

Addressing the New Goods Problem in the Consumer Price Index

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A frequent criticism of the U.S. CPI—and, presumably other countries' CPIs as well—is its failure to include the price movement of new goods and services quickly enough after consumers start buying them. Recently in the U.S. it often seems that many consumer goods and services (or their characteristics and features) are changing more frequently than their prices; this may be one reason why this issue has become increasingly prominent.

The CPI item samples, regardless of how carefully designed to represent the consumer items the target population buys, generally do not represent the set of items that consumers are *currently* buying. There are some practical limits to how current the items can really be. The CPI is a measure of *change*; change is something that occurs over time. The old practical way to measure change is to make multiple observations at fixed intervals. Consequently, the set of items the CPI uses cannot include items that have not been in the marketplace for a minimum of two periods. In practice the need to draw a proper sample of consumer item means they must be in the market place for much longer than two periods. The CPI item samples contain a selection of items that consumers bought during the item samples' initiation reference periods and, absent some special effort, omit items that arrive after that time. An important exception is items that enter the sample as *replacements* for previously selected sample items (usually things that have exited the market). As discussed below, replacements can in principle be very new items, although traditional CPI procedures work against this. As a result of the care we take conducting the sampling, any retail outlets in which the U.S. CPI collects prices must be at least 2 years old and the newest item that the CPI is following—other than those brought in by replacement—must be a minimum of six months old.

The objective of the CPI is to be an unbiased estimate of the change in the prices of the consumer items being consumed now, mimicking consumer behavior as new items displace the old ones. In addition, there are statistical objectives (low variance on the estimates) and practical ones (keep the CPI's cost within budget). There are two ways that ignoring the arrival of new items may bias a CPI. First, their prices may move differently than the prices of old items do.

There are arguments that the new goods and services do exhibit different price behavior. Some types of new items enter at a high price and then experience price declines. Other types of new items do the opposite, entering at a low introductory price and then undergoing price increases if they become established. Items following a “U-shaped cost curve” exhibit an initial price decline and a subsequent relative price increase as they mature.

The second way that ignoring new goods may bias the CPI is that the new goods in some sense replace or displace existing products. This fact may make it appropriate for the CPI to replace the items in its sample with the new items that serve the same consumer need in a new way. To the degree that we are able to put new goods into the samples as replacements for old goods and the degree that we can isolate the price and quality differences between them, we could solve the major part of what we now call *the new goods problem*.

The index number literature generally ignores new goods; the usual assumption is that there is a set of consumer items whose prices and quantities are greater than zero in all time periods under consideration. The recent conference volume *The Economics of New Goods* presents several papers that describe how failures of this assumption can be addressed.¹ Another interesting exception is the paper² that Bert Balk presented at the 1999 meeting of the Ottawa Group. The paper proposes a way one can modify the Constant Elasticity of Substitution index formula to account for the arrival of new consumer items that didn’t exist in an earlier period and the disappearance of other items that are no longer available in a later period. As the U.S. CPI experiments with new index methods and formulas, we should be open to trying to adopt extensions such as the one Balk proposed.

The U.S. CPI has long had procedures—*reinitiation*, *replacement* (or *substitution*³), *augmentation*, and *rotation*—that put new items into play, but we never focused specifically on trying to incorporate new goods as soon as they appear. There are two likely reasons for our

¹ *The Economics of New Goods* (T. Bresnahan and R.J. Gordon, eds.), Studies in Income and Wealth, Vol. 58, University of Chicago Press, 1997.

² Bert M. Balk, “On Curing the CPI’s Substitution and New Goods Bias”, Rosmundur Gudnason, ed., *Proceedings of the Fifth Meeting of the International Working Group in Price Indices*, Statistics Iceland, forthcoming.

³ I’m using the terminology the way Ralph Turvey has proposed for the new edition of the International CPI Handbook. What he calls *replacement* we in the U.S. CPI have always called *substitution*. Turvey reserves the term *substitution* for the behavior of consumers as they switch from one item to another or from one outlet to another in response to changes in relative prices. At the same time he suggest that we use the term *replacement* to refer to what we CPI practitioners do when we find a new item (or outlet) as a successor for one we used to have in our sample.

seeming indifference to this. First, the U.S. CPI has been a Laspeyres index, which is the change in the cost of what was bought in the base period, and, consequently, is concerned with new goods and services only to the extent that they are replacements for goods and services that have disappeared since the base period. Since January 1999 the U.S. CPI has used a hybrid of the Laspeyres and geometric mean index formulas; this weakens that rationale for ignoring new items.

