Comparing market basket changes and the CPI

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Consumer expenditures on specific items vary widely over time, consumers tend to maintain a pattern of expenditures for much longer time periods. The market basket of goods and services that make up the Consumer Price Index (CPI) is divided into seven major groups, such as food and beverages or housing. The pattern of consumer expenditures at this level changes more slowly than the components within a group.

A Consumer Price Index is one of the most widely used economic indicators. It is a measure of the average change in the prices paid, in the United States, by urban consumers for a fixed market basket of goods and services. Knowing that consumers are constantly offered new items to include in their market basket, how do changing market baskets influence the CPI? The answer is not unambiguous and depends on the importance of the change in terms of total expenditures by consumers.

When the price of a commodity goes up or down it is usual to expect consumption of that commodity to go down or up, respectively, as a result. In fact, most of us frequently make such choices every time we go the supermarket. Price indexes are produced to provide government, business, and individuals a measure to compare prices over time and make informed decisions on economic behavior. Many believe changes in the Consumer Price Index reflects changes in their standard of living. Because the CPI is a modified Laspeyres index and keeps quantities fixed between revisions, it is a measure of price change not a true Cost of Living Index.

The base period expenditure weights for the 1987 CPI revision relied on the 1982, 1983 and 1984 Survey of Consumer Expenditures (CE) and the 1980 Census of Population. While there were many improvements to sampling techniques, data collection, processing, and estimation associated with the 1987 revision, it also introduced a "rolling in" process for new areas replacing discontinued areas.

The BLS sponsors the Continuing Point of Purchase Survey (CPOPS) annually to provide an outlet frame to select outlets in which to price items for the CPI. This survey is used in combination with the now ongoing Consumer Expenditure Survey to select items and outlets in approximately one-fifth of the geographic areas (defined by the Bureau of the Census for the Current Population Survey) included in the CPI each year. Since the 1987 revision, two years of the most recent Consumer Expenditure Survey data are used in selecting items being rotated each year (Marcoot, 1985). New items and outlets selected for the 1994 CPOPS were based on the 1992 and 1993 Consumer Expenditure Survey data. Thus, new items and new outlets are being introduced in twenty percent of the pricing areas annually. The entry level item reselection has gradually changed the composition of the entry level items being priced.

Market baskets and price change

Prior to 1945 the CPI was called a "cost of living" index. Since then the BLS has more correctly named it the Consumer Price Index. Because the Consumer Price Index is weighted by consumer expenditures in a previous time period and uses a fixed market basket of goods and services, it represents a ratio of the prices in subsequent time periods to that of the base period. The CPI is a measure of price change based on a sample of prices of food, apparel, housing, transportation, medical care, entertainment and other goods and services. It does not include many consumer outlays, for example, income taxes, charitable contributions, personal insurance, pensions or investments.

A true Cost of Living index (CLI) is a ratio of the minimum expenditure required to attain a particular level of satisfaction in two price situations; it attempts to measure the price change associated with a constant standard of living. A Laspeyres index is identical to a cost of living index if the consumer preferences do not permit substitution, and goods and services are purchased in the same proportion over time. The CPI is estimated using a fixed market basket to hold the base-period consumption patterns fixed. It is calculated by using a modified Laspeyres price index formula which measures the ratio of the costs of purchasing a basket of items of constant quality and constant quantity in two different time periods. As we noted above the current CPI uses the 1982-84 expenditure weights from the Consumer Expenditure Survey but they are updated for price change from the midpoint of the base period to the introduction of the new weights in 1987; hence, it uses a modified Laspeyres formula.

The Laspeyres price index formula requires the expenditure base (quantity) and reference periods to coincide.

To calculate the CPI an estimate of the expenditure pattern is needed to define and weight the market basket of goods and services for which the index is computed. Each expenditure-population weight is the product of estimates of mean expenditures per consumer unit derived from the 1982-84 Consumer Expenditure Survey and estimates of the number of consumer units obtained from the 1980 census files. Mean expenditures are calculated using preliminary expenditures and their relative importance, composite estimated and raked to minimize the average mean square error of the relative importance of the total weight for the index.

Two important factors to consider in using a consumer price index are the formula used to calculate it and the commodities and services included. As we noted before, the CPI uses a modified Laspeyres index formula. It measures the ratio of the cost of purchasing a basket of items of constant quality and constant quantity in one period to the corresponding cost in another period. The CPI revises the quantities of items consumed in its basket of goods and services approximately every ten years.

