The BLS Response to the Boskin Commission Report

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I HAVE BEEN ASKED TO PROVIDE the Bureau of Labor Statistics (BLS) perspective on the Boskin Commission Report, and a description of its influence on the Consumer Price Index (CPI) program. I am a natural choice for this assignment because I was the chief of the CPI program during the period of the Commission's deliberations. In fact, I became Assistant Commissioner for Consumer Prices and Price Indexes on July 10, 1995, only two weeks after the Commission came into existence.

In this paper my focus will be on the arguments presented and the decisions made by the BLS during the Boskin Commission period. Although the paper makes many references to BLS documents and publications, it contains no review of the economic literature that formed the basis for the Commission's criticisms and recommendations. Thus, the large volume of theoretical and quantitative work on the CPI by Erwin Diewert, Jack Triplett, the individual Commission members themselves, and many others will go mostly unrecognized here. Moreover, I will make no attempt to characterize the present state of knowledge with respect to the issues raised by the Commission, nor will I present any official BLS position on the existence of upward bias in the CPI.

The context of the CPI in 1995

It is difficult to exaggerate the impact of the Boskin Commission on CPI day-to-day activities during and immediately following the Commission's deliberations. Although only a handful of formal meetings were held between the BLS and the Commission, there was extensive communication through email and telephone correspondence, and CPI staff responded to numerous information requests, especially from Zvi Griliches and Robert Gordon. The indirect effects on BLS activity were probably even greater than the direct interaction. Commissioner Katharine Abraham testified before several Congressional committees, and BLS conducted briefings for the press and public, for Congressional staff, and for Executive Branch officials. Meanwhile, numerous papers and reports were issued, either reporting the results of BLS research on "Boskin" issues[2] or presenting BLS views and action plans.[3] Completely aside from any programmatic changes that resulted from this period, the Boskin Commission years called forth a great deal of analysis and clarification of the Bureau's goals and methods in producing the CPI.

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2 See, for example, Moulton (1996a, 1996b), Aizcorbe et al. (1996), Reinsdorf and Moulton (1997), McClelland (1996, 1998), Moulton and Moses (1997), Greenlees (1998).

3 For example, Abraham (1995, 1996, 1997b), Abraham et al. (1998), Bureau of Labor Statistics (1997), Greenlees (1996, 1997).

It is important to note, however, that from the BLS perspective at least, the period of heightened outside concern about CPI bias began several years before the formation of the Boskin panel. One major trigger was the paper presented in 1990 by BLS economist Marshall Reinsdorf[4] in which he attributed a significant upward bias to the CPI from its failure to account for the lower prices offered in discount outlets.

In the wake of the Reinsdorf paper and the considerable interest it generated, the BLS devoted the December 1993 issue of the *Monthly Labor Review* to four articles on consumer price measurement issues written by economists in the Office of Prices and Living Conditions. Notable among these was the paper by Ana Aizcorbe and Patrick Jackman, who compared indexes based on the CPI's Laspeyres formula to indexes employing the "superlative" Fisher Ideal and Tornqvist formulas for the period 1982 to 1991. That paper was the first to construct superlative indexes using detailed CPI series defined by geographic area and item category, and it provided several estimates of the upward substitution bias resulting from use of the fixed-weight Laspeyres formula to aggregate those series. These Aizcorbe-Jackman results became the basis for many subsequent estimates, including those by the Boskin Commission, of what came to be called "upper level" substitution bias.[5]

Another article in the December 1993 *MLR* was an analysis authored by Brent Moulton of a complex but important problem in the way

the roughly 9,000 elementary area-item indexes in the CPI were calculated. This analysis built on the empirical anomaly, noted earlier by Reinsdorf, that many CPI indexes for food and energy items rose faster than the averages of the prices on which those index series were built. Although Reinsdorf had first attributed this difference to the influence of new discount outlets, in subsequent research he demonstrated that the BLS's operational implementation of the arithmetic mean formula to combine individual item prices led to a systematic upward bias in CPI indexes *relative to the Laspeyres objective*.[6] This discovery, which I will refer to as "formula bias" in this paper,[7] and Moulton's empirical demonstration that this bias was especially severe in the volatile food indexes, led the BLS to implement a technical, and costly, procedural change called "seasoning" in the CPI food-at-home components effective in January 1995. It was further discovered that a related bias existed in the CPI shelter (Rent and Owners' Equivalent Rent) indexes, and that bias also was corrected in January 1995. The BLS estimated that these changes together would reduce annual CPI growth by about 0.14 percentage point.[8]

Moulton (1993) and the subsequent paper by Reinsdorf and Moulton (1997) demonstrated that a geometric mean, unlike the arithmetic mean, is not vulnerable to the bias described in the previous paragraph. Moulton therefore suggested that the BLS consider moving to a geometric mean formula in the CPI. Such a change, he argued, would have the additional value of

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4   This conference paper was subsequently published as Reinsdorf (1993).

5   The Boskin Commission, having no budget for research, necessarily relied on work by BLS and others for many of its quantitative bias estimates.

6   That research was first presented in 1993 and subsequently published as Reinsdorf (1998). The analysis of this problem by Reinsdorf and Moulton is also reported in their 1997 article.

7   There has been some semantic ambiguity in the term "formula bias." As noted later in this section, the Boskin Commission used the term in a broader sense than I do here.

8   Including other changes in the CPI made at the same time, the estimated effect was a negative 0.12 percentage point. See Armknecht et al. (1995).

reflecting consumer responses to relative price change; as is well known from cost-of-living index theory, use of the geometric mean yields a true cost-of-living index when consumers have Cobb-Douglas preferences characterized by unitary elasticities of substitution among items. The arithmetic mean or Laspeyres form, by contrast, is consistent with Leontief preferences or zero substitution elasticities. Under certain assumptions, movements in a Laspeyres index will tend to overstate movements in a cost-of-living index if consumers do, in fact, change their purchasing patterns in response to changes in relative prices.