A second reason for not sampling new goods instantaneously is a desire to avoid difficult quality adjustment situations. The CPI procedures instruct data collectors to follow the prices of the items they started with for as long as they can, which may be well after the item has become obsolete. Only when data collectors are forced by circumstances beyond their control (most commonly when the sample outlet no longer sells the initiated item) are they to find a replacement item. When they do replace a sample item, the procedure calls for the replacement to be the item that the outlet currently sells that is most similar to the original item; the replacement may not be what most consumers are currently buying, rather it may be something almost as obsolete as the discontinued item. These established practices tended to keep new items out of the CPI between sample rotations or, in some cases, between revisions.

Types of new goods. The debate over how well the CPI handles consumer items that arrive in the marketplace after the index's base period can be confusing. One source of the confusion seems to result from the variety of cases of new goods. We have identified five general categories or types of new goods (or services). Each can lead to a different problem for the CPI and there likely are different ways to improve the handling of each one. Sometimes when one person is talking about the new goods problem, s/he is thinking of just one of the cases and the listener is thinking of a different one.

The problem the *generic equivalents* category presents is that, absent some special procedure, the CPI doesn't recognize that many consumers are indifferent between the original good and the new arrivals and therefore will buy whatever is the cheapest. Unless a special effort is made, the CPI ignores this behavior and continues to price the original item.

Table 1		Types of New Goods	
Type of New Good	Definition	Predecessor(s)	Examples
1. Generic equivalent	Good that provides the same service as an existing good	Clear predecessor(s) that are not leaving the marketplace	Generic drugs; “house brands” of clothing
2. New variety	Good that widens the available options	Predecessors that are not immediately leaving the market	New varieties of cereal
3. Replacement model	A new model of an item that will be replacing a model that is becoming obsolete	Clear predecessor(s) that are leaving the marketplace	New model-year cars; new high-end computers; television
4. New approach	Good or service that provides an old service in a new way	Predecessors are quite different, they may eventually be driven from the market place	Microwave ovens; new drugs like Viagra that provide a better way to treat a medical problem
5. Radical innovation	Good or service that provides a completely new service	No clear predecessor; satisfies a consumer need that has not been addressed by any previous good	VCRs; cell phones; vaccines that treat a medical problem with a drug for the first time

The new goods that are in the *new varieties* category widen the options for consumers. Some will prefer the new option and some will not, but the added consumer choice can be seen as a price decline at one remove. The new variety may enter at a low price in an attempt to take market share from the established items, and then—if the new variety is a success—its price may rise to a level similar to those of the established items. In any event, CPI procedures do not reflect the value of the increased range of options.

The *replacement models* category is the case that has historically forced CPI action. When a new item drives an old one from the market place, the CPI must replace the old with something else; that replacement may be the new item or it may be something more similar to the old one. The problem for the CPI becomes how to compare the old price of the old item to the new price of the new item when the new item is different and often better. Having quality adjustment values, such as those from an hedonic model, can be very useful in this situation.

The *new approaches* category and the *radical innovations* category present particular problems. First, the new item is so different from anything that precedes it that it may command a premium price when it first arrives in the market. This price will fall over time as production gears up and as competitors enter the market. Second, unless the CPI is very flexible, the uniqueness of the new item may prevent it from being sampled as part of the normal replacement and rotation processes. Third, because the new items are so different from the old, it is difficult or impossible to make quality-adjusted price comparisons between them.

We can simplify the new goods problem somewhat by looking at the two issues of maintaining representative samples and of measuring the benefits of the new products. If we are systematically excluding a class of consumer items from consideration and if their price movement differs from that of the included goods, we will have a biased index. The deeper problem, however, is not whether we add new goods to the samples promptly. It is how to add new goods in a way that will reflect the improvement to living standards that the new goods provide.