The Laspeyres formula is known to represent an upper bound to a true cost of living index. This occurs because the fixed quantity (base period relative importances) does not allow for substitution of goods as prices change. Our common experience tells us that consumers are likely to purchase more quantities of items when their prices go down and fewer quantities when their prices go up. This implies that consumers attempt to maximize the utility of purchases. Economic literature refers to this as the substitution effect as individuals move along an indifference curve purchasing more as the price falls; and the income effect which allows individuals to purchase more as the price goes down (raising the individual's purchasing power) and thereby move to a higher indifference curve. In the CPI the relative importance of items at the base period is held constant and multiplied by the ratio of price change. When prices of a group of items goes up faster than average, the CPI continues to give the same importance to this group even as consumers shift to lower cost substitutes. Under this condition we can understand how the CPI may overstate the price experience of individual consumers.

There have been several attempts to quantify the difference between a cost-of-living index and the CPI. Much of the recent literature on index theory has focused on eliminating or measuring bias or how to account for quality changes- defining a true cost of living index.

For the most part consumer price indexes attempt to measure how much more it would cost to purchase a set of goods at a point in time compared to some specified base period. It shows how prices of a fixed basket of goods and services change over time. Other studies have found that the amount of the substitution effect amounted to an average annual rate of 0.1 to 0.2 percent per year. (Braithwait, 1980) (Marilyn E. Manser and Richard J. McDonald 1988) (Aizcorbe and Jackman, 1993)

Effects of updated market baskets on the CPI

For this study we began five years after the 1982-84 current CPI base period, and created alternative indexes for each subsequent three-year period using Consumer Expenditure data from 1987 to 1993 (e.g., the base period for Alternative index A uses CE data from 1987-89; Alternative index B uses CE data from 1988-90; etc.). The CPI uses three years of consumption expenditures to smooth out the variability associated with any one or two years of data. These alternative indexes are used to compare potential effects of changes in consumption patterns with the current CPI. The effects of market basket changes are compared in five overlapping periods.

Table 1 below shows the relative importances based on CE data for the seven major groups of the CPI and a few selected other categories for each of the alternative index periods. Relative importance refers to the ratio of expenditure of an item or a group of items to the total expenditures for all items. The patterns of expenditures at major group levels are quite similar over these time periods.

When we compare relative importances of consumer expenditures from the official CPI base period to those of the Alternative indexes, we see more similarities among the five alternative periods (which begin five years from the base period of the current CPI) than any one with the base period of the current CPI. To capture these movements argues in favor of using more recent expenditure data to represent spending patterns in calculating a price index. We should not negate the importance in selecting a base period that minimizes the impact of short-term economic conditions on consumption patterns. For example, during the alternative index

Table 1. CE Relative Importances for three year averages compared to the base period expenditures used for the official CPI

	Official CPI	Alternative Index periods (Expenditure weight base periods)				
	1982-84	(1987-89)	(1988-90)	(1989-91)	(1990-92)	(1991-93)
		A	B	C	D	E
Food and beverages	17.910	16.501	16.506	16.603	16.565	16.460
Food at home	10.196	9.136	9.210	9.520	9.698	9.895
Food away from home	7.714	6.150	6.138	5.954	5.746	5.514
Housing	42.087	42.548	42.639	42.801	43.26	43.341
Apparel and upkeep	6.518	6.537	6.516	6.620	6.552	6.432
Transportation	18.874	19.221	18.875	18.182	17.708	17.687
New vehicles	5.517	6.225	5.865	5.263	4.988	4.991
Motor fuel	4.847	3.491	3.506	3.338	3.200	3.093
Medical care	5.031	5.198	5.425	5.570	5.709	5.908
Entertainment	4.461	4.759	4.761	4.814	4.773	4.781
Other goods and services	5.119	5.229	5.280	5.412	5.433	5.389

period E (1991-93) food and beverages, apparel and upkeep, and transportation, are smaller portions of all expenditures than in the official CPI while housing, medical care, entertainment, and other goods and services represents larger portions of total expenditures. The relative importance of food away from home in Alternative E is lower than for any other base period in Table 1. The portion of consumer expenditures for food away from home was highest during the period of the late 1980's.

