

The Costs of Nations

(*in progress*)

Thomas F. Crossley¹ Serhat Ugurlu² Ingvild Almås³

¹Department of Economics, University of Essex

²Norwegian School of Economics (NHH)

³IIES Stockholm University and NHH

September 2018

- 1 The Challenge
- 2 Proposed Approach
- 3 Some Empirical Results
- 4 Conclusions

- 1 The Challenge
- 2 Proposed Approach
- 3 Some Empirical Results
- 4 Conclusions

Multilateral (Spatial) Price Comparisons

- A set of price indices that capture the difference in prices between pairs of countries or regions.
- Spatial analogue of more familiar temporal prices indices (CPI, RPI, etc.) → PPPs.
- Critical for:
 - comparing living standards and real incomes,
 - counting and locating the poor,
 - cross-country (or region) research (growth, productivity...).
- Eg. “GEKS” used by World Bank, EuroStat, recent editions of Penn World Tables.
- Note: $\frac{X_1}{X_0} = Q_1 P_1 \rightarrow \frac{X_1}{P_1} = X_0 Q_1$.

Cost of Living Index

- Start with a simpler problem.
- Consider a consumer (Tom, in America) facing prices P_T with total expenditure X_T enjoying utility u_T .
- We'd like to know "how much more or less expensive" another environment (the UK, with prices P_M) is for Tom.
- The economist's answer is the Konüs Cost of Living Index (COLI):

$$K_{TM} = \frac{c_T(P_M, U_T)}{c_T(P_T, U_T)} = \frac{c_T(P_M, U_T)}{X_T}$$

- Where the cost function $c_T(\bullet, \bullet)$ is a representation of Tom's preferences.
- This index has a welfare basis.

Problems (1)

- Suppose there are two more consumers (Martin, in the UK, and Richard, in Spain) each facing their own local prices.
- We can define additional COLIs:

$$K_{TR} = \frac{c_T(P_R, U_T)}{X_T}, K_{MT} = \frac{c_M(P_T, U_M)}{X_M}, K_{MR} = \frac{c_M(P_R, U_M)}{X_M}$$

$$K_{RT} = \frac{c_R(P_T, U_R)}{X_R}, K_{RM} = \frac{c_R(P_M, U_R)}{X_R}$$

- But, in general: $K_{TR} \neq 1/K_{RT}$, and $K_{TR} \times K_{RM} \neq K_{TM}$.
 - Not symmetric or transitive (path dependence).
 - With spatial comparisons these are desirable properties.

Problems (2)

- If we are talking about the U.S., U.K. and Spain (rather than Tom, Martin and Richard) there are many consumers in each country, with different income levels and possibly different preferences. Whose cost function are we talking about?
 - Prais (1959), Nicholson (1975).
- So we face an aggregation problem within each country.

- Existing approaches: Glni-Elteto-Koves-Szule (GEKS), Geary-Khamis (GK), Geary-Allen International Accounts (GAIA)....
- Good axiomatic properties: deliver a single set of transitive parities.
- Eg. GEKS.
 - Calculate all possible bilateral Fisher indices.
 - Collapse to single set of parities by geometric averaging.
- But welfare consistent only under strong restrictions on preferences.
 - GEKS: identical quadratic preferences.
 - GAIA: identical homothetic preferences.
 - Identical preferences *within and between* countries.

Outline

- 1 The Challenge
- 2 Proposed Approach
- 3 Some Empirical Results
- 4 Conclusions

- We take a new approach with two components:
- ① Replace the Konüs COLIs with social cost of living indices (SCOLIs) that hold *social welfare* constant.
 - Social welfare measured by a Bergson-Samuelson social welfare function $W_i(u_i^1, \dots, u_i^{N_i})$ giving the level of social welfare for country i .
 - We consider three different types of SCOLI.
 - For each type, we calculate all possible bilateral indices (between pairs of countries).
 - Preferences vary between and possibly within countries.
 - Note: *not* symmetric and transitive (proofs).

- We take a new approach with two components:
 - 1 Replace the Konüs COLIs with social cost of living indices (SCOLIs) that hold *social welfare* constant.
 - 2 Impose symmetry and transitivity on the set of bilateral SCOLIs.
- We do this in two ways.
 - Geometric averaging (as in GEKS).
 - A new proposal that holds global social welfare constant.