Under Paul Armknecht, then the CPI chief, the CPI program did begin building the capability to shift to a geometric mean formula. By mid-1995 a "requirements" document had been completed, detailing the computer system processing changes that would be necessary to implement the shift. Certainly no decision had been made to adopt the geometric mean, but significant resources had been committed to a planning effort.

Public interest in the CPI accelerated greatly after testimony by Federal Reserve Board Chairman Alan Greenspan to the Senate Finance Committee in January 1995. In that testimony he estimated that the CPI measure of consumer price inflation was overstated by about one percentage point annually. This estimate was based on a paper by Board economists David Lebow, John Roberts and David Stockton (1994) that was an update of a 1992 paper by the same authors and the first of several published analyses of upward CPI bias arising from different sources.[9] Greenspan's testimony led to Congressional hearings in which subsequent testimony on CPI issues was heard from 13 witnesses.[10] The outgrowth of these hearings was, of course,

the formation of the Advisory Commission to Study the CPI, the "Boskin Commission."

Another BLS activity in the period immediately prior to the Boskin Commission's formation was the preparation of a report on CPI issues in response to a request from the House Budget Committee. This report, completed in April 1995, broke little new ground. It did, however, include a discussion of previous research on potential CPI biases. It also indicated that within the next year the Bureau hoped to publish an evaluation of the geometric mean and other formulas for aggregating item prices.

Finally, any discussion of the CPI program and the Boskin Report would be incomplete without noting that 1995 was also the year in which the BLS embarked on a multi-year CPI revision effort. This was the sixth such major revision in the program's history. Like the previous revisions, it included an updating of the CPI's underlying expenditure weights and its geographic area and housing unit samples based on the latest Decennial Census data. Also like its predecessors, this revision included other CPI improvement efforts: a thoroughgoing redesign of the Point of Purchase Survey (POPS), which is used to generate the sampling frame for CPI retail outlets; an overhaul of data processing systems for the Consumer Expenditure Survey, which generates CPI weights; a reworking of the item classification structure used in the CPI; a modernization of the housing index estimation system, including an improved method for recovering homeowner shelter costs from rental market data; and the implementation of computer-assisted data collection for CPI prices, replacing paper survey forms with pen-pad computers and electronic survey instruments.[11]

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9   See also Wynne and Sigalla (1994), Shapiro and Wilcox (1996) and the later study by Lebow and Rudd (2003).

10   The hearings were held in March, April and June. See U.S. Senate (1995).

11   See Greenlees and Mason (1996) for a summary of the revision effort.

The BLS Response to the Boskin Report Recommendations

The Boskin Report and the recommendations therein were important drivers of CPI activity during the late 1990s and beyond. Interestingly, the aspect of the report that received the most attention was not its 16 recommendations for action by BLS and others. Instead, the Commission's estimates of CPI upward bias were the most widely cited, and they also were the elements of the report that were most closely associated with subsequent BLS methodological changes. For example, the Boskin recommendations contained little about dealing with product quality change or new goods; but their estimates of CPI bias arising from inadequate handling of those phenomena were widely cited and debated, and intense interest surrounded the subsequent expansion of hedonic quality adjustment for quality change in the CPI.

One recommendation that was widely cited was the Commission's first, overarching recommendation that the BLS should establish the economic concept of a cost-of-living index (COLI) as the measurement objective for the CPI. Viewed from the context of statistical agencies around the world, this recommendation was relatively controversial. As Triplett (2001) has noted, the COLI is rejected as a measurement objective in many countries, including the United Kingdom and Australia. The recommendation was accepted rather readily by the BLS, however. In Congressional testimony in January 1997, Commissioner Abraham stated simply that "this seems basically right to me."[12] For many years, the *BLS Handbook of Methods* had contained language indicating that although for several reasons the CPI could not be considered a COLI,

cost of living theory was used as a guide to operational problems in constructing the index. Moreover, the 1995 BLS report to the House Budget Committee had characterized the CPI as a subindex of the general COLI concept (Greenlees, 2001). Thus, formal acceptance of the Boskin recommendation did not represent a major shift in concept or practice. By the same token, however, it may have made it easier for the BLS subsequently to take steps to make the CPI a closer approximation to a COLI.

The remainder of this section presents the methodological changes made by BLS between 1996 and 2002. It is convenient to divide these changes into three areas, roughly corresponding to the categories of bias identified by the Commission: upper and lower level substitution bias; quality change and new products; and new outlets.

Substitution Bias

Constructing the CPI involves two stages of aggregation. At the "lower level" of aggregation, price changes for individual items are averaged together to produce basic item-area CPI indexes such as the index for apples in Chicago. The item weights used in this lower-level aggregation are primarily a function of the probability-sampling rates used to select individual outlets and items for pricing. In "upper-level" aggregation, the item-area indexes are combined using spending data taken from the Consumer Expenditure Survey to produce the overall U.S. All Items CPI along with subaggregates such as the CPI for Chicago or the CPI for Food and Beverages. The issue of potential substitution bias, and related issues of formula and weighting, arise at both of these two levels of aggregation, although in somewhat different forms due to the different types of information available.

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12   Abraham (1997a). See also Abraham et al. (1998:27).

Lower-level formula

In their September 1995 Interim Report (Advisory Commission to Study the CPI, 1995), the Commission members attributed an upward bias of 0.5 percentage point to "formula bias," which was their term for problems arising from the arithmetic mean formula then used to compute basic item-area CPI indexes. Their estimate of bias was based on comparisons of simulated CPI series to geometric mean equivalents presented in Moulton (1993), and their criticism — and their definition of formula bias, as opposed to the one used elsewhere in this paper — thus included both aspects of the geometric mean: its immunity to the item-weighting bias discovered and explained by Moulton and Reinsdorf, and its reflection of consumer substitution behavior.

