Price index research in the coming decades

A panel of price research experts convened to discuss research agenda that they believe should merit the highest priority over the next two decades

The year 1999 marked 20 years since the National Bureau of Economi Research (NBER) established its Program on Technological Change and Productivity Measurement. Over the past two decades, one of the important research emphases of this program has been its focus on price and output measurement. As part of the 20th anniversary and during the NBER's 1999 Summer Institute, Ernst Berndt and Zvi Griliches convened a panel of price index specialists to present their individual views on what research agendas they would propose as meriting highest priority over the next 20 years.

After the panel session, Ernst Berndt asked the formal presenters to write up their remarks. This summary is based on an edited version of those reports provided to *Monthly Labor Review* by Professor Berndt.[1]

As might be expected from such an eclectic group, the presentations were wide-ranging in their emphases and remarkable in their intellectual breadth. However, a relatively manageable set of themes emerged to be woven from the disparate strands of the papers:

1. Given the diversity of price index users, what are the right concepts toward which the indexes should be pointed and what are the boundaries constraining the operationalization of those concepts?
2. Within the conceptual scheme, what are the statistical issues that must be addressed?
3. Within a statistical framework, what are the operational issues that must be resolved?
4. Once these issues are resolved in a general way, what sector-specific challenges will remain?

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From user to concept to boundaries

Different users, different tools. The Bureau of Labor Statistics history of consumer price data collection and price index statistics goes back at least to the turn of the 20th century. Throughout that history, the objective of measuring the "cost of living" was at least implicit as the Bureau's choice of objective. Charles Schultze noted that in recent times that choice has become explicit, but is not the only choice available; that, in fact, other countries have made other choices: "The United States, unlike many European countries, has explicitly accepted the cost-of-living concept as a basic theoretical construct that should, to the extent feasible, be used as a guide in pointing the way towards making improvements to the CPI. Is this an appropriate choice?"

The lack of unanimity of official practice was expanded on by Jack Triplett: "The United States is one of a small number of countries (which also includes the Netherlands and Sweden) that accept the [cost-of-living] index framework. Most

countries' statistical agencies do not." He continued: "These HICP [European Union *Harmonized Indexes of Consumer Prices]* indexes are emphatically *not* COL index oriented. They follow the intellectual parentage of Hill, who contends that a COL index is not appropriate as a price index for measuring inflation.[2] The HICP indexes do not subscribe to a flow of services approach to measuring owner-occupied housing, and under a 'no imputations' rule, they will not use the rental equivalence approach for measuring owner–occupied housing that was adopted in the U.S. CPI in 1983."

Triplett also noted that "the idea that the CPI should approximate a COL index is not without controversy in the United States. For example, Angus Deaton has written (in *The Journal of Economic Perspectives*, Winter 1998): 'The Boskin Commission's . . . recommendation that the Bureau of Labor Statistics should establish a cost-of-living index as its objective in measuring consumer prices, taken by them as essentially obvious, is a contentious proposition that requires serious argument. In fact it is unclear that a quality-corrected cost-of-living index in a world with many heterogeneous agents is an operational concept'."[3]

The refrain of "different users need different tools" was sounded early and often. Schultze, for example, asked: "What kind of an index would a central banker want? Would the monetary authority want to distinguish between the index it sought to stabilize, and a different index that would provide the most informative guide about the current state of inflationary (or deflationary) pressures in the economy? Which index would be most appropriate for escalating Social Security benefits, and would that be the same as the measure used for indexing the tax code or inflation-indexed government bonds?"

Zvi Griliches agreed that considering the different applications of price data to analysis was important: "In particular, I think it is important to take into account the fact that different price indexes can and will be used for different purposes. While construction and publication of different indexes may be feasible for the BLS today, publication of multiple indexes can create political difficulties. For example, if the BLS published a large number of price indexes (more than it does now), which, if any, would be suitable for cost-of-living adjustments for Social Security payments?"

