Three kinds of monthly CPI

by Ralph Turvey

The purpose of this paper is to provide a reminder that
- different questions should elicit different answers;
- some departures from the pure Consumer Price Index concepts are inescapable,
- biased estimates are unavoidable.

All the three kinds of Consumer Price Index that are distinguished approximate some concept of the current period cost of doing what consumers did in the base period — viewed as obtaining utility, acquiring consumer goods and services or paying for consumer goods and services — with the cost in the base period.

Because current weights are not available for a monthly or quarterly index, all three are fixed-base approximations to a Fisher, Törnqvist or other such index which requires current as well as fixed base weights and would be preferable in principle.

To simplify the exposition, it is assumed that the weight reference-period and the price reference-period coincide; they are called the "base period" and the index is an estimate of a Laspeyres index.

True Cost of Living basis

The aim is to ascertain the sum of the consumers' expenditures (including imputed expenditures on utility-yielding durables) which would enable each consumer to obtain the same level of utility from consumption as in the base period, assuming unchanged preferences. This is the notion that avowedly inspires the design of the American CPI.

The approximation compares current and base period total value at market prices and at equivalent rentals of, respectively, base period acquisitions of non-durable goods and of services and base period use of durable goods. If, in practice, equivalent rentals cannot be imputed for the use of some durable goods, their acquisition will have to be included along with the acquisition of non-durable goods. For these, and for services, no distinction is made between acquisition, payment and use, for they are all more or less synchronous.

One feature of a True Cost of Living index frequently escapes attention. Suppose the index stands at 110. There has been a 10% increase in the value of consumption which would provide the same collection of goods and services that the target population consumed in the base period. Suppose, however, that the equivalent rentals of the durable goods that they used in the base period have risen by more than 10% and prices actually paid for non-durable goods and of services by less than 10%. Then a 10% increase in money expenditure would raise utility.

In other words, *a True Cost of Living index is inappropriate for determining or judging wages, pensions etc. because it covers not only the prices that the target population pays but also the imaginary prices which they are imagined to pay themselves — and people can always afford those prices!*

Acquisitions basis

The aim is to measure inflation in the markets for consumer goods and services since the base period. The relevant prices are those agreed or accepted in explicit or implicit contracts, possibly excluding indirect taxes and subsidies.

The approximation compares current and base period values of base period acquisitions of consumer goods and services through market transactions. There are choices to be made between

(i)   computing a market price index or a net price index;

(ii)   including housing acquisitions for owner occupation or excluding them. In the latter case they should be covered by a separate index or included in an Investment price index.

The distinction between market and non-market transactions, i.e. the decision what to exclude from the index because it is not part of an inflationary process, a market phenomenon, is difficult to make. My attempt to provide a definition follows:

A market determined price is the price of an item which is paid for and:

1. which, if not in totally inelastic supply, has an identifiable monetary cost of production (or, in the case of joint products, has an identifiable cost of production together with the other products);
2. which the buyer can choose whether or not to buy;
3. for which the seller endeavours to make a profit, or at least to avoid a loss, on sales plus any subsidy received and less any tax paid by him; whether or not part or all of the price is paid by someone other than the buyer (the person receiving the item) or is reimbursed to him.

Thus a rise or fall in costs will sooner or later raise or lower a market determined price, or, in the case of a rise, force the seller to go out of business. A rise or fall in demand may, but need not, raise or lower a market determined price.

But if there is a subsidy that is determined as equal to the seller's costs less a price whose amount is fixed by the provider of the subsidy, so that the subsidy (which may take the form of a government-financed deficit) is open-ended with respect to costs, then that price is not a market price; it does not respond to market forces.

Note that:
- For most market determined prices, the total amount paid by or for each buyer reflects the number of units sold to him, but as with unmetered water or an "eat as much as you want" restaurant, the item bought may be the right to consume.
- Some market determined prices may be uniform between buyers or locations even though costs are not.
- Some market determined prices may be regulated by government yet still meet the three requirements listed above.

Payments basis

The aim is to measure how much money would currently be needed to pay for a set of goods and services like those that consumers were paying for in the base period, including interest on debt incurred to finance consumption and repayments of such debt. (This is probably what laypersons may have in mind when they speak of a "cost of living index".)