A fundamental principle accepted by the Commission was that the CPI should as closely as possible approximate a cost-of-living index. The closeness of the approximation resulting from any index formula will depend on the accuracy of the embedded assumption about consumer demand elasticities, and no CPI data exist with which to estimate elasticities within item-area cells. The Commission argued that the Cobb-Douglas preference assumption incorporated in the geometric mean formula was much closer to the truth than an assumption of zero substitution elasticities, and that therefore the geometric mean was clearly preferable to the formula used in the CPI. Under the assumption that the BLS was about to introduce a geometric mean formula, the Commission believed that formula bias was a thing of the past.

During the months following the Interim Report, the BLS devoted much additional attention and research to this issue of "lower-level" formula. As viewed by Bureau management, disentangling the two geometric mean effects — formula bias and consumer substitution — was

crucial. It was clear that using the geometric mean would systematically reduce the rate of growth in the CPI. This was clearly justified to the extent that the reduced rate of growth arose from the complete elimination of formula bias, which had thus far only been addressed in the food and shelter indexes. On the other hand, incorporating consumer substitution in the CPI had never been done before; as noted above, the BLS had always been comfortable portraying the index as an upper bound to a COLI due to its use of the Laspeyres formulation. Commissioner Abraham agreed that taking such a step would require careful analysis to ensure that the Cobb-Douglas assumption did, in fact, provide a reasonable characterization of consumer preferences within CPI cells. BLS practice also would require that CPI users and stakeholders be given notice of such a major methodological change.

These considerations would have been moot if it could be established that the formula bias accounted for nearly all of the difference between the CPI and simulated geometric mean indexes. BLS research on CPI microdata, however, demonstrated that this was not the case: arithmetic-mean indexes that were purged of formula bias remained systematically higher than geometric mean indexes.[13] Therefore, it was decided to expand the "seasoning" approach from the food indexes to the entire CPI in 1996, which, combined with another simultaneous operational change, could be expected to align the CPI with its Laspeyres measurement objective. The BLS estimated that the changes would reduce the CPI's aggregate annual growth rate by about 0.1 percentage point (Stewart, 1996). Meanwhile, the BLS would continue its research on an experimental geometric mean index.

Recognizing the 1996 changes, the December 1996 Boskin Commission Final Report gave an estimate of 0.25 upward bias from lower-level substitution bias, this arising from the consumer

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13 See McClelland (1996), Erickson (1995, 1996), and the discussion in Moulton (1996a).

substitution issue. Adoption of the geometric mean formula was one of the Commission's formal recommendations, and it is one with which the BLS ultimately did agree. In April 1997, the BLS unveiled and began releasing monthly the CPI-U-XG, an experimental index covering the historical period from December 1990 forward.[14] A literature review was conducted by BLS to evaluate the Cobb-Douglas assumption, and several outside experts were retained to provide recommendations on whether the geometric mean should be adopted. In April 1998, based on all these considerations and the performance of the CPI-U-XG, the BLS announced that effective with data for January 1999 it would employ the geometric mean in the overwhelming majority of the 211 CPI item categories, the exceptions being 15 in which it was unreasonable to expect consumers to respond quickly or smoothly to relative price changes.[15] The change was justified explicitly on the basis that it would reflect consumer response to relative price changes. The estimated impact on CPI growth was 0.2 percentage point annually.

Upper-level formula

Two Commission recommendations were concerned with the formula for upper-level aggregation. The Boskin members argued that the preferred formula for a cost of living index was a superlative index formula like the Fisher Ideal formula used in the National Income and Product Accounts chain indexes or the Tornqvist formula used in the BLS Multifactor Productivity series. Based on BLS updates of the Aizcorbe and Jackman (1993) results (Aizcorbe et al., 1996), along with estimates by Matthew Shapiro and David Wilcox (1996), they estimated that the substitution bias resulting from the CPI's Laspeyres formula was about 0.15 percentage point annually.

They recognized, however, that a superlative index cannot be computed in "real time" due to the inherent delays in receipt of the consumer expenditure data required for weighting the monthly price changes. They also recognized that a primary value of the CPI is as a timely measure of consumer inflation. Consequently, their Recommendation 3 proposed that the official, "timely, monthly" CPI be constructed using a geometric mean formula with annually-updated but not contemporaneous expenditure weight information. (The Boskin Report referred to this formula as a "Trailing Tornqvist" index and called it "superlative," notwithstanding the fact that the use of simultaneous weight data is an inherent feature of superlative indexes.) Meanwhile, Recommendation 3 also proposed an annual index that would employ a superlative formula and would also incorporate retroactive revisions to reflect new information on the historical introduction of new goods and improved methodologies.

By the time that the Commission's Final Report was released in December 1996, the BLS had already committed internally to dealing with the upper-level substitution bias issue. Earlier that year, as part of the submission process for the Fiscal Year 1998 budget, the BLS proposed a funding package called the Timeliness and Accuracy, or CPI Improvement (CPII), Initiative. Among the components of that initiative was the development of a superlative CPI.

The standard practice is for budget requests to be closely held until they are formally included in the President's Budget, but the BLS received permission to announce its CPII initiative slightly earlier, in Commissioner Abraham's testimony to the Senate Finance Committee in January 1997. The details of the proposed index were not given until much later, and in fact the BLS took years to ana-

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14 See Moulton and Stewart (1999) for a description of the CPI-U-XG and several other experimental BLS indexes.

15 This BLS analysis is summarized in Dalton et al. (1998). Two additional item categories were shifted to the geometric mean in 2004, and the proportion of CPI weight now indexed using a geometric mean is about 61 per cent.

lyze whether the index should be annual or monthly, whether it would be published in a current or only retrospective form, and what superlative formula it would employ. The BLS did make clear that the new index would be inaugurated in 2002; that it was intended to provide a closer approximation to a COLI than the existing CPI-U and CPI-W; and that it would be a complement to those series, rather than a replacement for either.