W. Erwin Diewert began to illuminate the specific technical choices that different end uses might drive. He also gave the statistical system credit for having created indexes that meet some of these user needs: "Multiple CPIs may be calculated that reflect different index number purposes or methodologies. For example, some users may feel that a *rental equivalence* or *user cost* approach to major consumer durable goods like housing is more appropriate than a *money purchases* or *acquisitions cost* approach. Thus statistical agencies may provide alternative indexes that reflect the two approaches. Similarly, some users may want a CPI that has incorporated hedonic quality adjustments or adjustments for increases in the size of consumer choice sets. On the other hand, other users may regard such adjustments as lacking in *objectivity* and *reproducibility* and demand a CPI without such adjustments. Finally, some users may want a price index for the domestic *purchases* of consumer goods and services while other users may want a price index that reflects domestic *sales*. Of course, this demand for multiple indexes is already being met by the statistical system: the first index is a traditional household CPI while the second index is part of the system of producer price indexes that is imbedded in the national accounts of each country."

The boundaries of a COLI (if COLI is the right 1). The participants analyzed the specific statistical and operational issues faced in producing a cost-of-living index. They generally bridged the gap with discussions of the conceptual boundaries of such an index. From Schultze: "Within the cost-of-living concept, how comprehensive should be the definition of the 'standard of living' or 'consumer well-being' underlying the cost-of-living index? What is the *universe of the standard of living* that is to be held constant? Decisions about this matter involve not only conceptual issues but questions of feasibility, objectivity, and public acceptance…. In discussing its longer run recommendations, the Boskin Commission implied a broad definition of the standard of living, including, for example, the positive or negative effects on that standard—and therefore on the COLI—from changes in the surrounding economic, social, and environmental climate…. It is possible, nevertheless, to make a few comments about some of the substantive issues involved in establishing the universe or the boundaries of what goes into the COLI. Start with the broadest or most abstract issue—conceptually, should the index incorporate the effects of broad environmental changes on the cost of living: crime, pollution, congestion, etc? One possible approach would be to adopt a definition of the COLI based on a conditional sub-index that would seek to measure the change in a household's expenditures required to prevent changes in market prices from altering its standard of living. In other words, the COLI would not attempt to measure changes in the cost of living that do not operate through changes in the prices of private goods and services."

Griliches noted that the boundary issue was a difficult one, but that its resolution remained pivotal for continued research. He asked: "What is the commodity and consumer space over which prices are measured? Among other issues, here I think it is important to recognize the link between BLS price measures and the GDP accounts at the BEA, and that there should

be consistency between national accounts and price measures. Two examples come to mind. The first involves treatment of auto emission controls. If the costs of mandated auto emission controls are taken into account when the BLS creates price indexes for, say, automobiles, then the quantity benefits of these controls should show up somewhere in the national GDP accounts. The second example of consistency issues involves the medical area. Here, the additional issue is that the BLS prices only the out-of-pocket payments by consumers in its medical CPI, plus making a general health insurance adjustment based on insurers' retained earnings. However, there is no price index that measures the 'purchases' and purchase prices paid by third-party payers, such as private insurance companies and governments. In the GDP accounts, there is an attempt to measure the real output of the medical sector, but the price indexes used to deflate expenditures are not right. There's a big need to focus on conceptual and practical consistency issues between BLS price measurement and the BEA's GDP measurement."

Diewert developed some of the theoretical issues involved in setting the conceptual boundaries of a cost-of-living index. In an argument for an expanded boundary for a cost-of-living concept, he wrote: "In Becker's model of consumer behavior, households combine their time with market goods and services to produce finally demanded commodities" that yield direct utility. For example, a consumer combines the services of a bed with time to produce 'sleep utility.' The theory also takes into account the disutility of time spent working on the external market and the disutility of the time spent commuting to work. The advantage in implementing this theory is that it will give a more complete picture of household activities: the time costs spent on each consumption activity will be valued at some opportunity cost of time and added to cost of purchasing goods and services from the marketplace.[4]

