Expenditure Weight Updates and Measured Inflation

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Abstract: This paper considers whether the use of more recent expenditure weights reduces estimates of year-to-year changes in the all-items Consumer Price Index (CPI). The issue is addressed using three sources of evidence. The first two are "overlap" indexes computed for six months following each of the last three CPI revisions, and annual inflation estimates using alternative three-year expenditure base periods and compared to the official CPI. The third, and richest, source of evidence comes from two databases containing Laspeyres index series for the years 1984 through 1995 using one-year expenditure base periods ranging from 1982 to 1994.

Taken together, the results show no conclusive evidence of a consistent relationship between estimated price change and the age of the expenditure weights upon which the estimates are based. One cannot say with certainty that substitution bias increases over time with the age of the market basket, or predict with confidence that more frequent market basket updates would reduce the rate of growth of the CPI.

Notwithstanding the above conclusion, it does appear that the 1982-84 expenditure patterns underlying the current official CPI have produced consistently higher measured inflation rates than those generated using later expenditure base periods. For example, one can conclude that had the CPI market basket been updated in 1991 using 1987-89 expenditure data, measured inflation would have been lower by approximately 0.1 percentage points annually during the 1991-95 period.

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This paper summarizes evidence on how the use of more recent expenditure weights affects estimates of year-to-year changes in the all-items Consumer Price Index (CPI).
The fundamental issue of interest is whether estimated inflation is lower when more recent expenditure weights are employed. This will tend to occur, for example, if

(i) consumers substitute toward goods and services whose relative prices have fallen, so that the more recent expenditure shares for these goods and services are larger than the earlier weights updated for price change, and

(ii) these same goods and services continue to experience relatively low inflation during the period under study.

Since goods and services that have exhibited unusually high inflation rates in the past may not continue to do so, using more recent expenditure weights does not necessarily reduce substitution bias. Superlative indexes account for substitution among item strata by combining both base-period and ending-period expenditure weights, not by using more recent base periods.

This issue is addressed using three sources of evidence:

- "Overlap" indexes computed for six months following each of the last three CPI revisions. Following two of these revisions, the revised CPI rose less rapidly than the overlap series based on earlier weights. The reverse was true following the 1978 revision, although this may be related to the introduction of probability sampling as part of the revision.

- Alternative CPI series computed using updated three-year expenditure base periods and compared to the official CPI, as reported by Mary Lynn Schmidt (1995). The analysis shows that the official CPI rose slightly faster, on average, than the indexes with more current weights.

- Alternative CPI series computed using various one-year expenditure base periods, updated from the Laspeyres index results reported by Ana Aizcorbe, Rob Cage, and Patrick Jackman (1993, 1996). The evidence from these data is very mixed. Indexes computed using expenditure shares from the years 1982 through 1984 or 1985 generally yield distinctively high inflation estimates. Aside from these base periods, however, the age of the market basket has little or no empirical relationship to measured price change.

The three above sources of evidence taken together are consistent with prior BLS estimates that measured annual inflation will likely be reduced by 0.1 or 0.2 percent per year when the expenditure weights are updated in 1998. Recent measured annual inflation might have been 0.1 percent or more lower had the CPI market basket been updated in 1992 (i.e., after five years). By contrast, based on the evidence presented here one cannot say definitively that substitution bias increases over time with the age of the market basket or that increasing the frequency of market basket updates would reduce the long-run growth of the CPI.

Numerous caveats are in order. One is that a revision is accompanied not only by changes in expenditure weights but also by new item and area stratification, re-initiation of outlet samples, and other changes. These changes are reflected in the overlap indexes but not in the other comparisons reported here. Also, this memorandum compares measured rates of change in the all-items index only over specific historical periods. In particular, the late 1980s and early 1990s have been characterized by low and stable inflation relative to some earlier periods, and the results for these years may not generalize to all inflation regimes.

The effect of market basket updates may also be sensitive to changes in the way individual stratum indexes are constructed. For example, later base periods yield higher relative importances for the Information Processing Equipment item stratum, which includes computers. If the CPI price index for this item stratum had fallen as rapidly as some alternative computer price indexes, it is likely that the relative importances and the all-items indexes corresponding to different base periods would have diverged more markedly.

Discussion of the three analyses follows below.

