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A Geometric Price Index for the Philippines: A Preliminary Assessment[1]

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1. Introduction

Published by the National Statistics Office (NSO), the Consumer Price Index (CPI) is a measure of the average price of a standard basket of goods and services consumed by a typical Filipino family. Headline inflation, defined as the rate of change in the CPI, thus captures the changes in the cost of living based on the movements of the prices of items in the consumer basket.

One of the difficulties in estimating changes in the cost of living is that consumer spending patterns change continuously because of evolving tastes and also because of adjustments in relative prices. Over time, as prices change, consumers will tend to buy more of those goods and services for which prices are rising slower than average (and conversely, less of those goods for which prices are rising faster than average). This substitution may cause the CPI to overstate the inflation rate.

The potential upward bias in the CPI has a direct implication for the BSP, whose mandate is to maintain price stability. Such upward bias may increase over time and be affected by the business cycle. This may lead to incorrect measurement of price conditions.

This article explores the use of a geometric consumer price index for the Philippines. We use a modified version of the Tornqvist index using a geometric mean formula. The aim is to build an alternative CPI that uses a geometric mean formula at the basic level to produce an overall index that will better reflect the impact that changing prices have on the average consumer.

Section 2 presents the major price indices methodological differences between the three major price indices – Laspeyres, Paasche and the Superlative Indices. Section 3 constructs a geometric CPI for the Philippines. Section 4 concludes.

2. Types of price indices

In general, three types of price indices are used to measure price behavior – the Laspeyres (equation 1), Paasche (equation 2) and the Superlative Indices which consist of Fisher price index (equation 3) and Tornqvist (equation 4).

Laspeyres

$$CPI^{L} = \sum_{i} {}_{i}w_{0}\left(\frac{{}_{i}P_{t}}{{}_{i}P_{0}}\right) \qquad (1)$$

Paasche

$$CPI^{P} = \left[\sum_{i} {}_{i}w_{t}\left(\frac{{}_{i}P_{t}}{{}_{i}P_{0}}\right)\right]^{-1} \qquad (2)$$

Fisher

$$CPI^{F} = \sqrt{(CPI^{L})(CPI^{P})} \qquad (3)$$

Tornqvist

$$CPI^{T} = \prod_{i}\left(\frac{{}_{i}P_{t}}{{}_{i}P_{0}}\right)^{\frac{1}{2}({}_{i}w_{o}+{}_{i}w_{t})} \qquad (4)$$

[1] This article is a condensed version of Bayangos and Estigoy (forthcoming in 2010), "A Geometric Price Index for the Philippines: A Preliminary Assessment," BSP Working Paper Series No. 2010-01.

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where

$_i P_t =$ Price of item i in comparison period t

$_i P_0 =$ Price of item i in base period ***0***

$_i w_0 =$ Expenditure on item ***i*** in base period ***0***, divided by expenditures on all items in base period ***0***

$_i w_t =$ Expenditure on item ***i*** in comparison period ***t***, divided by expenditures on all items in comparison period ***t***

$\prod =$ Indicates the product operator

The Laspeyres index calculates the changes in the aggregate value of the base year's list of goods when valued at current prices. In other words, a Laspeyres index measures the difference between the theoretical cost in a given year and the actual cost in the base year of maintaining a standard of living as in the base year.

Meanwhile, a Paasche index uses a formula similar to that of the Laspeyres index. The difference is that the Paasche method uses quantity measures for the current period rather than for the base period.

The literature notes that the Laspeyres and Paasche indices tend to produce opposite extremes in index values computed using the same data.[3]

In order to resolve such limitation in the use of the Laspeyres and Paasche formulas, superlative indices were introduced (Diewert 1976, 1987).[4] There are two major indices of this type: the Fisher Ideal index and the Tornqvist index.