CPI sampling methods. The CPI uses multistage probabilistic sampling to select the set of items whose prices it follows over time. The first sampling stage is the selection of geographic areas; the second is the selection of a sample of retail establishments (called *outlets*), and the final stage is the selection of consumer items in those outlets. At each stage sampling is probabilistic, meaning that the sample is drawn in proportion to the observed behavior of consumers at a point in time or during a recent time interval. There are many advantages to sampling in this way. A disadvantage, however, is that it takes some time to conduct the multistage sampling and identify the exact items whose prices we will follow. Consequently, the timeliness (how representative of what consumers are *currently* buying and where they are *currently* buying them) of the CPI samples suffers somewhat. The CPI follows the prices of items and outlets that represents what consumers bought and where they bought them at some point in the past, rather than the items they are buying, and the outlets they are buying them in, at the present time. It will be useful to review the CPI's sampling procedures with some attention paid to their effect on the timeliness of the samples.

The CPI is built from several surveys, each with its own sample and sampling method. All the CPI surveys have some procedures for *sample rotation* (replacing the old sample with a

new one) to keep them from becoming too out of date. Many of the CPI surveys are longitudinal (they observe each sample repeatedly at fixed intervals looking for changes in the key variable). During a rotation there is an overlap point in which the old sample is observed for the last time and the new sample for the first time. Some of the surveys also have procedures for *augmentation* (adding additional elements to the sample) and for *replacement* (or *substitution*, adding additional elements to the sample and dropping others). Rotation, augmentation and replacement help keep a survey from becoming out of date. One should note that these procedures are vehicles for putting *newly-selected items* into the samples. Newly-selected items represent what consumers are buying in a more recent period, but newly-selected items are not necessarily items that are *new to the market*.

Area samples. The first sampling stage is the selection of the pricing areas, geographic areas within the urban United States. The CPI has done this following each decennial census, at least since the 1960 Census. Consequently the sample of areas⁴ remains constant for about 10 years. In the United States there has been a noticeable, or at least commonly remarked on, phenomenon of people moving to lower cost areas, but our CPI does not reflect any such movement as price change. So, if we accept this, we can ignore the first sampling stage's effect on the sample timeliness. In any case, we *rotate* (replace the old sample with a new one) the area sample about every 10 years, but we do not have a program to *augment* (add additional elements to the sample) the area sample nor to *replace* area sample elements.

Outlet and item samples. With the pricing areas fixed for a long period, the subsequent sampling stages become our focus. To measure price change, the CPI uses two parallel surveys, the *CPI Commodities and Services (C&S) survey* and the *CPI Housing survey*. These are longitudinal surveys that follow the prices of a set of consumer items over time. Although the surveys observe price levels, we use them only to measure price change.

We will focus on the C&S survey and largely ignore the Housing survey. The Housing survey rotates once every decade, and has an augmentation feature that adds newly constructed units to its samples; its replacement procedure is limited to the fairly rare occurrence when a

⁴ It's not important for the discussion here, but for the record, the U.S. CPI has 87 CPI pricing areas, which we call *Primary Sampling Units (PSUs)*, and 38 CPI index areas, which consist of one or more PSUs. The we construct the elementary indexes for the CPI at the index-area level.

substantially-changed housing unit appears in the same location as the original one. Improvements to the Housing survey, such as more frequent rotations, are under consideration.

The C&S survey follows the prices of a set of consumer items in a set of retail outlets. The C&S Survey encompasses two stages of sampling, outlet sampling and item sampling. As we have noted, this combining of sampling stages may work against the objective of bringing in new items more quickly. The C&S survey *rotates* its outlet and item samples at the same time. During a sample rotation we draw a new outlet sample and then select a new item samples in each new outlet. In the future we hope to rotate the sample every four years instead of every five years as in the past.

C&S Outlet samples. For most CPI item strata the *Point of Purchase Survey (POPS)* provides the sampling frames for the outlet sample. The POPS yields a probability sample of outlets, for various item categories (called *POPS categories*), which correspond roughly to item strata. Introduced with the 1978 CPI Revision, the POPS was a major innovation to the CPI sampling procedures as it permits us to draw samples of outlets within various categories of consumer spending in proportion to consumers' spending in them.