1. Overlap indexes

Following each of the last three CPI revisions - in 1964, 1978, and 1987 - the BLS produced an alternative CPI based on the old expenditure weights for an overlap period of six months. Table 1 compares the annual rate of change computed over each overlap period.

The evidence from these comparisons is somewhat mixed. In the first six months of 1964, the CPI based on the 1960-61 expenditure weights rose at an annualized rate of 0.7 percent, compared to 1.1 percent for the index based on the older 1950 weights. In 1987, for both the CPI-U and CPI-W, the annual rate of increase was 0.8 percentage points lower using the 1982-84 weights than using the older 1972-73 weights. In 1978, however, the newer 1972-73 expenditure weights yielded a higher rate of increase, 10.1 percent compared to 9.9 percent using the 1960-61 weights.

The 1973 “oil crisis,” and consumer substitution in response, certainly had an important influence on the 1972-73 weights and on the impact of their introduction in 1978. The anomalous nature of the 1978 results, however, may be due largely to a fundamental change in BLS procedures, namely the simultaneous introduction of probability sampling and initiation of outlets in all strata. BLS research on formula bias indicates that this would raise measured inflation in the new index immediately following the revision.

2. Alternative three-year base periods

Table 2, taken from Schmidt (1995) compares annual December-to-December changes in the official CPI-U, based on 1982-84 expenditure weights, to changes in fixed-base Laspeyres indexes computed using alternative (and overlapping) three-year base periods. The alternative indexes are computed using national CPI indexes for each of the 207 CPI item strata. The table deletes results for the years immediately following the base period, on the assumption that expenditure weights could not be introduced that quickly.

Reading down a column, one can view the effect of using successively more current weighting information. For example, the official CPI rose 2.9 percent during 1992. Using 1987-89 expenditure patterns as weights, the estimated price change for 1992 is only 2.7 percent. The most current, 1988-90 weights yield an estimated price increase of 2.8 percent.

Table 2 shows no monotonic or definitive relationship between weight "currency" and estimated price increase. Nevertheless, there is some evidence of an effect. In each year except 1993, the official CPI, with the oldest weights, shows a larger inflation estimate than is obtained using the most recent weights.

3. Alternative one-year base periods

Since November 1996, two separate Aizcorbe-Cage-Jackman databases have been available for the construction and analysis of Laspeyres, Paasche, geometric mean, and superlative (Fisher Ideal and Törnqvist) indexes.

The newer database includes all CPI area and item strata, for the period December 1986 through December 1995, and for expenditure base periods from 1986 through 1995. Table 3, based on these data, has the same form as Table 2. The results are changes in annual-average levels of fixed-base Laspeyres indexes beginning in 1988.[2] In Table 3, the expenditure bases are single years rather than overlapping three-year periods. Also, the indexes are constructed from the individual CPI area-item strata indexes rather than the 207 national item strata indexes used for Table 2. Along the diagonal of the table, in bold type, are the superlative Chain Fisher Ideal estimates for each year.

Table 3 shows that the superlative Chain Fisher Ideal index changes are consistently lower than the Laspeyres inflation estimates. There is little evidence, however, that more current base weights yield smaller Laspeyres estimates of price change. In 1995, for example, the Laspeyres estimates of price change using nine different base years range only between 2.73 and 2.77 percent, whereas the Fisher Ideal estimate based on 1994 and 1995 weights is 2.62 percent. In 1992, the variation among the Laspeyres index changes is wider, but the 2.88 percent using the most recent base period, 1991, exceeds the 2.84 percent using an 1986 base. Both exceed the

[2] 1987 is excluded because annual average stratum indexes are not available for 1986.

2.74 percent superlative estimate.[3] Only 1989 demonstrates the clear relationship consistent with the "conventional wisdom."

Table 4 presents the same breakdown as Table 3, except that the index percentage changes are replaced by percentage deviations from the Chain Fisher Ideal estimates for the respective years. Thus, for example, the superlative estimate of price change in 1990 is 4.97 percent, and the estimate using 1986 weights is 5.16 percent, yielding a 0.18 percent deviation (1.0516/1.0497=1.0018).[4] Table 4 permits the same "vertical" comparison as in Table 3 of whether more recent expenditure weights yield lower inflation estimates in a given year. In addition, reading horizontally, one can examine whether the Laspeyres overstatement of inflation increases as the expenditure base period becomes less current. For example, using the 1986 expenditure base, the deviation from the Fisher Ideal estimate is 0.14 percent in 1988, peaks at 0.23 percent in 1989, but then falls to 0.13 percent in 1995. Viewing the rows of the table this way, one concludes that the upper-level substitution bias in a Laspeyres index varies from year to year, but without necessarily increasing between weight revisions.

