New goods as a challenge for index number making

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The basic technology for the making of price indexes is *long* established (for the early history, see Diewert 1993a) -- so much so that many treat price index making as a purely mechanical exercise. This is despite the pervasive importance of price indexes in both real world economic affairs and economic research. Values of the Consumer Price Index (CPI) affect the determination of national monetary policies, the behaviour of financial investors, transfer payments to individuals, wage negotiations, and much more. The index number methods pioneered for consumer price index construction are used as well, in modified forms, for producing a variety of other price and quantity indexes. And price index values directly enter into the construction of measures of national output such as real GDP and measures of productivity for the Canadian economy.

  The underlying technology for the construction of price and quantity indexes makes use of price and quantity measurements over time for a basket of goods and services that is viewed conceptually as being *fixed* in composition. This fixed basket is supposed to be representative of the universe of goods and services covered by an index. So what about new goods? What *are* new goods, for a start? How can they be brought into a "fixed basket"? The questions considered in this note challenge the prevalent view that the important problems of index number making have all been solved. A longer companion paper considers these issues in greater depth, and documents the treatment of new goods in the producer price index systems of Canada and Japan (see Baldwin, Després, Nakamura and Nakamura, 1996).

  Alternative definitions of new goods are considered in sections I and II. Sections III-V deal with the conceptual relationships of new goods, varieties of goods, and new processes for producing goods. Section VI concludes.

I. THE ECONOMICS INDEX NUMBER LITERATURE ON NEW GOODS

Like several other economists who have written on this topic, Diewert sums up the new goods problem as one of missing prices:

> Obviously, the quantity of a "new" good produced or consumed in the period before its introduction is zero. However, the economic theory of index numbers requires a price to go along with this zero quantity--what should this price be? (Diewert 1993b, p. 25)

The suggested solutions that Diewert reviews provide further clarification of the underlying definition for a new good in much of the economics literature. One solution is to ignore a new good in the first pricing period in which it is introduced, and to bring it into the market basket from the second period using the chain approach. Marshall (1887) is credited with suggesting this. A second approach involves imputing the missing price for a new good for the period prior to when it first appeared. To do this, a conceptual characterization of the missing price must be developed. Diewert sums up Hicks' (1940) characterization of the unobservable price:

> (i) from the viewpoint of a consumer buying units of the "new" good in the first period that it makes its appearance, the price in the previous period should be that price which would have been just high enough to have driven the purchaser's demand down to zero and (ii) from the viewpoint of the producer of the "new" good, the price in the previous period should be that price which would have been just low enough to have induced the producer to supply zero units. (Diewert 1993b, p. 25)

The imputed prices approach recommended by economists such as Hicks and Diewert implies the following *market behaviour new goods definition*:

(D1)   A new good is a good that is available in the present period, and for which there was no demand in the previous period because potential customers believed it could not be supplied at any price they would be willing to pay or there was no supply because potential producers believed it could not be sold at any price for which they would be willing to produce the good.

Marshall's approach of ignoring new goods in the first period of their existence suggests a simpler *new goods definition based on availability*:

(D2)   A new good is a good that is available in the present period, and that was not available in the previous period.

Definition D2, which encompasses definition D1, would allow for goods that no one had thought of prior to their appearance.

II. A TRADITIONAL INDEX MAKER'S DEFINITION OF A NEW GOOD

Our research suggests that the *de facto operational definition of a new good* for many statistical agencies is qualitatively different from D1 or D2, and more along the lines of the following:

(D3)   A new good is a good that is included (or being considered for inclusion) in an index number basket in the current period for this index, but that was not included in previous periods; or a previously included good for which the index status has been, is going to be, or is being considered for being upgraded.

The above definition reflects the reality that a new good is brought into an official price index through a series of steps: steps which by their institutional and operational nature are not taken before a "new good becomes well established with substantial levels of sales. There is a basket inclusion step, which may then be followed, soon or after a delay of years, by an upgrading of index status in terms of (a) the creation of a separate elemental index or (b) introduction into the price sample, or (c) both (in either order over time or simultaneously). A real example may help to clarify these steps.

Consider the treatment of fibre optic cable in the Canadian producer price index system. Fibre optic cable was, in fact, introduced into the index basket in the first basket reference year as part of the elementary index for miscellaneous glass products. Thus, fibre optic cable's elemental index has both existed and been covered by the producer price indexes in Canada for many years. However, it does not have its own elemental index. It is a new good in the operational statistical agency sense that it has been under consideration for this upgrade in index status, and will in fact get its own elemental index when the industry price indexes move to a 1992 basket. Even then, however, fibre optic cable may still not be included in the price sample. *Proxy pricing* is used for fibre optic cable now, and for numerous other goods in the index basket including many with their own elemental indexes. The reason for this proxy pricing is that there is expense associated with the collection of price quotes. This is not a missing prices problem in the sense of prices that were *unobservable* in the previous period. It is a missing prices problem due to budgetary constraints and the necessary

allocative decisions at the agency level. The distinction is important.

The seriousness of the new goods biases attributable to the fact that goods are not included in index baskets in the first pricing periods when they appear in markets is limited by the *low transaction volumes* for most newly available good. The budgetary restraint and allocation related biases due to delays of years in the introduction into the basket, and then the upgrading of status of goods to the sample for which actual price quotes are collected, are almost surely far more serious. Academic index number theorists and statistical agency officials tend to communicate badly on new goods issues when the distinction between these two aspects of the overall new goods bias problem is not explicitly recognized.

III. QUALITY CHANGE AS A SOURCE OF NEW GOODS

However, there is also a substantive interaction between the unobservable prices and the price collection resource limitations components of the new good bias problem. Many new goods evolve rapidly after first becoming available, leaving statistical agencies with a problem of trying to decide on specifications for these goods. Which variety or varieties should be included, and which ones should be priced?