The logic underlying the BLS superlative plan was that its superlative index, ultimately named the Chained CPI for all Urban Consumers or the C-CPI-U, would be an official CPI product rather than an experimental series. Users, whether in Congress, the Administration, or the private sector, would be given the opportunity to use whichever CPI series best suited their needs. The C-CPI-U would be attractive to users who wanted an index that reflected consumer substitution as much as possible. Conversely, the CPI-U or CPI-W might be more attractive to users who valued that those series are in final form when first published, unlike a superlative index, which must be published either substantially after the fact or subject to revision.

This BLS approach fell short of satisfying Recommendation 3 of the Boskin Report. Most importantly, the upper-level Laspeyres formula in the existing CPI series was left unchanged, so there was no effect on indexed federal programs. Any impact on future tax receipts and benefit payments would require Congressional action to change the basis for indexation from the CPI-U or CPI-W to the C-CPI-U.

Moreover, the BLS superlative plan contained no provision for incorporating the sort of historical revisions that the Boskin Report recommended. The C-CPI-U is subject to two annual revisions when more recent Consumer Expenditure (CE) data become available, but *ex post* infor-

mation such as the results from historical studies of hedonically-adjusted price indexes are not incorporated retrospectively in any of the three official CPI indexes.[16]

The details of how the BLS superlative index would be constructed were reported in 2002.[17] The C-CPI-U was the first official superlative CPI produced by a government statistical agency anywhere in the world. Its development required that the BLS resolve numerous issues that had not been addressed in the mainly theoretical literature on superlative indexes. The most difficult operational question arose from the fact that the CE survey can provide expenditure share data for about 8,000 item-area cells on a monthly basis, but those expenditure shares, as well as the associated monthly price indexes, are subject to considerable (and uncorrelated, since they come from different surveys) sampling error. Of course, superlative theory assumes that the observed expenditure shares reflect consumer decisions based on the observed price index movements. If both those data series are affected by sampling error, use of the superlative formula could yield inappropriate inferences. A decision had to be made, therefore, about the extent to which those prices and expenditures should be averaged across either time or geography, or both, so as to retain the benefits of the superlative formula. A discussion of the ultimate BLS decisions is provided in Robert Cage et al. (2003).

Empirically, the movements of the C-CPI-U relative to the Laspeyres CPI-U have been somewhat surprising. BLS simulations using data from the early 1990s suggested that a superlative index would rise by about 0.15 percentage point per year less than an otherwise-comparable Laspeyres index. Later simulations reported in Cage et al. (2003) showed a larger gap in the

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16 As discussed below, this Boskin recommendation was addressed to some degree by the development of the experimental CPI-U-RS series.

17 See Cage et al. (2003). These details are available on the BLS website at www.bls.gov/cpi/superlink.htm.

later 1990s, however, with the average annual difference for the 1990-99 period being approximately 0.3 percentage point. As of this writing, official C-CPI-U official data in final form are available for 2000 through 2004. The gap between the C-CPI-U and the CPI-U has continued at about 0.3 percentage point in the last four of those years, but was nearly 0.8 percentage point in 2000, apparently because of some extreme movements in energy prices in that year.[18]

Expenditure weight updates

Closely related to the choice of index formula is the choice of the frequency of expenditure weight updates. In fact, the two issues were sometimes confused in popular discussions of upper-level substitution bias.

In terms of its upper-level construction, the CPI in 1995 could be characterized by two features. First, it used a Laspeyres-type formula.[19] Second, its expenditure weights were updated once per decade; the last update had been in January 1987, when CE expenditure data from the three-year period 1982-84 became the basis for weighting basic component CPI indexes. Another update was scheduled for January 1998, when expenditure weights from 1993-95 would be incorporated.

The fact that CPI weights were updated only once a decade was among the most easily and often criticized aspects of the index. The statistical agencies in most other developed countries updated their CPI weights more frequently. At one time the BLS could have justified its policy by the lack of timely expenditure data. However, the Consumer Expenditure Survey, the source of CPI weights, had been put on a continuous basis during the early 1980s, so that beginning in 1986 the CPI had available expenditure data that would have supported more frequent, even annual, weight updates.

From the perspective of economic theory, all Laspeyres indexes have the same characteristic as an upper bound to a COLI, and there is no theoretical argument to be made for one base period over another. On the other hand, it seems natural to view an index with a more recent base period as being more representative of price movements in what consumers are purchasing currently, and this argues for more frequent updating. The strongest argument *against* frequent updating was the potential for "chain drift": an upward bias that could result from oscillations in prices and consumer spending. That is, one feature usually considered attractive of a fixed-weight index, relative to a chained index, is that when prices change and then return to their original position, the index itself will return to its original level.

Aside from chain drift, however, it was assumed by most analysts that a more frequently updated index, even one with a Laspeyres formula, would rise less rapidly than a less frequently updated one. This would occur if there were persistent secular trends in relative prices, and consumers tended over time to purchase more of the goods and services with falling relative prices. Somewhat surprisingly, the BLS found little evidence of this in its simulations of how the CPI would have moved differently had it employed more frequent updating.[20]

Nevertheless, in the FY 1998 CPII budget initiative referred to above, the BLS asked for and

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18 Recent CPI-U and C-CPI-U index movements are compared in Johnson et al. (2005).

19 More precisely, it used what is now often termed a Lowe index formula, since the expenditure weight base period (1982-84) was "linked in" at a subsequent date (January 1987). For the same reason the BLS usually employed the term "modified Laspeyres" to describe the CPI formula. On the properties of a Lowe index see International Labour Office (2004).