"Becker's model of consumer behavior is concerned with how the household combines purchases of consumer goods and services with its time to 'produce' final 'commodities' that are demanded by that household to satisfy wants. However, in recent years, as self-employment and contracting out of services have grown, many households are producing goods and services at home that are *sold* to other users. This home production for market sale is *not* taken into account in Becker's model and so it needs to be extended. The implications of this extension for the cost-of-living index are profound. Instead of just collecting information on typical consumer goods and services like food, clothing, housing, etc., the extended COL to cover household market production would have to include production-type inputs like materials (if a product was being made at home) or office equipment (if a business service was being provided) and various traditional consumer purchases (like heating fuel, telephone services, transportation, home computers, etc.) would have to be allocated between business and personal use. In addition to putting these business intermediate inputs into the scope of the COL, it would be necessary to account for the outputs produced as well."

Statistical issues

However broadly or narrowly one defines the boundary of the cost of living index, significant statistical issues appear. First is how to go about aggregating the tastes and demand functions of heterogeneous consumers. Schultze asked: "What is the appropriate way to aggregate across consumers with heterogeneous tastes to arrive at a single index? This question immediately raises the issue of plutocratic vs. democratic indexes and the issue of whether the BLS should regularly publish indexes for sub-groups of consumers. Let me just cover one point here. Empirical studies that have compared the path of sub-group indexes with the overall CPI have typically found only modest divergence. Essentially, however, these have involved simply re-weighting a common set of component indexes. And it has been argued that the central issue is not so much one of differing weights and common prices, but the fact that the poor and the rich, the young and the old, often buy different qualities or brands of the same goods, face different prices, and shop in different outlets."[5]

Diewert also saw multiple dimensions of heterogeneity across which price data must be aggregated to create a cost-of-living index: "There are many technical and conceptual problems with the existing plutocratic[6] theory of the cost-of-living index that will be addressed in the coming decades. Some of these problems include:

1. Current theories for group cost-of-living indexes assume that each household in the reference population faces the same price for each commodity.[7] This is obviously not true.
2. The existing theories for group cost-of-living indexes assume that the reference population is the same in the two periods being compared. However, births, deaths, and immigration make this assumption untrue.
3. The theory of the COL index assumes that tastes remain unchanged in the two periods being compared. However, education, experience, the process of getting older, and advertising will systematically change tastes over time.
4. The theory of the COL index assumes that various environmental and/or demographic factors are the same in the two periods being compared (or alternatively, that preferences are separable from these environmental variables—an unrealistic assumption). Examples of such environmental or demographic variables are: the weather (it

affects fuel consumption for heating and air conditioning and it affects what kinds of leisure activities are undertaken), the presence of a new child in the household, the amount of pollution around the household, the condition of the local transportation infrastructure, etc. For some hints on how these problems could be addressed in the context of COL theory, see Caves, Christensen, and Diewert (1982) and Pollak (1989)."[8]

Seasonal adjustment. Any statistical time series produced on a monthly basis must take into account the possibility of seasonal fluctuations and adopt some method of dealing with them. Diewert provided an instructive example and suggests a thought-provoking approach: "Two decades ago, Ralph Turvey (1979) sent around an artificial data [set] that had seasonal commodities in it that were not available in every month of the year. He then asked each statistical agency to use their normal seasonal adjustment procedures on this data set and to report the results back to him. Needless to say, he found a disconcerting spread in the resulting answers. This is to be expected since it is difficult or impossible to compare the price of grapes in the present month when they are in season with the price of grapes in another month when they are simply not available. [I] recently took another look at this very old problem and recommended that statistical agencies should construct at least three families of consumer price indexes to deal with this problem.[9] The first index should be a short-term month-to-month index defined over nonseasonal commodities. This index should be useful for the purpose of monitoring short-run inflationary trends in the economy. The second index should be a year-over-year index, where the prices in January are compared to the January prices of a base year, the prices in February are compared to the February prices of a base year, etc. This index should give an accurate measure of year-over-year inflation, which is free from seasonal influences. The third index should be an annual one, which compares a moving total of 12 months with 12 base year months.[10] This type of annual index can serve as a substitute for the present classes of seasonally adjusted price indexes that rely on 'black box' time series methods for seasonal adjustment. Thus again, there is a demand for a family of indexes rather than a single CPI."