The Census Bureau conducts the POPS for BLS. They draw a probability sample of households in the CPI pricing areas and ask them: (1) in what outlets did they buy items in each POPS category during a defined period of time, and (2) how much they spent in those outlets on those items during that time period. We recently began using an improved POPS (called the Telephone Point of Purchase Survey or TPOPS), which shortens the time needed to draw the outlet sample. In 1999 the CPI began the initiation of the first new group of outlets chosen from the TPOPS. By 2003, when the CPI has initiated an entire cycle of outlets based on TPOPS, the outlet samples will be significantly more current than they were before 1999.

The CPI uses POPS to rotate new outlets into its samples on a regular basis. The selection of each outlet in the CPI's outlet samples is based on a purchase reported on the POPS. The outlet samples we draw from the POPS sampling frames represent the universe of outlets as it existed at the time the POPS households made the purchases they reported. The POPS reporting period ends just before the POPS interview. The length of the period varies with the POPS category, depending on how frequently people tend to buy the items in it. The period can be as

short as one week for categories whose items are bought frequently. For a few categories it is as long as five years, although it is one year or less for most categories. Hence the actual expenditure that we rely on for the outlet sample frame occurred sometime before—perhaps on average six months before—the POPS interview. The new TPOPS process interviews households every quarter and requires the next quarter to compile the data. Then over the next six to nine months the CPI staff combines two quarters of data, conducts outlet address refinement and outlet collapsing (used when a newly-selected outlet is already in the outlet sample), obtains clearance from the respondents for the outlets, and prepares the initiation materials. Over the next half year, CPI field staff conduct the initiation and, finally, two months after that, the CPI begins using prices collected in the new outlets. Consequently, it is more than two years from the time of the reported expenditure to the time of the first use of prices in the index. The TPOPS will rotate through all the POPS categories every four years, adding an additional two years to the average age of the outlet sample. This brings the expected average age of the outlets in the CPI sample, measured relative to the TPOPS expenditure base period, to something over four years.

C&S Item samples. BLS assigns item categories called *entry level items (ELIs)*⁵ to each sample outlet. Each ELI has an *ELI definition* and it is further defined by an *ELI checklist* which contains *specification elements* that define how a consumer item fits within its ELI. With the ELI definition and checklist BLS field agents select a sample of specific items within each ELI in each sample outlet. The weights of the items depend on the POPS and therefore the weights are only as timely as the POPS from which they were drawn. The sample of items depends on the sample reference period the BLS agent used when the outlet is initiated.

The actual items in the C&S samples are selected by the BLS field agents when they first visit a selected outlet. Working with a representative of the outlet the field agent *disaggregates* the ELI, working from its fairly broad definition through the ELI checklist's successively narrower subdivisions of it until reaching a *unique item* (something that has a unique price). Ideally, the field agent uses the share of revenue during a recent period to weight each step of disaggregation. If that is not available, the field agent asks the respondent to estimate revenue

⁵ ELIs are subdivisions of Item Strata, which are the main building blocks of the CPI. The POPS categories similarly consist of one or more ELIs. The distinctions among these can be ignored here.

shares over the period. For most ELIs the recommended period is the latest 12 months; this helps remove seasonal influences. As a result an item selected in this way represents things in the ELI that the outlet currently sells according to their sales over the past year. Very new items are, therefore, at a disadvantage because the outlet had no sales for them over part of the year.

Some complex ELIs may use a different disaggregation procedure. For example, those in the Medical care services *component* use a selection from the last 20 sales. In selecting a unique item to represent a hospital, the field agent asks for the last 20 bills it issued and then chooses one, using the total amount as a sampling weight. We use this method to reduce the burden on the respondent. It yields a more current unique item, but at the cost of omitting things that are affected by the seasons. We never use this method for highly seasonal items.

Once the unique item is selected, we send the field agents back to contact the outlet every month or every two months to observe the price of the selected item. In most cases, as long as the outlet continues to sell the item we keep it in our sample; this is true even when new models or versions of it arrive in the outlet. If the item is no longer available in the outlet, the field agent selects a replacement, using the guidelines in the checklist to find what is most similar. Finding the most similar item may cause us to move to another older item, rather than the new model or version that drove our selected item out of the outlet and into obsolescence. So the items in the C&S samples tend to become more aged over time and potentially less representative of current sales.