20 Greenlees (1998) presents an analysis of this question. It should also be noted that it had always been BLS policy to publish "overlap" indexes for six months following an expenditure weight update, comparing the movements of the CPI under the two weighting structures.

received funding to expand the CE sample size by 50 per cent and to accelerate the editing and processing system for CE data. This would have three advantages. First, it would enable CE weights to be used in the CPI after one year instead of two (had the new system been in effect, the 1993-95 base period could have been employed in January 1997 instead of 1998). Second, a two-year base period would be sufficient to provide the same accuracy of weights previously provided by three (so a 1994-95 base period could have been implemented in January 1997). Both these improvements would make CPI weights more current when first used. Third, the BLS argued that the CE enhancements would make it more feasible to update weights in the future on a more frequent basis.

In December 1998, the BLS did announce that starting in January 2002 the expenditure weights for both the CPI-U and CPI-W would be updated biennially using two-year base periods (BLS, 1999). A 1999-2000 base period was introduced in 2002, a 2001-2002 base period in 2004, and so on. More frequent updating was rejected on the basis that biennial updating would make the weights sufficiently representative, and for fear of chain drift or other unforeseen consequences from annual weighting with necessarily overlapping base periods. At the time of the 1998 announcement, based on its simulation evidence, the BLS declined to make any estimate of the effect on CPI growth from moving to biennial updating.

In retrospect, it seems likely that the introduction of more frequent expenditure weight updating is a change that was accelerated by the increased public attention to CPI bias issues. Prior to the Boskin period, the BLS had been reasonably comfortable with decennial updating, on the basis that more frequent updating would be costly and that the available evidence was insufficient to show it would have any major effect. With significant outside criticism, however, it became difficult to defend the policy and more feasible to obtain funding to change it.

Quality Change and New Products

The Boskin Commission devoted approximately one-third of its report to a component-by-component review of the potential biases attributable to the CPI's allegedly insufficient recognition of the benefits from the introduction of new products and the improved quality of existing products. This part of the report received considerable attention both within and outside BLS, for two major reasons. First, the Commission's aggregate estimate of bias from new products and quality change was 0.60 percentage point per annum, more than half of their total point estimate of 1.1 percentage points from all sources of bias. Second, their 0.60 point estimate was built up from a large number of sometimes rough component estimates based on little firm evidence, making it vulnerable to criticisms and counter-arguments. By contrast, most economists readily accepted the concepts of upper- and lower-level substitution bias, and the Commission estimates of bias in those areas were based largely on BLS research.

To quote Shapiro and Wilcox (1996), "quality change is the house-to-house combat of price measurement." Each product area presents different measurement problems, and there is no single formula or approach that can solve those problems. For the same reason, it is impossible here to go through the various component bias estimates in the Boskin Report. The interested reader can consult Moulton and Moses (1997) or Bureau of Labor Statistics (1997) for a relatively detailed BLS rejoinder to those estimates.

It is probably worth noting that the terms "quality adjustment" and "quality change" themselves led to some semantic confusion in the context of the Boskin bias estimates. The BLS, and indeed all statistical agencies, must adjust each period for quality differences

between items leaving and entering their product samples. In the great majority of cases, however, this is not done by making an explicit comparison of the relative qualities of the two items being compared. Rather, the quality adjustment is made implicitly, through a "law-of-one-price" assumption. Typically, through a procedure called "linking," the rate of "true" price change between the new item in period t and the old item from period t-1 is assumed to be equal to the mean change observed for the sampled items that appeared in both periods; all the rest of the price difference, positive or negative, is assumed to be the value of quality difference. Armknecht and Weyback (1989) had demonstrated using 1984 data that, in aggregate, BLS quality adjustments had a significant impact in reducing CPI price change relative to the estimate that BLS would have obtained had it not adjusted for quality differences at all. Moulton and Moses (1997) updated that analysis, and showed that about half of the growth of the CPI in 1995 was attributable to the treatment of replacement items. Those results were sometimes misinterpreted, though, either by drawing an exaggerated conclusion about the extent to which BLS explicitly adjusted for quality change (most of the quality adjustment was by the implicit linking method), or by using the Moulton-Moses results to derive a measure of aggregate quality improvement in the consumer product sector (many of the most significant quality improvements occur in ways that would not show up in BLS item sample comparisons).[21]

The extent and detail of the Boskin Report's focus on quality bias was not mirrored in their recommendations. Only Recommendation 8, which advocated a flow-of-services approach for all durable goods and a revised treatment of insurance, referred to the handling of specific item categories, and those issues were not linked closely to discussions in the body of the report. Somewhat remarkably, the report did not recommend an expanded use of hedonic modeling. Nevertheless, the report may have been a major stimulus to the subsequent incorporation of several new CPI hedonic models into the CPI, beginning with personal computers.

Until 1998, the weight of computers in the CPI was extremely small, not surprisingly given that CPI weights were based on consumer expenditures during the 1982-84 period. Even when 1993-95 weights and a new category for Personal Computers and Peripheral Equipment were introduced in 1998, the relative importance of that component was only 0.234 per cent. In October 1997, the BLS announced that in January 1998 it would extend to the CPI the use of the hedonic model for PCs that had been regularly estimated and employed in the Producer Price Index (PPI) since 1990.[22]

A second hedonic model, for televisions, was adopted for use beginning in January 1999. That model was estimated using sample CPI data, and had been developed and reported by Moulton et al. (1999). The insufficiency of CPI item samples acted (and continues to act) as a roadblock to broader use of hedonics, however. Often, the CPI sample sizes that are adequate for the usual matched-model CPI methodology are too small to support estimation of a hedonic regression. Moreover, a matched model index may not require a large amount of accurate information on the characteristics of the products being priced, whereas such information is crucial to estimation of hedonic coefficients.

To address this problem, in 1996 the BLS included, as part of its 1998 CPII budget initia-

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21 Triplett (2000) provides a precise analysis of this point.