Quality adjustment. Many of the participants cited the difficulties surrounding the issue of quality adjustment. BLS Commissioner Katharine G. Abraham, in remarks that bridged the statistical and operational issues, outlined the Bureau's practical approach to adjusting prices for the changing quality of goods and services: "We are working to expand the use of hedonic quality adjustment methods in the construction of the CPI. Hedonic methods already are used in producing the CPI housing, apparel, television, and computer indexes. We are working to develop hedonic models for a range of additional products. Those selected for model development work in 1999 include telephones, VCRs, DVD players, camcorders, refrigerators, microwave ovens, washers, dryers and audio products."[11]

How to more precisely capture the impact of goods and services that were not part of the sampling methodology is somewhat more clearly a part of the operational problem. In this vein, Schultze remarked: "The next class of issues involves the question of whether to try to measure the consumer surpluses created and destroyed by the introduction and disappearance of goods, and of different varieties of existing goods à la Hausman, and by the changing composition of retail outlets. Whatever the theoretical pros and cons of defining the COLI to include the effect of these consumer surpluses, the fact is that at the moment neither the BLS nor anyone else is in the position of being able to estimate with any confidence the magnitude of the net changes in consumer surplus across a broad range of consumer expenditures. For example, there can be disagreement on the appropriate econometric specifications for measuring the consumer surpluses—look at Bresnahan's comments on Hausman.[12] And extending such estimates across the multiplicity of product categories in an economy characterized by imperfect competition and market strategies driven by product differentiation boggles the mind. Right now we simply do not know what ten to fifteen years of further academic and government research might produce by way of new or improved techniques for dealing with this issue."

The experimental use of scanner data may help develop methods to identify new products, as well as to improve other aspects of the Bureau's consumer price programs. According to Commissioner Abraham, an "important area of BLS research activity relates to the use of scanner data.[13] We currently are engaged in a test effort to produce real-time CPIs for certain products in certain geographic areas (specifically, in the first instance, breakfast cereals in the New York metropolitan area) using scanner data as an alternative to data collected by our field economists. So far, that test seems to be going well. Ultimately, of course, scanner data should be helpful for dealing with shifts in product mix and the emergence of new products."

Diewert envisioned extending these approaches to a more expansive use of new electronic data collection techniques. He suggested: "Firms will be asked to submit detailed price and quantity data from their own electronic records via the Internet to their statistical agency representative. Firms will also be asked to submit their basic accounting data via the Internet. This will be facilitated by the widespread adoption by firms of computer driven accounting packages like Sim-

ply Accounting or Quicken for small firms and by customized accounting packages for large firms…. Recent developments associated with the expansion of Internet services make it possible to collect some types of price information cheaply over the Internet. For example, there are Internet sites that collect information on prices for autos, standard insurance policies, computers. and many other products so that consumers can shop for the lowest prices. Internet auction sites might make it possible to collect information on the prices of used durable consumer and producer goods."

Even seemingly mundane matters as product and service classification will have an impact on more accurate measures of consumer prices. Said Commissioner Abraham: "One important thing we're involved in that might not generally be considered research is a major interagency—indeed, international—effort to develop a comprehensive product classification structure.[14] In addition to staff from the BLS, the Bureau of Economic Analysis (BEA) and the Bureau of the Census, Canada and Mexico also are engaged in this effort, which follows work done to develop the new North American Industry Classification System. I mention product classification in the present context for the reason that, if done well, a service sector product classification structure will go a long way towards defining the output of the service sector in an operationally useful fashion."