In an attempt to summarize the information contained in these results, equation (1) below presents coefficients and t-statistics from a regression of the Table 4 relationship between substitution bias and the age of the Laspeyres market basket. The dependent variable in the regression is the percentage differential between Chain Fisher Ideal and fixed-base Laspeyres estimates. The only independent variable in the regression is the age of the market basket: for example, AGE equals 6 in 1992 when 1986 weights are used for the Laspeyres index. The sample size consists of the 44 values displayed in Table 4. The highly significant regression constant indicates that the Laspeyres annual inflation estimates exceed the Fisher Ideal by 0.139 percent on average. The coefficient on AGE, however, is small and statistically insignificant, and the negative sign is inconsistent with the usually assumed relationship.

$$\text{(1)} \quad \text{DIFFERENTIAL} = \underset{(13.8)}{0.139} - \underset{(-1.0)}{.002}\ \text{AGE}$$

The second Aizcorbe-Cage-Jackman database is an updated version of that used to obtain previously reported results.[5] This database yields indexes for the period December 1982 through December 1995, and for expenditure base periods from 1982 through 1995. It excludes, however, a small number of item and area strata due to the geographic and item classification changes made during the 1987 CPI Revision. Tables 5 and 6 report the index results from this database, in the same formats used in Tables 3 and 4.

[3] To facilitate comparisons among estimates, the table displays percentage inflation estimates to two decimal places. This should not be taken as an indication of the precision of the estimates.

[4] At the low rates of inflation observed during the 1980's and 1990's, this computation is virtually identical to subtracting the superlative from the Laspeyres inflation estimate.

[5] See Aizcorbe-Cage-Jackman (1993, 1996). The results here also incorporate correction of an error in the earlier reported results.

Reading down the columns in Table 5, there is much more indication than in Table 3 that more current base weights yield smaller Laspeyres estimates of price change. In most cases, the changes in inflation estimates do not fall monotonically as one moves down the columns, but the 1982-base estimates are usually among the highest in each column. They equal or exceed the estimates using the most recent base period in eight of 11 years. Table 5 suggests that the expenditure patterns for years 1982 through 1984 or 1985 have a common characteristic that yields higher indexes than do later years' expenditure patterns. On the other hand, Table 6 is consistent with Table 4 in showing no convincing evidence that for a given expenditure base period, the substitution bias grows over time.

If the Table 6 data on the differential between Laspeyres and Fisher Ideal index changes are regressed on market basket age, using only the base period-index year observations corresponding to those used in equation 1, there is again only a negative and insignificant coefficient on AGE. If all 90 values from Table 6 are included, however, the estimated relationship is positive and significant, as shown in equation (2) below.

(2) DIFFERENTIAL = 0.100 + .008 AGE
(6.8) (3.2)

These estimated coefficients, both statistically significant, indicate that substitution bias averages about 0.1 percentage points plus another 0.008 percentage points for each year of AGE. These coefficients would imply that updating the CPI market basket by 11 years, as will occur in 1998, would lower estimated inflation by slightly less than 0.1 percentage points. A five-year update would have about a 0.04 percentage-point effect—that is, as compared to updating the market basket every ten years, updating every five years would reduce estimated inflation by 0.04 percentage points in each of the sixth through the tenth years of each cycle.

The above results have addressed the general question about market basket age and estimated inflation. Instead, one can ask a specific question about the impact on the CPI had weights been updated more often. Table 7 uses the data in Table 5 to focus specifically on the 1982-84 weights used in the current official CPI. The table compares inflation estimates obtained using the 1982, 1983, and 1984 weights with those that were yielded by weights from the 1987-89 period (i.e., the weights that would have been used had the CPI been revised in 1992 after five years). For the five-year 1991-95 period, the average measured inflation rates were 3.10, 3.15, and 3.15 percent using 1982, 1983, and 1984 weights, respectively. The average of these estimates is 3.13 percent, compared to the average 3.02 percent for the three years 1987-89.[6] The panel labeled "Differences" shows that 1987 weights yielded, on average, 0.10 percentage points lower measured inflation than 1982 weights, slightly lower than the 0.11 percentage-point differences between the 1988 and 1983, or the 1989 and 1984, estimates.