22 That hedonic model for PCs had been developed originally at the Bureau of Economic Analysis. As noted in Johnson et al. (2005), the growth of readily available component cost data via the Internet has led the BLS to discontinue the use of the PC hedonic model in the CPI.

tive, regular funding to collect special samples of prices and characteristics of products for the purpose of hedonic regression estimation. This activity bore fruit in 1999 and 2000, as several models were estimated and employed for a variety of products. Most of these were consumer durables, such as refrigerators, washing machines, and VCRs (Fixler et al., 2000).

The recent paper by David Johnson et al. (2005) presents estimated impacts on overall CPI growth of the use of hedonic models. Echoing a point made earlier by Charles Schultze, their estimates show that the quantitative effect of the models introduced since 1998 has been small.[23] The product categories to which these models have been applied have a small overall weight, and in the aggregate the hedonic quality adjustments have not been dramatically different from the implicit quality adjustments that would have been made using the default CPI methodologies. Further expansion of hedonic methods in the CPI has been hindered by the problems in obtaining satisfactory data sets for regression estimation, and by the inherent difficulty of applying hedonic methodology in the heavily weighted services areas. This continues to be a very important research area at the BLS, despite those obstacles.

Medical care is the other major product area in which the BLS has attempted to find improved methods of decomposing price and quality change. During the tenure of the Boskin Commission, the CPI was taking a set of costly and difficult operational steps to reduce its reliance on list, or "Chargemaster," rates for hospital services (Cardenas, 1996). This improvement, parallel to a change made in the PPI several years earlier, involved moving from pricing individual compo-

nent services, such as room charges, to pricing patterns of services associated with individual patient hospital stays. This moved the CPI unit of pricing closer to the service for which insurers typically reimbursed hospitals. Combined with other changes in data collection procedures, this made it easier for the BLS to collect third-party reimbursement rates for hospital care rather than having to fall back on the more readily available Chargemaster fees.

Even recognizing this improvement, the Boskin Report estimated an annual upward bias of 3 percentage points for hospital and related services in the CPI, due to the failure to capture the benefits of new and improved technologies and treatment methods. Since the report, the BLS has investigated two different approaches to addressing this well-recognized but difficult problem. The first was the approach of directly pricing health insurance: measuring the cost of hospital services, and other medical care covered by insurance, through the collection (and quality-adjustment) of health insurance premiums. Unfortunately, the BLS decided that the problems of adjusting premiums for utilization and other quality changes were prohibitive.[24]

A second approach to solving the medical care pricing problem is through the use of insurance claims files, as proposed in National Research Council (2002). In accord with that proposal from a National Academy panel, the BLS contracted with MEDSTAT, Inc., to develop experimental medical care price indexes using claims data and comparing those to simulated series replicating current CPI methodology. The paper by Song et al. (2004) reports on that work, and the BLS continues to be interested in this approach.

23 It should be noted that the BLS had employed hedonic models in some key areas of the CPI prior to 1998, notably in apparel beginning in 1991 and for age-bias adjustments in the shelter indexes beginning in 1987. The weight of these components and the quantitative impact of these earlier hedonic models have been significant, as shown for example in Stewart and Reed (1999).

24 See Bureau of Labor Statistics (2000) for a discussion of this proposal. The approach is discussed in National Research Council (2002:186-188). Health insurance had been priced directly in the CPI prior to 1964, as described by Armknecht and Ginsburg (1992).

New Outlets

The Boskin Commission linked the problem of new goods with that of quality change, but one could also link new goods with new outlets as a type of conceptual issue arising in price index construction. As others have noted, to the extent that a particular good is replaced in a CPI sample by a successor good, perhaps a new model produced by the same firm, this would usually be handled by explicit or implicit methods of quality adjustment. By contrast, when classes of goods are replaced by wholly new products, such as VCRs by DVD players, the usual statistical agency procedures typically do not allow for direct comparisons of quality or estimation of consumer welfare effects. This same situation applies with innovations in outlet type, such as online booksellers or large discount retailers. The CPI does not now reflect the benefits (or losses) to consumers of changes in the distribution of outlet types. The Commission attributed a 0.1 point annual upward bias to the new outlet problem, but I will discuss the BLS reaction in the context of new goods as well, since conceptually the issues are the same.

For many years BLS has employed a complete and sophisticated process of probability sampling for outlets and items. This has set the CPI apart from its counterparts in other countries, which have relied heavily on judgmental sampling. Although probability sampling is a major strength of the CPI, its goal of maintaining a representative sample can sometimes be in conflict with the goal of timely incorporation of new item and outlet categories. In the case of new outlets, inclusion in the CPI sample would require that they be reported as shopping destinations by households in the POPS survey. The data from the POPS, after delivery to BLS by the Census Bureau, which administers the survey, are used to construct the CPI's outlet sampling frame. Once sampled, these outlets would be visited by CPI data collectors, who would select items for subsequent pricing. At the time of the Boskin Commission, the POPS survey was being extensively improved and reworked from an annual personal-visit survey to a telephone-based quarterly survey called TPOPS (Cage, 1996). It continued to follow a five-year rotation process, however, meaning that in addition to the lags between appearance of an outlet type and the first use of its prices in the CPI, there would be several additional years before that outlet type was fully represented in the CPI sample.

Similar lags in inclusion would apply for those new goods that are associated with unique new outlet types (an example might be pad thai, introduced into wide availability through the expansion of Thai restaurants into more communities). New goods that are sold in traditional outlets could be included in the CPI much more rapidly if they are chosen as replacements when other products disappear from shelves, but otherwise they would tend to be included only through the outlet rotation process.