Sectoral issues

The participants agreed that there were many sector-specific issues that would challenge price measurement even after the more general challenges were met. Commissioner Abraham's reference to the service sector touched on one of the more difficult. As she observed in her opening remarks: "One major problem area is service sector measurement. Measurement can't begin without an output definition, and, for many services, there is no consensus regarding the appropriate definition. Customization of output is an important complication. If no two customers purchase exactly the same product, what rules can be used for defining the output that has been produced? This isn't a problem that is restricted to the service sector—it long has been important in construction and may be increasingly important in goods production more generally—but it certainly is a very serious problem for service sector measurement…. The nature of these problems is such that no general solution to them is possible. Rather, much of the work to improve our price and output measures must proceed on an industry-by-industry, product-by-product basis. That's not to say there won't be spillovers from studies in one industry or product that inform thinking about another, but rather that each ultimately will require individual analysis."

Brent Moulton identified some more of the industries in which prices have proven especially difficult to measure, and noted that "there is a lack of good price data for construction, especially non-residential construction. The recent Gullickson-Harper study of "problem" industries, as identified by long-run negative trends in multifactor productivity, drew attention to construction, as well as banking and insurance."[15] In consensus with most of the participants, he also singled out medical care services as an area in which statisticians face extraordinary challenges; he stated: "Measurement of medical care services has received a lot more attention recently, and was the topic of a recent CRIW conference. BLS is to be congratulated for developing PPI's that track a course of treatment instead of inputs. Nevertheless, much work remains in the area of quality adjustment." Commissioner Abraham outlined some of the work that is currently underway in medical care pricing; she noted: "In the medical care arena, working collaboratively with National Bureau of Economic Research (NBER) researchers, we are exploring the use of third-party databases to identify shifts in hospital treatment patterns that may affect what we should be pricing.[16] Under standard Producer Price Index (PPI) procedures, a hospital procedure selected for pricing would continue to be priced until the next time the survey sample was redrawn. In this case, however, we are seeking a way to identify new treatments that are now competing with older treatments and, where such new treatments can be identified, to begin substituting toward them in our pricing sample to reflect their current period usage."

The challenge of survey management

Charles Schultze quite neatly summed up the management issues that these research strategies bring forth: "It is necessary to consider the problem of balancing competing objectives in index construction. There is, for example, a tradeoff among the objectives of conceptual rigor, measurement feasibility, public credibility, and budget costs. (Budget costs should not be underrated as a criterion: some components that have been suggested for inclusion in a COLI would be exceedingly costly to measure with reasonable accuracy across a broad spectrum of goods and services, assuming they could be measured at all)." □

Notes

AUTHORS' IDENTIFICATION: Conference participants made formal panel presentations on July 21, 1999, at the NBER Productivity Program of the Summer Institute; they included:

Katharine Abraham (Commissioner of the U.S. Bureau of Labor Statistics);

Ernst Berndt (Massachusetts Institute of Technology and NBER);

W. Erwin Diewert (University of British Columbia and NBER);

Zvi Griliches (Harvard University and NBER);

Brent Moulton (Associate Director for National Income, Expenditure and Wealth Accounts, U.S. Bureau of Economic Analysis, and formerly Chief of the Division of Price and Index Number Research at the U.S. Bureau of Labor Statistics);

Charles Schultze (Brookings Institution, Chairman of the Council of Economic Advisors under President Carter, and recently named to chair a National Academy of Sciences Panel on the Conceptual, Measurement and Other Statistical Issues in Developing Cost of Living Indexes; he spoke for himself, not the Panel);

Jack Triplett (Brookings Institution and formerly Chief Economist at the U.S. Bureau of Economic Analysis).

[1] Note that the comments by Zvi Griliches have been transcribed from notes taken by Ernst Berndt; Professor Griliches was not able to review them, as he passed away on November 4, 1999.