Such an index compares current and base period payments not only for goods and services like those acquired during the base period, but also retrospective payments in respect of goods bought previously. *Consistency would require the inclusion of consumer credit interest and repayments,* though estimation may be difficult in practice. There is a choice to be made between including downpayments and repayments on houses, or excluding them on the grounds that they are saving rather than consumption payments, leaving only mortgage interest in the index.

A CPI is not a cohort measure

Fixed base indexes are intuitively difficult to understand, because we experience the passage of time. We are the people we were a year ago, one year older, and we belong to a cohort. Thus, where seniority partly determines wages, we can benefit from a wage that rises through time, even though a fixed-base wage index remains constant.

Similarly, from the point of view of an individual consumer, durable goods owned since the base period, though they have become older, will continue to yield utility, and payments may continue to be made in respect of goods for which payment was being made in the base period. *But such concepts relating to the experience through time of a cohort do not apply to a Consumer Price Index which is necessarily fixed-based, at least for a year at a time.* For such an index the comparison must relate to what consumers would do in the current period if both they and their durable goods had become no older. Thus if base period consumption included equivalent rent or interest payment in respect of a seven year-old house of given quality, the current equivalent rent or interest payment for a house that is currently seven years-old and of that same quality has to be estimated. The index does *not* record the change in the equivalent

rent or interest payment on a house that has now become eight years old, which is what naturally concerns its occupier.

The remainder of this paper explains why departures from the pure index concepts are unavoidable.

Unavailability

Computation of an index requires that current prices for all consumption items that were used, acquired or paid for in the base period be available in the current period. But they may not be, because:

    (i)   some items are temporarily out of stock, an outlet is temporarily closed or the prices could not be obtained;

    (ii)   some items have become seasonally unavailable;

    (iii)   some items are no longer on sale, having permanently disappeared from the market.

The appearance on the market of new goods or services, on the other hand, creates no problem, since a consumer price index relates only to goods and services that entered into base period consumption.

(i)   Missing observations

The problem here is that the price collector cannot obtain the price of a specified variety in a selected outlet.

In this case, it seems legitimate to estimate what the price would have been, since a problem relating to part of the particular sample of prices used to compute the index does not signify general unavailability.

(ii)   Seasonal items

The seasonality problem arises because the index is to be calculated using price data for only one single month, the current one, to estimate the cost of a whole year's consumption. Thus it requires a price for Christmas trees in every month, not just in December.

A solution is to use monthly weights within such expenditure groups as package holidays, fresh produce and clothing. If this be done, the set of micro indexes available to be combined into a higher-level aggregate for the group can vary from month to month.

It might be thought that the price reference period used for this purpose could be the corresponding month in the base year. But then month to month movements of the overall index would reflect not only current month to month price changes but also any price changes between the corresponding months of the price reference year as well as the change of weights. Hence the proposal (favoured, among other authors, by Balk and Baldwin[1]) to calculate relatives with respect to a weighted average of prices during the whole of the base year, thus producing the overall index:

$$\sum w_m \cdot I_{t/p} = \sum \frac{v_m I_{p/w}}{\sum v_m I_{p/w}} \cdot \frac{\hat{P}_t}{\frac{\sum_{m=1}^{m=12} X_m \hat{P}_m}{\sum_{m=1}^{m=12} X_m}}$$

where the summation is over all the micro indexes $I_{t/p}$ relating prices in the current month t to prices of the weight reference year. $v_m\, I_{p/w}$ represents values in month m of the weight reference year updated to price reference year prices, $\hat{P}_t$ is the arithmetic or geometric mean of the prices of the current month, $\hat{P}_m$ the similar mean of a price reference month, and X_m the relative quantity in a month of the price reference year. (Alternatively, the $I_{t/p}$ could be means of price relatives.) This is a Rothwell index, with preference year being a weighted average of prices in the twelve months of the reference year.

What does a month to month comparison mean with this index? Take the example of May and June. The index compares:

$$\frac{\sum p_{\text{current June}} q_{\text{weight reference June}}}{\sum \hat{p}_{\text{price reference year}} q_{\text{weight reference June}}} \quad \text{with} \quad \frac{\sum p_{\text{current May}} \phi q_{\text{weight reference May}}}{\sum \hat{p}_{\text{price reference year}} \phi q_{\text{weight reference May}}}$$

with $\phi = 1$

If May quantities would all have to be multiplied by a value of ø which might be greater or less than unity, to make May consumption as good as June consumption, the comparison will still give the same answer. This is true whatever is the true value of ø, so that value does not have to be known to make the comparison valid! It does not meet the axiomatic requirement of proportionality, (that if all current June prices are x% higher than in May, the index will rise x%) but since baskets of different composition are being compared, proportionality is not to be expected. Hence the procedure appears acceptable, and, in any case, all the alternatives seem to have greater problems.