Advantages of this approach

- Because we explicitly aggregate, and then impose symmetry and transitivity, we can characterize:
 - the deviation from (welfare-grounded) SCOLIs necessary to obtain symmetry and transitivity
 - the deviation from symmetry and transitivity necessary to hold country social welfare constant.
- Can also think about how representative an aggregate index is of individual household experience.

SCOLI details

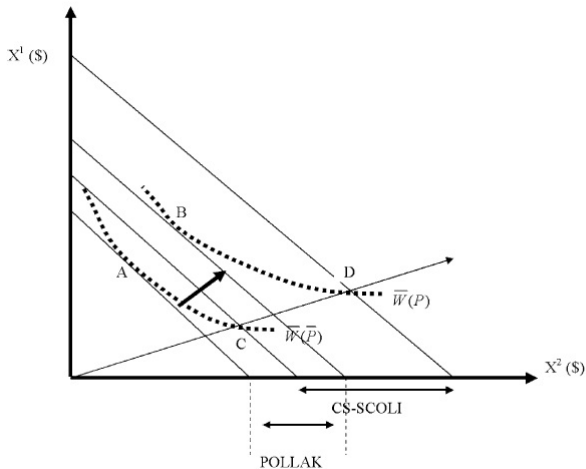


Figure 1. The CS-SCOLI and Pollak's SCOLI.

SCOLI details (2)

- The CS-SCOLI Π_{01}^{CS} solves:

$$B_0(P_0, X_0^1 \dots X_0^N) = B_0(P_1, \Pi_{01}^{CS} X_0^1 \dots \Pi_{01}^{CS} X_0^N)$$

- where $B()$ is an indirect social welfare function:
 $B_0(P_0, X_0^1 \dots X_0^N) = W_0(V_0(P_0, X_0^1, z_0^1), \dots, V_0(P_0, X_0^N, z_0^N))$,
- (and $V_0(P_0, X_0^h, z_0^h) = u_0^h$ is an indirect utility function).
- Can tune inequality aversion by choice of $W_C()$

- The constant utilities SCOLI is defined by

$$\Pi_{01}^{CU} = \frac{\sum c_0(P_1, u_0^h, z_0^h)}{\sum X_0^h} = \sum \left(\frac{X_0^h}{\sum X_0^h} \right) K_{0,1}^h$$

- can also be expressed in terms of CVs.
- SCOLIs are sometimes (exactly or approximately) weighted averages of COLIs or other price indices.
 - Note $\Pi_{01}^{CU} \leq \Pi_{01}^L$

- Geometric Averaging.
- Constant *global* social welfare.

Constant Global Social Welfare

- Define the global social welfare over country's welfare levels:

$$W_G = W_G(B_1(\mathbf{p}_1, \mathbf{x}_1), \dots, B_C(\mathbf{p}_C, \mathbf{x}_C))$$

- Let $X(\mathbf{p}_i, W^0)$ be the global total expenditure of C countries at the price vector \mathbf{p}_i and global social welfare W_G .
- For example:

$$X(\mathbf{p}_i, W_G) = \sum_{j=1}^C \sum_{h=1}^{N_j} \Pi_{j,i}^{CS} x_j^h = \sum_{j=1}^C \Pi_{j,i}^{CS} \sum_{h=1}^{N_j} x_j^h$$

where $\Pi_{j,i}^{CS}$ is the bilateral CS-SCOLI.

- The global total expenditures $X(\mathbf{p}_i, W_G)$ and $X(\mathbf{p}_j, W_G)$ achieve the same global social welfare.
- Then the Constant Global Social Welfare multilateral index is:

$$S_{j,i}^{CGW} = \frac{X(\mathbf{p}_j, W^0)}{X(\mathbf{p}_i, W^0)}$$

Outline

- 1 The Challenge
- 2 Proposed Approach
- 3 Some Empirical Results**
- 4 Conclusions

- We assume:
 - 1 A utilitarian social welfare function: $W_i(\cdot) = \sum_{h=1}^{N_i} V_i(\mathbf{p}_i, x_i^h, z_i^h)$,
 - 2 PIGLOG preferences.
- Estimate an AIDS demand system for each country.

- We use data from consumer expenditure surveys of three countries that collect household expenditures with COICOP expenditure categories.
 - Repeated cross sections.
 - 7 COICOP categories.