In its basic form, the Fisher Ideal index, uses a geometric mean by taking into account both the current year and base year prices, as in equation 5 below:

$$CPI^F = \frac{\sqrt{\sum P_1 Q_0 x \sum P_1 Q_1 x 100}}{\sqrt{\sum P_0 Q_0 \sum P_0 Q_1}} \qquad \textbf{(5)}$$

As evident in equation 5, the Fisher Ideal Index is the geometric mean of the Laspeyres and Paasche indices. Meanwhile, the Tornqvist index is the geometric average of the price relatives weighted by the average expenditure shares in two periods (equation 4).

3. Using a geometric mean formula for the Philippine CPI

3.1 Compilation of Philippine CPI data[5]

The market basket used in the construction of the CPI can be drawn either from the results of the Commodity and Outlet Survey (COS) or Interview/Survey of Key Informants.

Collection of data for the CPI is done by the NSO with assistance from the Bureau of Agricultural Statistics (BAS). BAS collects price data for agricultural commodities in the National Capital Region (NCR) and in provincial capitals where there are BAS offices while the NSO collects prices for all other commodities in all other areas.

The CPI is re-weighted every six years. The NSO uses 2000 as the base year for the CPI. The year 2000 was chosen as the base year for two major reasons: (1) it was the year that was perceived to be more politically, economically and socially stable; and (2) it was the year when the FIES which is the basis of weights was conducted. The current series also features the use of separate provincial and city market baskets.

The current CPI uses a Laspeyres formula. The formula used in computing the current CPI is the weighted arithmetic mean of price relatives, a variant of the Laspeyres formula. In computing the CPI, the formula is as follows:

[3] See Bayangos and Estigoy (forthcoming in 2010).
[4] See Steindel, Charles (1997).
[5] See Ericta and Sta. Ana (2009).

$$CPI^{P} = \sum_{i} \left[\frac{w\left(\frac{p_n}{p_0}\right)}{w} \right], \qquad \textbf{(6)}$$

where

$p_n =$ Price of an item in the current price

$p_0 =$ Price of an item in base period

$w =$ Weights

The current CPI has a fixed-weight formula. The Laspeyres formula has fixed base year period weights. The weights for the 2000-based CPI were derived from the expenditure data of the 2000 Family Income and Expenditure Survey (FIES), a nationwide survey of 41,000 households.

3.2 Statistical comparison

Using 2000 as base year, this section builds an alternative CPI series for the Philippines using a geometric mean formula based on the current Laspeyres formula. It would be ideal to consider a Paasche index, but in the absence of such index, the estimates are limited to a geometric mean formula of the current Laspeyres index.

Moreover, it would be reasonable to use the more disaggregated CPI data. However, due to data limitations, CPI data at the 3-4-digit disaggregated level are used. In addition, the Tornqvist index uses both current and previous year's weights. In the absence of current year's weights, the estimates are based on the base year's weights. This would imply that estimates may still have an upward bias (or the lower bound of the upward bias). These three factors comprise the limitations of the paper.

The formula

Equations 3 and 4 in Section 2 can be used to construct a geometric mean formula for CPI. Using cereal as an example, the geometric mean index for cereal can be computed from the Laspeyres indices for rice and corn as in equation 7 below:

$$CPI^{G}_{Cereal} = [(\ {}_{rice}P^{weight}_{current})x(\ {}_{corn}P^{weight}_{current})]^{\frac{1}{\sum weight(rice+corn)}} \qquad \textbf{(7)}$$

$$CPI^{G}_{Cereal} = [(171.37^{0.094}_{Nov2009})x(170.55^{0.009}_{Nov2009})]^{\frac{1}{0.102}}$$

$$CPI^{G}_{Cereal} = 171.29_{Nov2009}$$

The computation above shows that as of November 2009, the cereal index using geometric mean formula yields a slightly lower index of 171.29 compared to the same index of 171.30 using the Laspeyres formula.

