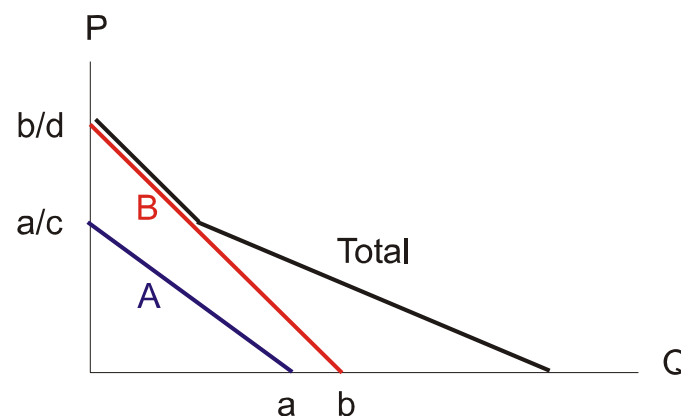
$Q_A = 12 - 2 P + 0.5 Q_B$ ,  $Q_B = 12 - 2 P + 0.5 Q_A$

Solve these jointly:

$Q_A = 24 - 4 P$ ,  $Q_B = 24 - 4 P$ , Total  $Q = Q_A + Q_B = 48 - 8 P$

Additional effect of prices because lower price has a direct effect on quantities,  
then a further effect of each quantity on the other, then a third round, ...

Total effect is the cumulation of all these



Definitions and calculations of price elasticities of market demand same as for individual ones

Formally, can also calculate elasticity of market demand with respect to total income

But doing and interpreting this needs some care:

Redistribution of income may alter individual demands unequally,  
and therefore change total demand

For necessities, more equal income distribution causes increase in quantity demanded,  
for luxuries, a decrease

## PRICE ELASTICITIES THROUGH TIME (P-R pp. 38-43)

Usual presumption – price elasticities of demand higher in the long run than in the short

Intuition – with more time, the consumers [1] are better informed about the price change,

[2] learn better how to cope with new goods, change habits,

[3] are less bound by previous commitments or contracts, ...

Therefore we should see larger quantity response the longer the run

This is broadly correct. But need more thought, and more precise specification

[1] Is the price change temporary or permanent?

[2] Is the good in question non-durable or durable?

If non-durable, how substitutable over time?

For durables, short-run elasticity often  $>$  long-run elasticity following permanent price change

Example: 1000 people, each buys 1 car, keeps for 5 years.

In the original “steady state” of the system, annual quantity demanded = 200

Now price drops. Each buys 1.2 cars (on average), keeps for 4 years

In the new “steady state”, annual quantity demanded = 300

But in the first year, two cohorts (200 owners of 5-year-olds, 200 of 4-year-olds)

replace their cars, plus the 200 who are going to buy a second car do so. Quantity = 600

In the second, third, and fourth years, back down to 200. Fifth year, back up to 600.

So new steady state may not even be reached; instead “echo” of initial impact.

In practice, the echo is gradually flattened by various uncertainties; go to new steady state.

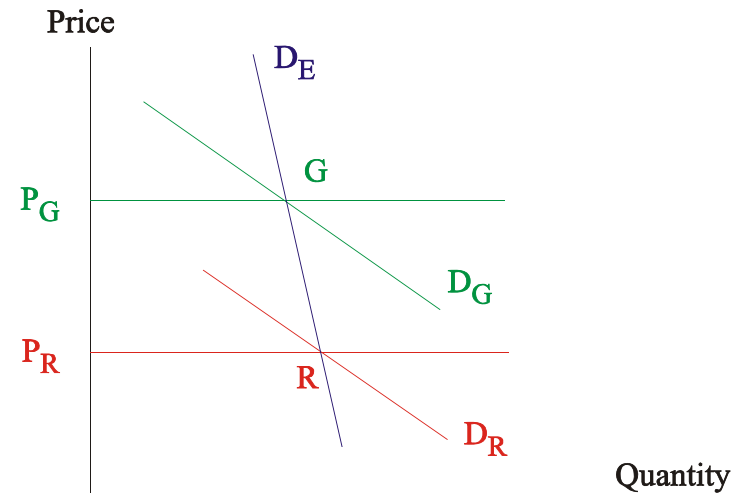
For temporary price changes, large effect if good is durable or substitutable over time

Examples – sales, “happy hours” or “early-bird specials”