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[1] Andrew Baldwin *Seasonal baskets in Consumer Price Indexes* Journal of Official Statistics vol.6 No. 3 1990 pp.251-273

Imputation will be necessary only when there is a change in seasonality such that an item consumed in the corresponding month of the weight reference year is not available in the current month and there are no valid current prices, although its micro index has a weight. Since the prices of seasonal products vary inversely with availability, a high price should be imputed. Would it be a reasonable, though unavoidably arbitrary convention to take 110% of the highest price observed in the preceding season updated by the movement since then in the overall CPI?

The Rothwell index requires twelve sets of monthly weights yet the necessary monthly data may not be available to compute them for all components of the overall CPI. There are two ways of dealing with this.

A.   In terms of an example, fruits could be given a constant total weight reflecting the share of fruits in annual total expenditure, with the weights of the constituent sub-indices for different kinds of fruit varying within that total, thus limiting the need for monthly weight reference year data to the seasonally available items.

B.   In section 5 of his paper, Baldwin argues (convincingly?) that for those expenditure categories where no seasonal expenditure weights are available, what should be held constant over the twelve months are not the relative weights themselves, but the value weights used for calculating those relative weights. Taking these value weights as constant at one-twelfth of their annual value in every month, they could be combined with the varying monthly value weights for seasonal items to calculate relative weights. Thus, though the value weight of, for example, dwelling rents, would be the same throughout the year, their relative weight would, ceteris paribus, be lower in months when the value weight of fruits was high. The whole CPI would thus be calculated as a Rothwell index.

Since a Rothwell index uses weighted mean prices over the price reference year, the linking of the index when reweighting takes place might be year upon year (see Baldwin section 6). The first month's index computed with a new price reference year would then be multiplied by the old annual index for that new price reference year divided by 100, to obtain its value with the original price reference year as index base.

(iii)   Disappeared Goods

My paper **Item & Outlet replacements and quality adjustment** discusses this problem It arises when an item which was bought in the base period can no longer be bought, so that its price can no longer be obtained.

Bias

Resampling locations, outlets and items when weights are changed is desirable in order to preserve the representativity of an index, but is normally done by linking in such a way that the change has no effect upon the index for the link month. *Hence the absence of bias is not guaranteed*.

Quality change

If all optional item replacements (to maintain representativity) and all forced item replacements (to replace goods that have disappeared) involved
> new, substitute items which would have been regarded by the reference population in the base period as perfect substitutes for the old items,
> or
> valuations of quality differences between the new and old items that fully reflected the preferences of the reference population in the base period,

then bias as regards the sample would be avoided. Unfortunately, even this would not guarantee absence of bias in the estimate unless sufficient and appropriate optional replacements had been made to preserve representativity.

Outlet substitution bias

Optional outlet item replacements are made to maintain representativity and forced outlet replacements are made to replace outlets that have closed. The feasibility of judging and evaluating quality differences between outlets is even less than with quality differences between items. Hence some rule of thumb has to be adopted: e.g. that any price difference fully reflects a quality difference, that half the proportional price difference reflects a quality difference, or that there is no quality difference (which is what linking implies).

Unit values and bias

Unit values may fall relative to the index for an elementary aggregate or higher-level grouping because:
(i)   There has been a shift of consumption towards items or outlets for which prices have fallen relatively. This is the "substitution effect" of economic theory;
(ii)   New, cheaper, items have come onto the market or new, cheaper outlets have opened;
(iii) Consumers and/or their preferences have changed.

The last two of these are strictly irrelevant to a base-weighted index, which estimates the current period cost of doing what consumers did in the base period. But all three would be relevant to a Fisher, Törnqvist or other such index which also took into account the base period cost of doing what consumers do in the current period! If a base-weighted index is calculated only because a Fisher, Törnqvist or other such index is not feasible, it is desirable that all three factors causing a fall in unit values should be reflected in the index. If they are not, then there is bias. But if a base-weighted index is wanted for its own sake, then failure of the index to reflect them does not indicate bias.

23.8.95