The monthly geometric mean CPI was calculated for major commodity groups from January 1994 to December 2009 as follows:[6]

Food, beverages and tobacco
Food
Cereal and cereal products
Cereal
Non-food
Clothing
Housing and repairs
Fuel, light and water
Services
Miscellaneous goods

3.3 Comparing Philippine CPI using Laspeyres formula *(ALLCPIL)* and geometric mean formula *(ALLCPIG)*

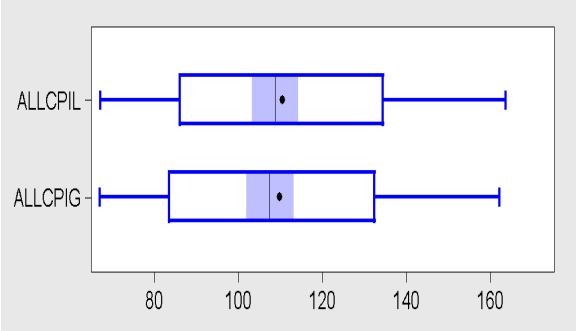
Figure 1 shows a boxplot comparing Philippine CPI using the Laspeyres formula (*ALLCPIL*) and the geometric mean formula (*ALLCPIG*).[7]

[6] This implies that the CPI weights are fixed from 1994 to 2009.

[7] A boxplot represents the basic descriptive statistics of a distribution, namely, the smallest observation (sample minimum), lower quartile, median, upper quartile, and largest observation (sample maximum). A boxplot may also indicate which observations, if any, might be considered outliers. Boxplots can be useful to display differences between populations, while the spacing between the different parts of the boxplot indicates the degree of dispersion and skewness in the data.

Figure 1 shows that both *ALLCPIL* and *ALLCPIG* are positively skewed, that is, both have relatively few high values. Both the maximum and minimum index are lower for *ALLCPIG* than those for *ALLCPIL*. In a similar manner, the mean (represented by the dot in Figure 1) and median (the vertical line in Figure 1) are relatively lower for *ALLCPIG* than *ALLCPIL*.

Figure 1: CPI: Descriptive Statistics



FULL SAMPLE 1994-2009	ALL ITEMS ALLCPIL	ALLCPIG
Observations	192	192
Mean	110.385	110.294
Median	108.600	108.616
Maximum	163.600	163.595
Minimum	67.000	66.878
Standard deviation	27.846	27.846
Skewness	0.253	0.253
Kurtosis	1.984	1.987
Sum	21,194	21,176
Sum Sq. Dev.	148,099	148,099

Although *ALLCPIG* is generally lower, a test of the equality of means between the *ALLCPIG* and *ALLCPIL* shows that both do not differ significantly in any year. In other words, both *ALLCPIG* and *ALLCPIL* are homogenous.

Indeed, tests suggest a co-integrating relationship between the logarithm of *ALLCPIL* and *ALLCPIG* from January 1994 to December 2009. Cross-correlation analysis also shows that the two series to be highly correlated over 24 months.

Boxplots for inflation rates show that *ALLIL* (inflation using the Laspeyres formula) and *ALLIG* (inflation using the geometric mean formula) are both normally distributed. However, a test for the equality of means shows that *ALLIG* and *ALLIL* are homogenous.

The average inflation (mean) is also relatively lower for *ALLIG* compared to that for *ALLIL*, suggesting that the latter may have a positive bias. In particular, the mean difference between the two series averaged 0.1 percentage point from January 1994 to December 2009. This finding is comparable to the Bureau of Labor Statistics (BLS) estimate for the United States.

Tests also indicate a co-integrating relationship between *ALLIL* and *ALLIG*. In addition, the two series are highly correlated up to seven months.

4. Conclusion

The preliminary estimates in Section 3 seem to indicate that there is a bias in the current official CPI measure based on comparisons with a geometric CPI, and that this bias tends to be positive. The difference may turn out to be larger if substitution effects are fully accounted for.

This finding implies that there is scope for the use of a geometric CPI in the Philippines to account for the impact of substitution effects in price data. The feasibility of adopting a geometric formula for the CPI deserves further study by statistical authorities. Periodic review and evaluation of price statistics will help to ensure that they reflect accurately the changing conditions in the economy.

It is important to note, however, that no measure of prices and inflation is perfect. Statistical agencies thus need to regularly assess whether their data properly reflect dynamic changes in the economy. For their part, policymakers need to be aware of the uncertainty inherent in assessing the conditions in the economy and rely on as wide a range of information as possible.

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