The Alternative indexes were updated for price change to December of each subsequent year using the price ratios from the official CPI (see Table 2). These indexes were calculated at lower-level aggregations using the new weights based on the more recent consumption patterns. There are 207 item strata or classes of similar items used to sample and calculate the CPI. There are 365 even lower level item categories where specific items to price for the CPI are selected. We are not able to discern the market

Table 2. Relative importances of major groups using Alternative indexes updated to December 1994.

	Official CPI	Alternative Indexes (Expenditure weight base period)				
	1982-84	(1987-89)	(1988-90)	(1989-91)	(1990-92)	(1991-93)
		A	B	C	D	E
Food and beverages	17.412	16.397	16.188	16.181	16.126	16.419
Food at home	9.934	9.255	9.093	9.309	9.466	10.004
Food away from home	5.904	5.909	5.911	5.720	5.579	5.406
Housing	41.187	41.194	41.814	42.071	42.815	42.834
Apparel and upkeep	5.656	5.938	6.026	6.104	6.138	6.000
Transportation	17.139	19.193	18.589	18.408	17.979	18.076
New vehicles	5.059	5.988	5.788	5.342	5.073	5.091
Motor fuel	3.106	3.418	3.055	3.087	2.910	2.831
Medical care	7.266	6.484	6.677	6.479	6.344	6.287
Entertainment	4.335	4.684	4.692	4.761	4.727	4.743
Other goods and services	7.005	6.111	6.013	5.996	5.870	5.640

basket substitutions within an item stratum (e.g., the substitutions that occur between Coke and Pepsi based on price change since both are contained in the same item stratum; additionally, lower-fat cookies for more traditionally prepared cookies).

But, we can observe the market basket changes in the major groups such as Food and beverages or more specifically, food at home and food away from home. The relative importance of Food and beverages in each of the five three-year periods is less than in the base period for the current CPI. The relative share of food away from home as a portion of total expenditures in the CPI as of December 1994 is lowest using the expenditure weights based in 1991-93 updated for price change. The food at home share was highest during the same period as compared to any other period. The reverse is true for Alternative B. Space limitations prevent further discussion here, more details are available from the author.

Table 3 presents the relative differences between the published U.S. All Items CPI for Urban Consumers (CPI-U) and each of the alternative indexes. It begins with the last 12 months of the base period for each alternative index and includes each 12 month period following that up to December, 1994. This difference reflects the change in consumer purchasing patterns in response to price changes and all the other factors associated with individual economic decisions. It is the percentage difference in the index values between the published CPI and an alternative index for a common timespan. Therefore, the first column shows how much lower the CPI could be if the alternative index with more recent weights were in place during the last 12 months of the base period. The results of the last two alternative index periods are especially interesting because of the small amount of the difference. The last column (6) in Table 3 shows how much lower the official CPI could be (-0.734 of 1 percent lower in 1994) if consumer expenditure patterns from 1987-89 (Alternative A) were used.

Table 3. Percentage differences between the CPI and alternative indexes with more current base periods[1], 1989-94

Cumulative from the midpoint of the base period to:

Alternative Index	Last 12 months of base period[2] (column 1)	12 months from end of base period (column 2)	24 months from end of base period (column 3)	36 months from end of base period (column 4)	48 months from end of base period (column 5)	60 months from end of base period (column 6)
Alternative A	- .169	- .353	- .513	- .748	- .809	- .734
Alternative B	- .147	- .360	- .437	- .544	- .498	
Alternative C	- .144	- .366	- .446	- .347		
Alternative D	- .065	- .187	- .272			
Alternative E	- .067	- .187				

[1] Alternative A, (1987-89 CE data updated for price change); Alternative B, (1988-90 CE data updated for price change); Alternative C, (1989-91 CE data updated for price change); Alternative D, (1990-92 CE data updated for price change); Alternative E, (1991-93 CE data updated for price change).
[2] The difference from the midpoint of the base period to the end of the base period (an 18-month period) was .243 for Alternative A, .186 for alternative B, .283 for Alternative C, .096 for Alternative D, and .096 for Alternative E.