[6] Table 7 also includes the official CPI-U all-items inflation estimates, which are close to those obtained from the individual base years.

This comparison would imply that updating the CPI base period expenditure weights by five years would reduce measured inflation by about a tenth of a percentage point per year. On the other hand, the table also indicates that this difference varies widely from year to year - the average effect in the last row of Table 5 varies from 0.05 in 1994 to 0.20 in 1991. Also, as noted in the discussion of Table 3, the base-year effects are not monotonic; for example, the estimated inflation rate in the last column of Table 5 is higher using 1984 than 1982 weights, and higher using 1989 than 1987 weights. Comparing only the 1989 and 1982 base periods, for example, one would estimate that updating the expenditure weights by seven years would lower estimated inflation by only 0.07 percentage points (3.10 vs. 3.03) on average.

The contrasts between Tables 4 and 6, and between equations (1) and (2), largely result from the distinctive behavior of the indexes with base years 1982 through 1984 or 1985. Examination of the spending distributions during this period relative to other base years indicated that no particular index component (such as energy or high-tech consumer goods) accounted for most of the differences. One potential explanation could be the incorporation of the 1980 Census-based geographic sample in the Consumer Expenditure Survey in 1986. This included the substitution of whole new urban area samples within the area-size class strata (such as medium-sized South cities), as well as revised definitions of some self-representing cities (for example, the inclusion of Riverside, San Bernardino, and Ventura Counties in the Los Angeles, California, index area). The difference in geographic samples represents, in effect, a “component of variance” in the Table 6 results, and it is reasonable to expect that it could help to explain why pre-1986 base years might yield distinctively lower or (in this case) higher inflation estimates.

Based on all these results, we can conclude that had the CPI market basket been updated in 1991 using 1987-89 expenditure data, measured inflation would have been lower by approximately 0.1 percentage points annually during the 1991-95 period. This result cannot easily be generalized, however. There is no definitive evidence that substitution bias increases over time with the age of the market basket. Moreover, among Laspeyres indexes using base periods later than 1985, there is little evidence of a relationship between market basket age and measured inflation in any given year.

References

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Table 1. Annual Growth Rates of Official CPI and Overlap Index

First Six Months of	Old Weights	New Weights	Difference
1964	1.1	0.7	0.4
1978	9.9	10.1	-0.2
1987 (CPI-W)	6.5	5.7	0.8
1987 (CPI-U)	6.3	5.5	0.8

Table 2. All-Items Indexes with Alternative Three-Year Base Periods, December-to-December Percentage Increase

Base Period	1991	1992	1993	1994
1982-84 (Official CPI)	3.1	2.9	2.7	2.7
1987-89	2.9	2.7	2.7	2.8
1988-90		2.8	2.7	2.7
1989-91			2.7	2.8
1990-92				2.6

Table 3. Annual-average Laspeyres and Fisher Ideal Estimates of Inflation Expanded Aizcorbe-Jackman Sample

Base Year	1988	1989	1990	1991	1992	1993	1994	1995
1986	3.98	4.69	5.16	3.93	2.84	2.80	2.58	2.75
1987	3.98	4.64	5.11	3.95	2.83	2.80	2.57	2.75
1988	**3.84**	4.56	5.09	3.95	2.87	2.84	2.61	2.77
1989		**4.45**	5.12	3.95	2.94	2.79	2.60	2.75
1990			**4.97**	3.92	2.88	2.81	2.51	2.74
1991				**3.78**	2.88	2.86	2.60	2.76
1992					**2.74**	2.76	2.60	2.76
1993						**2.68**	2.59	2.73
1994							**2.48**	2.74
1995								**2.62**

Values in bold are chain Fisher Ideal estimates using period *t* and *t-1* weights.

