Estimating True Cost-of-Living (Konüs) Price Indices from Household Data
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The issue

- Conventional price indices like the CPI don't allow for the fact that utility differs between households and is changing over the period covered by the index.
- This wouldn't matter if consumer demand were *homothetic.* But all the empirical evidence suggests the opposite: income elasticities are *not* all equal to 1 (Engel's Law).
- Solution: a *Konüs price index* which holds utility constant at some pre-specified reference level.

Our approach

- We calculate Konüs price indices for 5 different household types over the period 2006-2015 and compare with conventional indices.

- We use survey data on some 4,600 households in 2015. Household expenditure data is for 87 products and is consistent with the national accounts.

Conventional versus Konüs price indices (1)

A Divisia price index is a continuous time analogue of a conventional chain index like the CPI.

Divisia price index

$$\hat{P}^D(t) = \sum_{i=1}^{i=N} s_i(t,t)\hat{p}_i(t)$$

The $s_i(t,t)$, the budget shares at t, depend on prices and the utility level (real income) at t:

$$s_i(t,t) = s_i(\mathbf{p}(t), u(t))$$

Conventional versus Konüs price indices (2)

Divisia price index

$$\hat{P}^D(t) = \sum_{i=1}^{i=N} s_i(t,t)\,\hat{p}_i(t)$$

Konus price index

$$\hat{P}^K(t) = \sum_{i=1}^{i=N} s_i^C(t,r)\,\hat{p}_i(t)$$

The $s_i^C(t,r),$ the *compensated* budget shares at $t,$ depend on prices and a reference level of utility (real income), u_r:

$$s_i^C(t,r) = s_i(\mathbf{p}(t), u_r)$$

Demand systems

We can estimate the compensated shares by estimating a demand system. We need to estimate only the parameters which describe the response to *income* changes, not the parameters describing the response to *price* changes.

Oulton (J of Ec., 2008), Oulton (ROIW, 2012)

The linear PIGLOG system

Deaton and Muellbauer (1980).

For a single cross-section of households in year t,

the regression equation for the i-th budget share is

$$s_{ijt} = a_{it} + \beta_i \ln x_{jt} + \varepsilon_{ijt} \qquad x : \text{income}; \ \varepsilon_{ijt} : \text{error term}$$

$$\sum\nolimits_i a_{it} = 1; \ \sum\nolimits_i \beta_i = 0$$
$$i = 1,...,N; \ j = 1,...,M$$

Note Prices assumed the same for all households so all price effects are absorbed by the constant term a_{it}.

Compensated and actual shares in the linear PIGLOG

$$\hat{s}_{ijt}^{C} = s_{ijt} - \hat{\beta}_i (\ln x_{jt} - \ln x_{Rt})$$

$$x_{Rt} : \text{reference level for real income}$$

So we estimate the betas from a cross-section regression of the shares on income.

Next we calculate the compensated shares.

Then we calculate the Konüs price index.

We also estimate the Konüs from the *quadratic* PIGLOG which adds a term in squared log income to the regression equation (Banks et al., REcStats, 1997).

Data

LCFS and ETB surveys. Dataset gives (a) expenditures for each household on each of 87 products covering the whole of consumers' expenditure; (b) a price index for each of the 87 products. Total expenditure on each product is consistent with national totals. Period: 2006-2015.

Number of households by household type in 2015

Household type	Sample (number)	National (millions)
1. Single adult, no children	671	3,764
2. Single adult, with children	270	1,239
3. Couple, no children	970	5,439
4. Couple, with children	1,444	8,252
5. Retired	1,303	6,602
Total	4,658	25,296

Consumer demand is *NOT* homothetic

Number of products for which the income variable(s) are significant:

Linear model: **49-70** (depending on household type)

Quadratic model: **49-80** (depending on household type)

NB: we would expect 4-5 products out of 87 to have significant income coefficients just by chance.

Average R^2 over 87 share regressions, by model and household type, 2015

Household type	Linear	Quadratic	Cubic
1	0.1158	0.1274	0.1328
2	0.1746	0.1882	0.1964
3	0.1108	0.1229	0.1274
4	0.0962	0.1089	0.1137
5	0.0916	0.1059	0.1107

Note: Each regression equation includes age, sex and region dummies as well as income variables.

Number of compensated shares estimated to be negative, by household type

Household type	Linear model	Quadratic model
1. Single adult, no children	35	12
2. Single adult, with children	12	20
3. Couple, no children	165	89
4. Couple, with children	38	11
5. Retired	80	14
TOTAL	330 **(8%)**	146 **(3%)**

Note: For each household type, there are (87 x 10 =) **870** estimated compensated shares.

Conventional price indices: average annual growth rates, 2006-2015, % p.a.

Index number (chained)	Household type				
	Single adult, no children	Single adult, with children	Couple, no children	Couple, with children	Retired
Paasche	2.17	2.09	2.10	2.13	2.13
Laspeyres	2.32	2.27	2.27	2.35	2.33
Fisher	2.25	2.18	2.19	2.24	2.23
Törnqvist	2.25	2.18	2.19	2.24	2.23

Source: ONS. LCFS and ETB surveys.

Note: Official index (CPIH, chained Laspeyres) grew at 2.32% p.a.

Reference real income level for the Konüs

We adopted a "pro-poor" standpoint.

We set the reference (equivalised) income at the upper bound of the 10th percentile for all households in 2006.

I.e. the income level such that 90% of households were better off than this in 2006.

Conventional versus Konüs price indices, by household type: average annual growth rates, 2006-2015, % p.a.

	Household type	Conventional	linear Konüs	quadratic Konüs
1	Single adult, no children	2.25	2.89	2.95
2	Single adult, with children	2.18	2.59	2.75
3	Couple, no children	2.19	2.65	2.72
4	Couple, with children	2.24	2.63	2.76
5	Retired	2.23	2.67	2.93

Source: ONS, LCFS and ETB surveys, and own calculations.
Note: All indices are chained Fisher. For the Konüs indices, the reference income level is the upper bound of the 10th percentile for all households in 2006

Average annual growth rates of real household expenditure, conventional and Konüs, by household type, 2006-2015, % p.a.

Household type	Deflated by:		
	conventional price index	linear Konüs price index	quadratic Konüs price index:
1. Single adult, no children	-0.10	-0.74	-0.80
2. Single adult, with children	-1.53	-1.94	-2.11
3. Couple, no children	0.14	-0.32	-0.39
4. Couple, with children	0.40	0.01	-0.11
5. Retired	1.98	1.54	1.29

Source: ONS, LCFS and ETB surveys, and own calculations.

Conclusions

- Compared to a conventional price index, the Konüs index shows *worse* outcomes for all household types.

- Outcomes are worse on the quadratic Konüs than on the linear Konüs.

- Using the quadratic Konüs, *all* household types except the retired had *falling* living standards over 2006-2015.