Braithwait pointed out (Braithwait, p. 74) that "it is clear that the size of the bias (difference) depends on the extent of relative price change and the amount of commodity substitution". The annual increase in the official CPI-U was 3.1 or lower from 1991 to 1994. This was the first time since the first half of the 1960s this occurred in 4 consecutive years. Coincidentally, it appears that the amount of market basket changes were lower not only in Alternative D and Alternative E for both the last 12 months of the base period (.065 and .067, respectively), but additionally, lower in the first 12 months from the end of the base period

(column 2) than previous periods (.187 for both) adjusted for price change.

The Consumer Price Index is used as a measure of price change. The difference between the index level from one time period to another is calculated to yield a percent change. Table 4 below shows the 12-month percent changes in the CPI All Items and each of the Alternative indexes for the years 1989 to 1994. The price change is calculated to one decimal point because the CPI is published at that level. The 12-month percent change for Alternative A and Alternative C, shown in Table 4, would be 0.1 percent higher than that of the official CPI in December, 1994. While Alternative D and E would be 0.1 percent lower than that of the official CPI in December, 1994.

Table 4. CPI All Items and Alternative indexes[1], 12-month percent changes, 1989-94

	1989 (column 1)	1990 (column 2)	1991 (column 3)	1992 (column 4)	1993 (column 5)	1994 (column 6)
Official CPI (1982-84)	4.6	6.1	3.1	2.9	2.7	2.7
Alternative A	4.5	6.0	2.9	2.7	2.7	2.8
Alternative B	-	6.2	2.9	2.8	2.7	2.7
Alternative C	-	-	3.0	2.8	2.7	2.8
Alternative D	-	-	-	3.1	2.7	2.6
Alternative E	-	-	-	-	2.7	2.6

1 Alternative A, (1987-89 CE data updated for price change); Alternative B, (1988-90 CE data updated for price change); Alternative C, (1989-91 CE data updated for price change); Alternative D, (1990-92 CE data updated for price change); Alternative E, (1991-93 CE data updated for price change).

As you can see, one could assert that the alternative indexes do yield lower percent changes, but not always. We are not able to anticipate what to expect next. In the first four alternative indexes one 12-month period was 0.1 (3 times) or 0.2 (once) percentage point higher than the official CPI. In 1993 each of the alternative indexes showed a 12-month percent change equal to that in the official CPI, not higher and not lower. The estimates of change from the CPI and the alternative indexes are subject to sampling error, thus, the differences in Table 4 are not necessarily statistically significant. Research done by Sylvia Leaver and Rick Valliant found that the CPI estimates of 12-month price change had standard errors of about .144 index points during the period 1987-91 (Leaver and Valliant, 1995, Table 28.1). Assuming a high correlation between the CPI and an alternative index, the differences in Table 4 would have to be greater than .1 to be statistically significant.

Conclusion

Earlier we mentioned that consumer behavior is sensitive to a number of factors other than price movement. (Much of this discussion is omitted here because of space limitations) Because the alternative indexes are built on different time periods the relative importance of items during each time period is influenced by all of these factors. This study has focused on how alternative weighted indexes updated for price change would differ from the official CPI and influence substitutions in the consumer market basket. We have attempted to address the question we asked at the beginning, which is: How do changing market baskets influence the CPI.

From this analysis we can state that substitutions in the market basket are less of an influence during periods of lower rates of inflation, as noted in the most recent periods. Taking the cumulative percentage difference between the official CPI and Alternative A (the longest period) in this study and dividing it by the number of years studied, we find the average annual amount of percentage difference in the updated market basket would be 0.15 index point lower than the official CPI. This is consistent with the studies mentioned earlier including Braithwait's estimate of the difference,

approximately one-tenth of one percent per year (Brathwaite, 1980).

During the course of this century, the Consumer Price Index has been continually revised, expanded and improved. New consumption patterns based on more recent Consumer Expenditure Surveys have been introduced approximately every ten years over several decades. The Bureau of Labor Statistics is currently developing some test indexes using a geometric mean of the price changes to calculate a consumer price index. This method of calculation is believed by some to combine the positive points of both the Laspeyres and the superlative indexes. It is thought that a geometric mean index would more closely resemble the superlative indexes without the necessity of providing current weights for consumer expenditures.

"The increasingly significant role that index numbers have been assuming in business planning and in the formulation of executive decisions not only puts a tremendous burden on the statisticians who are responsible for their construction, but it also presents the businessman who uses them with the responsibility of using them intelligently in full awareness of what, through their strength, they show and, through their inherent weaknesses and limitations, they fail to show" (Freund, 1962).

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