Table 4. Laspeyres Differences from Fisher Ideal Estimates of Inflation Expanded Aizcorbe-Jackman Sample

Base Year	1988	1989	1990	1991	1992	1993	1994	1995
1986	0.14	0.23	0.18	0.14	0.09	0.12	0.09	0.13
1987	0.13	0.18	0.14	0.16	0.09	0.12	0.09	0.13
1988		0.10	0.11	0.16	0.13	0.16	0.13	0.15
1989			0.14	0.16	0.19	0.11	0.12	0.13
1990				0.13	0.13	0.13	0.02	0.12
1991					0.13	0.18	0.11	0.14
1992						0.08	0.11	0.14
1993							0.10	0.11
1994								0.12

Table 5. Annual-average Laspeyres and Fisher Ideal Estimates of Inflation, Original Aizcorbe-Jackman Database

Base Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1982	4.09	3.89	2.46	3.97	4.10	4.90	5.52	4.23	2.95	2.88	2.59	2.85
1983	4.06	3.96	2.61	3.95	4.06	4.84	5.40	4.26	3.05	2.98	2.66	2.82
1984	**4.01**	3.95	2.64	3.88	4.02	4.77	5.33	4.21	3.05	2.97	2.67	2.84
1985		**3.87**	2.57	3.85	4.03	4.75	5.26	4.12	2.97	2.89	2.63	2.78
1986			**2.40**	3.84	4.02	4.79	5.25	4.05	2.93	2.86	2.61	2.75
1987				**3.73**	3.98	4.72	5.24	4.02	2.87	2.80	2.57	2.74
1988					**3.88**	4.64	5.26	4.06	2.95	2.86	2.61	2.73
1989						**4.56**	5.27	4.04	3.03	2.80	2.59	2.73
1990							**5.12**	4.01	2.95	2.83	2.52	2.71
1991								**3.89**	2.97	2.86	2.59	2.71
1992									**2.84**	2.78	2.60	2.73
1993										**2.71**	2.60	2.73
1994											**2.53**	2.75
1995												**2.66**

Values in bold are chain Fisher Ideal estimates using period t and t-1 weights.

Table 6. Laspeyres Differences from Fisher Ideal Estimates of Inflation, Original Aizcorbe-Jackman Database

Base Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1982	0.07	0.03	0.06	0.23	0.22	0.32	0.37	0.33	0.10	0.17	0.06	0.19
1983	0.05	0.09	0.21	0.21	0.18	0.27	0.26	0.36	0.20	0.26	0.13	0.16
1984		0.08	0.23	0.14	0.14	0.20	0.19	0.31	0.20	0.26	0.14	0.18
1985			0.17	0.11	0.14	0.19	0.13	0.23	0.13	0.18	0.10	0.12
1986				0.10	0.14	0.22	0.12	0.16	0.08	0.14	0.08	0.09
1987					0.10	0.15	0.11	0.13	0.03	0.09	0.04	0.08
1988						0.08	0.12	0.17	0.10	0.15	0.08	0.07
1989							0.13	0.14	0.18	0.09	0.06	0.07
1990								0.12	0.10	0.12	-0.01	0.05
1991									0.12	0.15	0.05	0.05
1992										0.07	0.07	0.08
1993											0.07	0.07
1994												0.09

Table 7. Annual-average Laspeyres Estimates of Inflation, Original Aizcorbe-Jackman Database

Base Year	1991	1992	1993	1994	1995	5-Yr Avg.
			Inflation Rate			
CPI-U	4.2	3.0	3.0	2.6	2.8	3.1
1982	4.23	2.95	2.88	2.59	2.85	3.10
1983	4.26	3.05	2.98	2.66	2.82	3.15
1984	4.21	3.05	2.97	2.67	2.84	3.15
3-Yr Avg.	4.23	3.02	2.94	2.64	2.84	3.13
1987	4.02	2.87	2.80	2.57	2.74	3.00
1988	4.06	2.95	2.86	2.61	2.73	3.04
1989	4.04	3.03	2.80	2.59	2.73	3.03
3-Yr Avg.	4.04	2.95	2.82	2.59	2.73	3.02
			Difference			
1987	0.21	0.07	0.08	0.02	0.11	0.10
1988	0.20	0.10	0.12	0.05	0.10	0.11
1989	0.17	0.02	0.18	0.08	0.12	0.11
3-Yr Avg.	0.20	0.07	0.13	0.05	0.11	0.11