Finally, the longest lags would arise for a uniquely new product that did not fall clearly into any CPI category. The famous example of this scenario, featured prominently in the Boskin Report and by other writers during that period, was cellular phones. These were not brought into the CPI through outlet rotation because they were not considered in scope for any of the CPI's communications categories; in particular, the category Telephones was part of the Housing major group, and cellular phones were not judged to be part of the cost of Housing. As a consequence, despite the growing consumer use of cellular phones, they were not scheduled for inclusion in the CPI until the 1998 decennial revision, when a new Education and Communication major group would be defined with compo-

nent categories for both land-line and cellular telephone services.[25]

The interest in new outlet bias in the CPI was based on the previously-noted work by Marshall Reinsdorf of BLS. Reinsdorf (1993) attributed an upward bias to the failure to incorporate the impact of discount stores. Meanwhile, Jerry Hausman (1997, 1999) argued that the CPI accrued an important upward bias by failing to reflect the consumer surplus gains from new cereal products and cellular telephones. These and similar analyses and critiques, repeated in the Boskin Report, led to an increased recognition on the part of the BLS that the CPI should improve its efforts to include new products quickly. At a fundamental level, a decision was made within the CPI program that the item categorization implemented in January 1998 would be viewed — operationally as well as conceptually — as encompassing the universe of consumer goods and services; that is, no new products would be treated as out of scope for CPI collection in the way that cellular telephones had been. The program also accepted the idea that one of its goals would be to achieve a product and outlet sample that was as representative as possible of *current* consumer spending patterns.

In addition, the 1998 CPII initiative included funding for special data collection activities to sample new products. In its early years this money was used for special efforts to include Viagra (a new product with decreasing price and rapidly increasing market share) quickly. New procedures also were instituted to accelerate the resampling of prescription drugs, an area where product innovations were especially prevalent (Lane, 2000).

Somewhat later, using funding from another CPI budget initiative for Fiscal Year 2002, the

BLS made two significant improvements aimed at making its item and outlet samples more current. First, it reduced the TPOPS outlet sample rotation period from five years to four. It also instituted a broad program of faster item rotation. In many product categories, the item sample is rotated midway between outlet rotations; that is, within a given outlet the item sample is rotated after two years.

The BLS has not, as yet, attempted to implement Hausman's recommendations for reflecting consumer welfare gains from the introduction of new goods or outlets. Although the measurement objective is accepted, the technique has been considered too untested for use by a statistical agency.[26] The BLS also has not devised satisfactory procedures for comparing the quality and price at disappearing and appearing outlets, although this has remained an issue of continuing interest, as discussed, for example, in Walter Lane (2000).

Other recommendations

At the request of Chairman Jim Saxton of the Joint Economic Committee (JEC), the BLS submitted a report in June 1997 that addressed the issues raised by the Boskin Commission. That report included a response to each of the Commission's thirteen recommendations to BLS. It is outside the scope of this paper to discuss all the recommendations and responses, but a few points are worth noting here.

In two cases, the BLS expressed misgivings about the advisability of the changes that the Commission proposed. Recommendation 5 suggested that CPI sampling and data collection activities should focus on providing "information on the future longer-term movements in the index." This seemed to run counter to what the

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25 It is also true that analysts tended to exaggerate this problem, forgetting that much use of cellular phones during the early 1990s was business use out of scope for the CPI.

26 The National Academy panel was divided on the conceptual desirability of including consumer surplus, while agreeing that implementing the Hausman approach was premature. See National Research Council (2002:157-161).

BLS has considered the fundamental goal of the CPI, which is to measure current price change. BLS sampling procedures are designed to minimize the variance of estimated overall price change subject to the program's constraint on data collection cost, not to support development of an inflation forecast or estimate the degree of inflationary pressure. Therefore, the BLS essentially rejected this Commission recommendation.

Another recommendation urged that CPI sampling should de-emphasize geography by sampling commodities at a national level. In its report to the JEC, the BLS argued that "the practical meaning of this recommendation is somewhat unclear," and discussed the practical difficulties of obtaining national frames for commodity samples. Underlying the Commission's recommendation may have been the belief that the markets for many products are national rather than local, so that it is unnecessary to follow the CPI process of pricing those products in numerous different geographic areas. Subsequent BLS econometric research by Dennis Fixler and Robert McClelland (1999), however, casts doubt on that assumption by rejecting the hypothesis of a common national price trend for most of the item categories studied.

Several recommendations were accepted by the BLS as identifying reasonable directions of research or effort. One of these was the recommendation that the BLS have "a permanent mechanism for bringing outside information, expertise, and research results to it." The report to the JEC indicated that the Bureau was studying the possibility of creating an academic advisory committee, and in 2000 this came to pass with the formation of the Federal Economic Statistics Advisory Committee (FESAC), which advises the BLS as well as the Census Bureau and Bureau of Economic Analysis. The FESAC model does not satisfy the Boskin Commission's recommendation that the advisory group be organized by an independent professional entity, but it does constitute a formal and permanent source of input on methodology from the economic and statistical academic community.

The Commission's Recommendation 8 stated that the price of consumer durables such as cars should be measured using a flow-of-services approach such as the rental equivalence method used in the CPI to measure the price of owner-occupied housing. In the JEC report the BLS noted that it was introducing an automobile leasing index in the CPI, reflecting the growth of that market. Data collected for that index could at some point provide the basis for a flow-of services (i.e., leasing equivalence) approach to vehicle pricing. It is interesting to note, however, that in recent years the rapid increase in housing prices has led many outside analysts to question the appropriateness and accuracy of the rental equivalence approach. Notwithstanding those criticisms, the BLS remains fully committed to the flow of services concept for housing.[27]

The three longer-run Boskin recommendations involved fundamental research efforts, to look beyond the CPI's "market basket" framework, to investigate the CPI's embedded assumption of price equilibrium, and to undertake data collection initiatives such as on time use and quality of life. The BLS did institute the American Time Use Survey in 2003, although that program is not directly associated with the CPI. Meanwhile, the concerns underlying these longer-run recommendations have much in common with the issues addressed by the National Academy panel organized and partially funded by the BLS in 2000. That panel, under the chairmanship of Charles Schultze, was asked to explore the implications of COLI theory for index construction and to address, for example, the design of indexes for particular purposes and the role of public goods and the environment.