Table 1: Data Sets

Country	Survey	Year	Sample Size
Spain	Household Budget Survey	2006-2015	216426
US	Consumer Expenditure Survey	2009-2013	134874
UK	Living Costs and Food Survey	2008-2013	33266

- Prices are from ICP 2011, and extrapolated monthly using country-time-category specific consumer price indices.
- Prices and expenditures are matched using country-time-category.
 - All consumer from the same country interviewed at the same month/year face the same prices.
- For demand estimation, for each country, we use all available years with monthly extrapolated prices.
- Comparisons are for 2011.

Table 2: Asymmetric Bilateral Indices

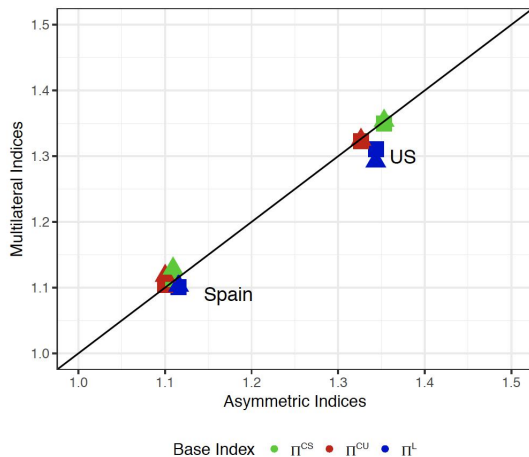
Home (h)	Foreign (f)		
	UK	US	Spain
	Aggregate Laspeyres $\Pi_{h,f}^L$		
UK	1	1.344 (0.744)	1.116 (0.896)
US	0.789 (1.268)	1	0.869 (1.151)
Spain	0.913 (1.095)	1.240 (0.806)	1
	Constant Utility $\Pi_{h,f}^{CU}$		
UK	1	1.326 (0.754)	1.100 (0.909)
US	0.759 (1.317)	1	0.853 (1.172)
Spain	0.902 (1.110)	1.226 (0.816)	1
	Common Scaling $\Pi_{h,f}^{CS}$		
UK	1	1.353 (0.739)	1.109 (0.901)
US	0.742 (1.348)	1	0.843 (1.187)
Spain	0.896 (1.116)	1.238 (0.808)	1

Table 4: Multilateral Indices

Country	$S_{h,UK}^{GEKS,L}$	$S_{h,UK}^{GEKS,CU}$	$S_{h,UK}^{GEKS,CS}$	$S_{h,UK}^{CGW,L}$	$S_{h,UK}^{CGW,CU}$	$S_{h,UK}^{CGW,CS}$
UK	1	1	1	1	1	1
US	1.310	1.323	1.349	1.292	1.325	1.354
Spain	1.101	1.104	1.113	1.103	1.118	1.129

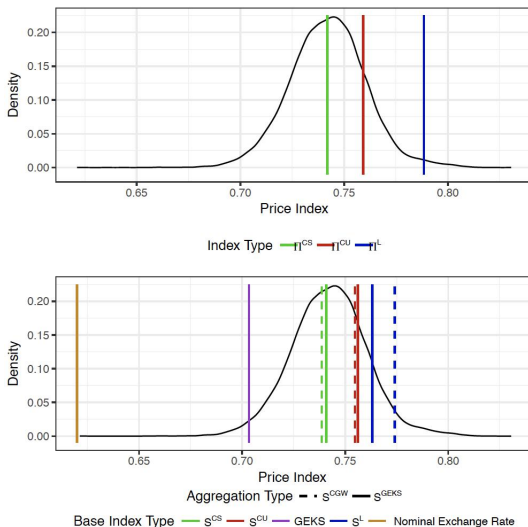
Multilateral Results

Figure 3: Deviations from Symmetry - Multilateral Indices



Aggregate Indices and Individual Household Experience

Figure 8: Individual Konüs Price Indices - Home: US, Foreign: UK, $\pi_{US,UK}^{US,K}$



Outline

- 1 The Challenge
- 2 Proposed Approach
- 3 Some Empirical Results
- 4 Conclusions

- Work to do.
 - More countries.
 - Many goods.
 - Metric for deviations from constant social welfare.
 - Are costs of transitivity truly small?
- Draft available: tfcrossley@gmail.com.
- Thanks.