[2] Citation from a conference presentation by Peter Hill, "The Measurement of Inflation and Changes in the Cost of Living," prepared for the Conference of European Statisticians, Joint ECE/ILO Meeting on Consumer Price Indices, Geneva, November 24–27, 1997.

[3] Citation from the article by Angus Deaton, "Getting Prices Right: What Should Be Done?" *Journal of Economic Perspectives*, Winter 1998, pp. 37–46.

[4] Robert A. Pollak and Michael L. Wachter note that it will be difficult to accurately determine the full price (including its time cost) of each finally demanded "commodity." However, for the purpose of constructing a cost-of-living index, it is not necessary to construct these full prices: all that is required is information on the household's purchases of market goods and services, an opportunity cost of time (usually an external market wage rate), and information on the household's allocation of time across activities. For further information, see "The Relevance of the Household Production Function and its Implications of the Allocation of Time," *Journal of Political Economy,* April 1975, pp. 255–277.

[5] See Robert Pollak, "The Consumer Price Index: A Research Agenda and Three Proposals," *Journal of Economic Perspectives*, Winter 1998, pp. 69–78.

[6] This is a term coined by S. J. Prais. It refers to the current concept of the consumer price index, which weights households according to their expenditures, so that rich households get more weight in the index than poor households. Further information may be found in the article, "Whose Cost of Living?" *The Review of Economic Studies*, February 1959, pp. 126–34.

[7] See Robert A. Pollak, "Group Cost-of-Living Indexes," *American Economic Review,* May 1980, pp. 273–78 and "The Social Cost-of-Living Index," *Journal of Public Economics,* June 1981, pp. 311–36; or W. Erwin Diewert, "The Theory of the Cost of Living Index and the Measurement of Welfare Change," in W. Erwin Diewert and Claude Montmarquette, eds., *Price Level Measurement,* (Ottawa, Statistics Canada, 1983), pp. 163–233; reprint: ed., W. Erwin Diewert, *Price Level Measurement* (Amsterdam, North-Holland, 1990), pp. 79–147.

[8] See Douglas W. Caves, Laurits R. Christensen, and W. Erwin Diewert, "The Economic Theory of Index Numbers and the Measurement of Input, Output and Productivity," *Econometrica,* November 1982, pp. 1409–11; and Robert A. Pollak, *The Theory of the Cost-of-Living Index* (Oxford, Oxford University Press, 1989), pp. 181–85.

[9] W. Erwin Diewert, "Index Number Approaches to Seasonal Adjustment," *Macroeconomic Dynamics,* March 1999, pp. 48–68.

[10] This index can be built up from the second class of year-over-year indexes.

[11] Dennis Fixler, Charles Fortuna, John Greenlees, and Walter Lane, "The Use of Hedonic Regressions to Handle Quality Change: The Experience in the U.S. CPI," paper presented at the Fifth Meeting of the International Working Group on Price Indexes, Reykjavik, Iceland, August 25–27, 1999.

[12] Timothy F. Bresnahan, "Comment on Hausman," in Timothy F. Bresnahan and Robert J. Gordon, eds., *The Economics of New Goods,* National Bureau of Economic Research Studies in Income and Wealth, Vol. 58 (Chicago, University of Chicago Press, 1997), pp. 237–47.

[13] Ralph Bradley, William Cook, Sylvia Leaver, and Brent Moulton, "An Overview of Research on Potential Uses of Scanner Data in the U.S. CPI," paper presented at the Third Meeting of the International Working Group on Price Indexes, Washington, DC, April 16–18, 1998.

[14] "Economic Classification Policy Committee; Initiative to Create a Product Classification System, Phase 1: Exploratory Effort to Classify Service Products," *Federal Register* (Office of Management and Budget, April 16, 1999), 18984-89.

[15] William Gullickson and Michael J. Harper, "Possible measurement bias in aggregate productivity growth," *Monthly Labor Review,* February 1999, pp. 47–67.

[16] "Medical Care Quality Adjustment Initiative in the Producer Price Index," unpublished document, Bureau of Labor Statistics, 1999.