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27 BLS discussions of this issue are found in Poole et al. (2005) and Verbrugge (2005).

The Schultze panel's report (National Research Council, 2002) has helped to clarify and extend the debate on many of the same issues dealt with by the Boskin Commission.[28]

Finally, in the body of the Boskin Report, not in its formal recommendations, the Commission argued that the CPI should treat changes in automobile prices due to additional anti-pollution devices as price rather than quality increases. This was a viewpoint that had been advocated by the BLS decades earlier, but which had failed to gain support from the overall federal statistical community. In 1999 the BLS did change its handling of mandated clean air improvements in both the vehicle and motor fuel components of the CPI, treating those improvements as equivalent to indirect taxes (Fixler, 1998).

Overall Impacts of the Boskin Report

I cannot comment on how the Boskin Commission's work may have changed the way economists viewed published price index movements, or how the report was used in the consideration of ways to reduce the federal budget deficit during the mid-1990s. Certainly the Commission debates had important repercussions on statistical agencies around the world. Many of those agencies differed from the United States by not accepting the COLI as a measurement objective for their CPIs. Nevertheless, they had to discuss how the Commission's arguments applied to their index construction procedures, such as formulas they employed and their techniques for quality adjustment.

As for the US CPI, as discussed earlier, the impact of the Boskin Commission is difficult to separate from the impacts of Federal Reserve criticism or the attention from Congressional committees. The Commission Report did, however, prolong and greatly accentuate public attention on CPI methods. It is likely that by forcing the BLS to scrutinize the strengths and limitations of all its CPI procedures, and by highlighting and publicizing the budgetary impact of the CPI, the Commission paved the way for the various index improvements made by the BLS in the wake of the report.

Some, although not all, of those CPI improvements had predictable impacts on CPI growth. At the request of the General Accounting Office, the Boskin Commission members themselves provided updated estimates of bias in 2000; their median updated point estimate of bias was 0.8 percentage points annually, indicating that they estimated a 0.3 percentage point impact of the BLS changes to that point. The 1999 *Economic Report of the President* contained a table indicating that the CPI changes had slowed measured growth by 0.68 percentage point annually (Council of Economic Advisers, 1999:93-94). That table, and a similar table presented by Maurine Haver (1999), drew largely on formal estimates provided by the BLS. Finally, in 1999 the BLS introduced an experimental index, the CPI-U-RS, showing estimated CPI movements from 1978 to the present under the assumption that the current CPI-U methodology had been used throughout that period. Comparison of the CPI-U-RS to the official CPI-U provides a measure of the impact of subsequent CPI improvements, including those in the late 1990s such as the elimination of formula bias, use of the geometric mean formula, and application of hedonic models. The CPI-U-RS, described in Kenneth Stewart and Stephen Reed (1999), can be thought of as a partial response to the Boskin Commission's call for a historically revised CPI.

As suggested in the previous section, to some extent the Boskin Report led to the subsequent

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28 One of the Boskin Commission members, Zvi Griliches, was a member of the National Academy panel until his untimely death.

decision by the BLS to support formation of the Schultze panel. Many of the underlying issues that the Boskin Commission did not have time to address thoroughly, such as the treatment of environmental changes, or that the Commission took as given, including the COLI framework, were the subject of detailed analysis by the Schultze panel. Some of the positions taken in National Research Council (2002) were controversial, such as the panel's reluctance to fully endorse the COLI objective, its caution about rapid expansion of hedonic adjustment in the CPI, and its recommendation not to employ estimates of consumer surplus from new goods. In other areas, such as medical care, the Schultze panel advocated lines of research that are being followed by the BLS.

In characterizing the BLS reaction to the Boskin Commission, it is important to note the support given to the CPI program by Commissioner Abraham and the rest of the BLS leadership, including Kenneth Dalton and William Barron. The Commissioner played a crucial role in explaining and defending CPI methods to Congress and other audiences, and she successfully led the effort to secure funding for the 1998 CPI budget initiative (as well as the subsequent 2002 initiative). More crucial, perhaps, was her energy in questioning the CPI program about its methods, and her firm support for methodological changes whenever she was convinced of their validity.

Another factor that cannot be overestimated is the role of BLS's Division of Price and Index Number Research (DPINR) as a driving force in many of the methodological debates during the Boskin Commission period. This is not to downgrade the value of other CPI program staff, who not only implemented many methodological improvements but also wrote many of the BLS papers and reports cited here. Under the leadership of Brent Moulton and then Dennis Fixler, however, DPINR provided the conceptual guidance for the BLS positions on numer-

ous difficult measurement issues; devised specific procedures for handling technical problems such as solving formula bias or implementing a superlative formula; completed a prodigious number of quantitative research papers that provided much of the knowledge base for both the BLS and its critics; participated closely in the preparation of BLS testimony, official announcements, and other materials; and often acted as the link between the BLS and the academic community, explaining CPI methodology and demonstrating the Bureau's technical competence. Formation of a price research division was one of the recommendations of the 1961 Stigler Committee. The value of that recommendation was highlighted during the Boskin years, and DPINR continues to play a key role today.

Finally, in comparing the CPI program before and after the Boskin Report, there appears to be a closer relationship now with the economics research community. The issues raised in the report undoubtedly increased the interest in price index methodology among academic economists. Much credit, however, must go to Ernst Berndt, Charles Hulten, Jack Triplett, and others who have worked assiduously through such activities as the Conference on Research in Income and Wealth, the Brookings program on economic measurement (Triplett and Bosworth, 2004), and the NBER Summer Productivity Conference to strengthen the ties between BLS and outside researchers.

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