## EMPIRICAL ESTIMATION – ISSUES (P-R 136-40)

- [1] Choice of level of aggregation – over consumers, and over commodities
  - Often dictated by data availability and computational complexities
  - Increasingly, large samples of individual households' choices available
  - Commodity data still quite coarsely aggregated except for specific marketing studies
  - Computer power increasing rapidly
- [2] Functional form specification – linear, logarithmic ... ?
  - Each imposes implicit assumptions about substitution etc.
  - Richer the form, the more we can estimate parameters from data rather than impose
  - But too many parameters leave too few degrees of freedom.
- [3] Scope of estimation – do you include saving, labor supply etc.
- [4] Biggest problem – estimates are biased if there are feedbacks from quantities to the supposed explanatory (exogenous) variables. Example:

Two data points, R and G  
Prices  $P_R$ ,  $P_G$  differ because higher tax in G  
Why is the tax higher in G? Could be because demand is higher G than in R ( $D_G$  upward shift of  $D_R$ )  
Economist might see points G, R and fit  $D_E$   
But that would be wrong: too inelastic  
Lesson — understand your data  
and reasons for variation you see  
Look for “experiments” in data:  
“control group” and “treatment group” that  
differ only in the aspect you want to focus on



## EMPIRICAL ESTIMATION – EXAMPLE

From Richard Blundell, “Consumer Behavior: Theory and Empirical Evidence,”  
Economic Journal, March 1988

Recognizes  $n = 6$  commodity classifications. Prices  $P_k$ , quantities  $Q_k$ , income  $I$

Dependent variables – expenditure shares  $S_k = (P_k Q_k) / I$

Data – expenditure survey of 65,000 U.K. households

(those sampled are required to keep detailed notebooks on their spending)

$$S_k = \frac{P_k Q_k}{I} = \sum_{i=1}^n \theta_{ik} \left( \frac{P_i P_k}{I^2} \right)^{\alpha/2} + \beta_k \left[ 1 - \sum_{i=1}^n \sum_{j=1}^n \theta_{ij} \left( \frac{P_i P_j}{I^2} \right)^{\alpha/2} \right]$$

No need to remember this, but note that *applied* economics needs a lot of math

By fitting these formulas to the data, he estimates the “parameters”  $\alpha$ ,  $\beta_k$ ,  $\theta_{ij}$

Results shown in tables on last two pages of handout

Note – in the tables, “compensated” means considering only the pure substitution effect,  
with income adjusted to keep the consumer on the original indifference curve

“uncompensated” means the total effect, holding money income constant

Results give considerably detailed information about income elasticities (budget elasticities)

and price elasticities – “compensated” ones correspond to pure substitution effects,

“uncompensated” ones correspond to total effects of the price changes

## EXPERIMENTAL EVIDENCE

1. Endowment effect – “The value of a good appears to be higher when the individual views it as something that could be lost or given up than when the same good is viewed as a potential gain.”  
Thaler’s experiments on college undergraduates showed strong effect  
List’s experiments showed effect declines with experience of trading  
Related effects in dealing with uncertainty will be discussed later  
Framing – [1] Choice depends on what is designated as the default option  
Important in design of pension and health plans for employees  
[2] Choice depends on what is designated as status quo, because  
Departure from it may look good or bad even when final state is same
  2. Use of heuristic principles instead of calculation in judging values and probabilities  
Significance for consumer choice depends on whether the situation is  
a habitual or familiar one where good heuristics have developed, or  
a new one where heuristics from other experiences are mistakenly transferred and used
  3. “Satisficing” instead of “optimizing”  
Thaler’s claim that NYC taxi drivers have a daily income target in mind,  
so will give up sooner on good days instead of working longer as in standard theory  
This has now been effectively refuted by Prof. Farber  
But other situations are still subjects of ongoing research and debate
- My “bottom-line” advice: Use standard theory as starting point, then modify and supplement it  
Will work better for aggregates, routine purchases than for single individuals, new situations