The treatment of quality change for successive varieties of a good is inextricably interrelated with the treatment of new goods even though, to most of us, new models of cars and new styles of clothes and shoes are not "new goods." Statistical agencies use a number of methods for relating new varieties of goods to ones they were previously pricing.

Direct comparison is used when the new variety is viewed as the same, in quality terms, as the old one. The entire price difference is treated as a pure price increase or decrease.

The other methods allow for changes in quality.

If both the new good or variety and the old one were available in the same pricing period and if the price difference between them can be viewed as solely reflecting the quality difference, then relative prices for the goods at a point in time can be used in *linking* the price for the new good or variety to the price for the old one. A second method makes use of *cost evaluation* information for stated quality changes. Usually the cost information comes from the reports of manufacturers on the quality changes instituted in their products and the costs of making these changes. A third approach is to use available prices for different models of the good of interest and information about the characteristics of these models deemed to affect prices to estimate

the values of the characteristics. In this *hedonic approach*, the estimates of characteristic values are then used to allow for quality differences in relating the price for a new model to the price for the old one.

All of the above approaches involve relating new varieties of goods to old goods. A different type of approach is to treat new varieties as distinct goods: in particular, as new goods. Triplett comments on this approach in the context of the old Wholesale Price Index (WPI) for the United States:

> A traditional method for handling the quality problem in index numbers has been to convert it into the (supposedly) more tractable product-mix problem: different varieties are treated as if they were different products. In the WPI, for example, prices may be collected for several varieties of an item of machinery and separate components published for each of them. Then, when the quality of machines improves, it may be possible to allow for the change by shifting the weights attached to each of the separate subcomponents.   (Triplett 1971, p. 199)

The choices about when to quality adjust, when to ignore changes in goods for pricing purposes, and when to treat changed goods as new goods are the operational reasons why the treatment of new goods is interrelated with the treatment of quality change in official price statistics. New varieties of old goods that are treated as new goods may be new in either the market or the availability sense of D1 or D2, or in the operational sense of D3.

IV. THE NEW GOODS PROBLEM IN THE CONTEXT OF HEDONIC PRICING

In the hedonic approach to pricing, sellers and buyers are viewed as transacting characteristics of goods. That is, goods are viewed as bundles of marketable characteristics. Theoretically at least, this approach makes it possible to deal with many more goods that are new in an operational sense -- and perhaps in market or availability respects as well -- as quality adjusted varieties of goods that were already included in the index. Nevertheless, there are at least two ways in which a new goods problem can arise in this context. The first is with the appearance of goods with new characteristics. The second is if old characteristics are combined in a new way that cannot be represented using a hedonic equation estimated with data for the previously available goods and their characteristics.

V. NEW WAYS OF PRODUCING GOODS AND SERVICES

It is also the case that none of the methods of allowing for quality change that have been considered will necessarily capture the effects that new or

improved goods may have on the costs or usability of *other* old goods that are produced or used together with the new or improved ones.

Remarks in Gordon's 1990 book, *The Measurement of Durable Goods Prices*, make it clear that this sort of secondary new goods bias problem may be substantial. Gordon writes about his book production process:

> Since this is a book about quality change and technological progress in durable goods, a word is in order about the change in the production technology of this book between the 1974 and 1988 versions. The draft of the first version was typed on a Smith-Corona portable typewriter and retyped in its entirety, often several times, by a secretary using an IBM selectric typewriter. Any change that I might have contemplated, particularly an extra paragraph early in a chapter, required extensive retyping by the secretary and a difficult cost-benefit calculation as to whether it was really worth it. Technology was a barrier to improvements in substance. In contrast, the new chapters written in 1988 were composed and printed at the level of professional typesetting inside my home by a 386 "clone" personal computer, a Hewlett-Packard laser printer, and WordPerfect 5.0. Revisions could be made instantly and chapters reprinted at the rate of eight pages per minute, all without any involvement of a secretary.   (Gordon 1990, p. xvi)

In the case study example laid out in the above quotation, there are two processes for producing printed manuscript pages: a typewriter based "process A," and a personal computer based "process B." Input collection A for process A consists of a Smith-Corona portable typewriter, an IBM selectric typewriter, and a secretary. Input collection B consists of a 386 "clone" personal computer, a Hewlett-Packard laser printer of a given vintage, and WordPerfect 5.0. (For convenience, Professor Gordon's typing time is ignored as a free input good.)

Printed pages are not a new good at any point over the 1974-88 period, by any of our above definitions. Rather, they are an "old" good for which the price has been falling because of the declines in price and spreading adoption of new machinery. The impacts of the new machines on prices might be sorted out more appropriately if the personal computer were treated as a quality adjusted typewriter, perhaps using printed pages as the metric for making this adjustment much as MIPS are sometimes used in quality adjusting new models of computers. However, quality adjustment between dissimilar goods like typewriters and personal computers would place a much heavier burden on statistical agencies, and is not being

attempted for any of the price index systems examined in this paper.

Alternatively, statistical agencies might go further in making price information readily available for elemental goods categories. This information together with information on the alternative technologies used for producing outputs of interest, including their prevalence, could then be used by other researchers to compute and explain price movements for particular output goods. This would be an output-good-specific, microsimulation sort of approach to estimating price changes.

VI. CONCLUDING REMARKS

We believe that new goods -- goods that are new in all of the various perspectives discussed -- are pervasive. We believe new goods have profound implications for the measurement of price level changes over time. We believe that major challenges remain for arriving at satisfactory procedures for dealing with new goods in official statistics. And we feel it is important for economists to pay more attention to the new goods problems the statistical agencies are operationally struggling with.

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