The New Goods Project. Recently, the BLS sought and received some extra funding to improve the CPI in a variety of ways. This extra funding is known by various names but here I'll refer to it as the CPI Improvement (or CPII) Initiative. Although the greater part of the CPII money went to other activities, particularly the expansion of the Consumer Expenditure Survey sample, the initiative provided some money for special data collection to incorporate new goods into the CPI in a more timely manner. It is also worth noting that BLS has an active project underway⁶ to investigate the use of scanner data to produce indexes. Scanner data provide a

⁶ David Richardson, "Scanner Indexes for the CPI", to be presented at the National Bureau of Economic Research Conference in September 2000.

number of advantages, in particular the ability to produce superlative basic indexes for the CPI; these would render most of the procedures proposed here unnecessary.

The CPII Initiative did not specify the precise manner in which new goods were to be identified and sampled. Consequently, the approach we have been taking is to identify methods or approaches that we can use to bring new goods into our samples quickly, and then to experiment with those approaches. Table 2 lists the numerous ways of bringing in new items that we identified and gave names to. The list is exhaustive rather than exclusive, in other words it covers (or tries to cover) every feasible case and combination. It may include some that are inferior in all respects to others; so that we will never even try to implement those. The list includes four methods—*regular outlet/item rotation*, *regular outlet/item augmentation*, *regular item replacement* and *regular item reinitiation*—that we have used all along; I refer to these—methods 1, 12, 17, and 19 in the table—as regular for that reason. They remain a feature of the U.S. CPI and are on the list primarily for comparison with the proposed new procedures. The other fifteen are the proposed new procedures, which are variations on three of the old procedures: They apply one of the old processes—*rotation*, *augmentation* or *replacement*—using them to bring in new consumer items quickly. We determined that regular item reinitiation, the last procedure in Table 2, was not a promising avenue to expand. I'll get into this later.

We expanded the other three existing procedures along two dimensions. The first was decoupling outlets from items. The entries in Table 2 explicitly distinguish whether a method is aimed at *outlets and items jointly*, *items individually*, or *outlets individually*. For example, up to now when we spoke about *augmentation* we meant *regular outlet/item augmentation*—bringing in additional outlets to the outlet sample and at the same time new sample items in those new outlets. But there may be cases when it is faster/cheaper/better just to add quotes to existing outlets.

Table 2 Ways to bring new items and outlets into the CPI samples more quickly				
Rotation-based ways				
Method	When used?	Compare to old item ?	Outlets	Items
1 Regular (directed) outlet/item rotation Initiate new outlets with new items and drop old outlets and their items after an overlap period	Follows 4 year rotation schedule, All POPS Categories in all CPI areas rotate every 4 years	No	New outlets from new POPS frames	Select a new set of items representing a more recent period's purchases for the entire ELI
2 Variable (directed) outlet/item rotation Same as above	Follow a more complex schedule that rotates some POPS categories more frequently and others less frequently	No	New outlets from new POPS frames	Select a new set of items representing a more recent period's purchases for the entire ELI
3 Directed item rotation Initiate items in old outlets and drop old items after an overlap period	Should be regularly scheduled for an ELI. Perhaps halfway between the regular outlet/item rotation	No	Old outlets	Select a new set of items representing a more recent period's purchases for the entire ELI
4 Directed outlet rotation with item overlap Price old outlet's item sample in new outlet during its initiation period	Should follow 4 year rotation schedule	Yes, briefly	New outlets from new POPS frames, mapped back to old outlets	Old items (try to find the same item in the new outlet, otherwise follow the replacement procedure to get the closest item)
5 Flexible (targeted) outlet/item rotation Temporarily put a POPS category on a more frequent schedule	Ad hoc, When we notice a new type of outlet	No	New outlets from new POPS frames	Select a new set of items representing a more recent period's purchases for the entire ELI
6 Targeted item rotation Initiate specific new items and drop old ones after an overlap period	Ad hoc, When we notice a new item we feel we can't ignore	No	Old outlets	Mandated specific new item replaces specific old item.
7 Targeted outlet rotation with item overlap Initiate specific new outlets; drop old ones take the items from old outlets to new.	Ad hoc, When we notice a new type of outlet	Yes	Find new outlets to stand in for an old ones	Old items (try to find the same item in the new outlet, otherwise follow the replacement procedure to get the closest item)