Table 2  
*Price and Income Elasticities*

	Commodity Group					
	Food	Alcohol	Fuel	Clothing	Transport	Services
	<i>(a) Households with Children</i>					
Budget elasticities	0.668	2.014	0.329	1.269	1.212	1.654
Uncompensated price elasticities						
Food	-0.494	-0.006	0.051	-0.005	-0.088	-0.076
Alcohol	-0.541	-1.983	0.865	-0.136	0.668	0.000
Fuel	0.342	-0.653	-0.747	-0.008	-0.534	-0.258
Clothing	-0.242	-0.030	-0.089	-0.852	-0.045	-0.103
Transport	-0.404	0.276	-0.364	-0.023	-0.674	0.066
Services	-0.629	0.020	-0.327	-0.143	0.027	-0.767
Compensated price elasticities						
Food	-0.246	0.032	0.110	0.066	0.021	-0.004
Alcohol	0.210	-1.869	1.043	0.080	0.999	0.218
Fuel	0.464	0.671	-0.718	0.027	-0.480	-0.223
Cloth	0.231	0.042	0.023	-0.716	0.163	0.045
Transport	0.048	0.345	-0.257	0.106	-0.475	0.197
Services	-0.012	0.114	-0.181	0.034	0.298	-0.587
	<i>(b) Households without Children</i>					
Budget Elasticities	0.613	1.738	0.278	1.301	1.180	1.556
Uncompensated Price Elasticities						
Food	-0.431	0.001	0.057	-0.010	-0.092	-0.081
Alcohol	-0.355	-1.731	0.635	-0.090	0.465	-0.014
Fuel	0.330	0.717	-0.733	-0.017	-0.553	-0.264
Clothing	-0.255	-0.040	-0.098	-0.830	-0.059	-0.121
Transport	-0.333	0.231	-0.308	-0.018	-0.728	0.052
Services	-0.504	0.006	-0.274	-0.115	0.006	-0.813
Compensated Price Elasticities						
Food	-0.235	0.049	0.107	0.048	0.027	-0.003
Alcohol	0.201	-1.596	0.777	0.076	0.801	0.208
Fuel	0.419	0.739	-0.710	0.010	-0.499	-0.228
Clothing	0.161	0.062	0.008	-0.706	0.192	0.045
Transport	0.044	0.323	-0.212	0.095	-0.500	0.203
Services	-0.007	0.127	-0.147	0.034	0.307	-0.614



Table 3  
*Distribution of Elasticities by Income Group*

Income Percentile	Children		No children		All	
	Mean	STD	Mean	STD	Mean	STD
<i>(a) Uncompensated Own Price Elasticities</i>						
Food						
Low 5 %	-0.51	0.06	-0.48	0.07	-0.49	0.06
6-10 %	-0.50	0.07	-0.44	0.10	-0.47	0.07
11-25 %	-0.48	0.04	-0.40	0.10	-0.45	0.05
Mid 50 %	-0.42	0.04	-0.32	0.09	-0.39	0.04
76-90 %	-0.36	0.10	-0.24	0.21	-0.31	0.11
Top 10 %	-0.29	0.23	-0.12	0.44	-0.22	0.24
All	-0.40	0.04	-0.29	0.07	-0.36	0.04
Fuel						
Low 5 %	-0.92	0.04	-0.08	0.05	-0.90	2.04
6-10 %	-0.90	0.04	-0.83	0.07	-0.87	2.04
11-25 %	-0.86	0.03	-0.78	0.06	-0.83	3.03
Mid 50 %	-0.77	0.03	-0.68	0.05	-0.74	4.02
76-90 %	-0.67	0.08	-0.55	0.11	-0.62	6.07
Top 10 %	-0.56	0.14	-0.41	0.19	-0.50	9.12
All	-0.75	0.03	-0.65	0.04	-0.71	5.02
<i>(b) Income (Budget) Elasticities</i>						
Food						
Low 5 %	0.72	0.05	0.67	0.06	0.69	0.05
6-10 %	0.71	0.06	0.64	0.08	0.68	0.05
11-25 %	0.69	0.03	0.61	0.08	0.66	0.03
Mid 50 %	0.65	0.03	0.56	0.06	0.62	0.08
76-90 %	0.61	0.07	0.51	0.14	0.52	0.16
Top 10 %	0.56	0.15	0.43	0.28	0.51	0.16
All	0.64	0.03	0.54	0.05	0.60	0.03
Fuel						
Low 5 %	0.62	0.08	0.53	0.04	0.56	0.07
6-10 %	0.58	0.08	0.43	0.13	0.52	0.08
11-25 %	0.49	0.05	0.35	0.11	0.44	0.06
Mid 50 %	0.33	0.04	0.17	0.08	0.28	0.04
76-90 %	0.17	0.13	-0.03	0.18	0.09	0.11
Top 10 %	-0.01	0.23	-0.24	0.31	-0.11	0.19
All	0.31	0.04	0.13	0.06	0.24	0.04