Laspeyres and True-Cost-of-Food Indexes

The CPI is a fixed-weight Laspeyres type of index. A Laspeyres index can be formally defined as:

$$I_t = \Sigma P_t Q_0 / \Sigma P_0 Q_0, \quad (1)$$

with I being the index, P the component prices in the current period t and the base period 0, and Q the fixed-quantity weights in the base period, with summations taken over the components of the index category.

Food is just one component of the total CPI. The other components are housing, apparel, transportation, medical care, entertainment, personal care, and other goods and services. The food-at-home component of the CPI represents about 7 percent of the average household's expenditures. Within the food-at-home category are 16 food commodity groups. They consist of cereals, bakery products, dairy products, eggs, fresh fruit, fish, fats and oils, fresh vegetables, nonalcoholic beverages, beef, poultry, pork, other meats, processed fruit, processed vegetables, and sugar and sweeteners. Like the total index, each item is weighted by the average household expenditure in the United States. Thus, as relative food prices change among the various categories, it is assumed that the representative household allocates its food budget in the same proportion as before.

The CPI is an excellent measure of changes in the price of a fixed basket of goods and services. However, it may be a poor indicator of changes in the cost of living or the cost of food, because it ignores the fact that consumers substitute among goods and services as relative prices change and that different consumers make different substitutions.

A true-cost-of-living or food expenditure index, on the other hand, takes into account substitution as relative prices change. It specifically represents the costs or expenditures of obtaining a given level of utility (or indifference curve) under two different price regimes. It is thus a function of the two sets of prices, the preference of an individual or a household and the level of utility chosen for reference (Muellbauer, 1975). If no substitution occurs as relative prices change, then the Laspeyres and true-cost indexes will be the same. When substitution does occur, the two indexes generally will be different, although the actual outcome depends on the shape of the consumers' indifference curves and the relative prices of the goods under consideration.

In reality, the closest we are likely to approach the calculation of a true-cost index is through the estimation of a complete demand system. However, there are as many different true-cost indexes as there are functional forms for demand systems, because each true-cost index depends on the estimated parameters of the demand system. For example, true-cost indexes calculated from an Almost Ideal Demand System and a Linear Expenditure System will be different, because the estimated parameters of each system will be different.

There have been attempts to improve on the Laspeyres index by finding a true-cost index that does not require direct estimation of a complete demand system. Work by Fry and Pashardes (1989) has been useful in this regard. They have shown that the Tornqvist price index defined as:

$$\ln P(p_1, p_0, t) = \Sigma_k \, 0.5 \, (w_1 k + w_0 k) \ln (p_1 \, k / p_0 k), \quad (2)$$

where w_1 and w_0 are budget shares in the two time periods, is a true-cost index if the logarithm of the cost function underlying the demand system is quadratic in the logarithms of prices and utility. However, if budget shares tend to be rather constant over time, this index will also fail to capture the substitution effects as relative prices change. Later we will demonstrate how the estimated intercepts from Engel curves can be used to capture the substitution effects as relative prices change and how these intercepts can be substituted for the observed budget shares in the Tornqvist index.