Table 2 Cont'd.					
Augmentation based ways					
Method	When used?	Compare to old item ?	Outlets	Items	
8 Directed outlet/item augmentation Add new outlets (that supplement old outlets) and initiate new items in them	Desire to beef up outlet sample, e.g., to account for new entrants following deregulation.	No	New outlets from new Non-POPS frames	Select a new set of items representing a more recent period's purchases for the entire ELI	
9 Directed item augmentation Add new quotes to existing outlets	An alternative to outlet/item augmentation	No	Old outlets	Select additional items representing a more recent period's purchases for the entire ELI	
10 Targeted outlet/item augmentation Add new outlets (that supplement old outlets) and initiate new items in them	Ad hoc, When we notice new outlets or outlet types that we feel we can't ignore	No	Specific new outlets added	Select a new items representing a more recent period's purchases for the entire ELI in the new outlets	
11 Targeted item augmentation Add specified unique item	Ad hoc; new item arrives that can't be ignored and there are no predecessors in the sample	No	Old outlets	Particular new item placed in sample	
12 Regular (forced) outlet/item augmentation Add new outlets (that supplement old outlets) and initiate new items in them	Forced by external circumstances. Triggered by sample deficiencies (e.g., outlets going out of business)	No	New outlets from old frames	Select a new set of items representing a more recent period's purchases for the entire ELI	

Table 2 (Cont'd.)				
Replacement-based ways				
Method	When used?	Compare to old item?	Outlets	Items
13 Directed item replacement Replace unique item or a class of items with new	Should be regularly scheduled for an ELI	Yes, if quality adjustment is possible	Old outlets	Disaggregate, within a narrow category that includes the old item.
14 Directed outlet replacement Replace an outlet for any reason	Ad hoc? New outlets mapped to old ones	Yes	New outlets from old frames	Old items or replacements selected with the standard replacement procedure
15 Targeted item replacement Replace unique item with a new item	Ad hoc, a new item arrives that can't be ignored and there are predecessors in the sample	Yes, quality adjustment is generally ready beforehand	Old outlets	Disaggregate between a particular new item and an old item to give the new a chance to replace old item
16 Targeted outlet replacement Replace an outlet we deem obsolete	Ad hoc, a new outlet or type of outlet arrives that we feel we can't ignore and there are predecessor outlets in the sample	Yes	Field agent finds a new outlet to stand in for an old one	Old items or replacements selected with the standard replacement procedure
17 Regular (forced) item replacement Find a replace a sample item whose price we can no longer follow	Forced by external circumstances. (disappearance of item from its outlet)	Yes, if quality adjustment is possible	Old outlets	Follow standard replacement procedure to get the item in the outlet that is most similar to old item that disappeared
18 Forced outlet replacement Find a new outlet to proxy for one we lose	When forced by external development (disappearance of outlet)	Yes	Field agent finds a new outlet to stand in for an old one	Old items or replacements selected with the standard replacement procedure
19 Regular item reinitiation Replace entire item sample for an ELI	Ad hoc, as collection forms are revised to define in new ways	No	Old outlets	Select new items to represent the entire ELI in a more recent period

Some of the new proposed procedures use the terms *forced* and others *directed* or *targeted* in their names. *Forced* procedures are triggered by external events. We launch *directed* and *targeted* procedures even though we do not have to. *Targeted* refers to a specific, unique (or nearly unique) new thing we want to add. *Directed* refers to a broader class (but narrower than an ELI) that contains some new items. The last important distinction among the methods is whether they are directed toward keeping the sample of outlets or the sample of items more current.

Some of the approaches are characterized as *ad hoc*. By this I mean that they depend on our taking notice of the arrival of a new item and then deciding to take some action. New goods appear in the market place sporadically. When they first show up it is not always obvious that they will be important. There are many new items that fail to catch on. It's easy to see later where we should have acted, but it's not as easy to identify the important ones immediately. Given our earlier trouble identifying new goods, this will likely be a significant disadvantage for the *ad hoc* methods. We are likely to apply them inconsistently. On the other hand we should keep them in our quiver for extreme cases, when we face some situation in which we really have to take immediate action.

Old and proposed new methods Lets take a more detailed tour through the various methods, considering how we apply or could apply them and when it is or would be appropriate to do so.

Rotation: Methods 1 to 7. Sample rotation updates a survey by swapping a new sample for its old one. Rotation is the main way the CPI keeps its surveys current. Rotation is always something the survey administrators choose to do; it is not something that circumstances beyond their control force them to do. As mentioned above, the CPI is nearing the end of a long effort to revamp the C&S rotation methods. Starting in 1999, we began to rotate C&S by item category rather than by CPI area. More importantly for the matter at hand for this paper, we also began rotating 1/8 of the cells every half year—so as to complete a full rotation over a four-year period. Previously we rotated 1/5 of the cells every year, which completed a full rotation cycle every five years. By 2003, after we complete a full rotation cycle under the new method, the CPI outlet samples—and with them the CPI items samples—will be more current than they have ever been at least since the modern CPI began in 1978.

- 1 Regular (directed) outlet/item rotation:** *Initiate new items in new outlets and drop old outlets and their items after an overlap period.* This is the traditional rotation program that the C&S survey has used for some time. For regular rotation there is a new POPS for a subset of the 6992 C&S cells (184 priced item strata in each of 38 areas). We draw a new sample of outlets for these cells from those reported on the new POPS, send BLS field agents into those outlets to select new items and begin following the prices of the new sample of items in the new outlets. While this is going on we continue to price the former sample for the cells. At *link month*, we price the old sample for the last time. We also price the new sample during link month. We base CPI's measure of price change for a cell on the old sample for the last time during link month. The next time we measure price change for the cell, we will use the price changes we observe in the new sample. The outlets and items in the new sample represent spending in a more recent period than that for the old sample. They are not necessarily newer outlets or items, since everything gets a chance of selection in CPI samples, but on average the new samples must contain newer retail outlets and items.
- 2 Variable (directed) outlet/item rotation:** *Rotate some POPS categories more frequently than others.* This is a proposed enhancement to regular rotation. The POPS treats all C&S cells the same. Each comes up for rotation at the same frequency, currently once in four years. Some cells, however, correspond to items and outlets that are in more stable markets and don't need frequent rotation. The idea underlying *variable (directed) outlet/item rotation* is to permanently put one class of cells on a fast track so they would rotate, say, every two years. To compensate for this, another set would have to move to a much slower track so that total cost would remain about the same. (The algebra of this tradeoff is not immediately obvious, and does not favor variable rotation. For example, assume that resources permit rotation of one-quarter of the total sample each year. If one half of all item categories were rotated on a two-year frequency, no resources would be available for rotation of the other categories. One feasible combination would be a two-year rotation for one quarter of the items, and a six-year rotation for the other three-quarters.)
- 3 Directed item rotation:** *Initiate items in old outlets and drop old items after an overlap period.* This method de-couples item rotation from outlet rotation. Under it, the item samples in an outlet would be swapped for new item samples at scheduled intervals. There would be a

link month during which both the new sample and old sample are collected, so that under the “law-of-one-price” assumption, no price change is missed. This method avoids the expense and time lags of the POPS process and gives new items—although not new outlets, of course—a chance to enter the samples between the full outlet/item rotation. It would be very useful if combined with *Variable (directed) outlet/item rotation* scheme for the POPS categories assigned to the slow track.

4 Directed outlet rotation with item overlap: *Price old outlet’s item sample in new outlet during its initiation period.* The previous proposal (*Directed item rotation*) above rotates items without rotating their outlets. The proposal here, *Directed outlet rotation with item overlap*, would do the reverse, rotating outlets without rotating items. This method would address *outlet substitution bias*, a common criticism of the CPI. The argument is that when newer, more efficient, outlets—like mass merchandisers or on-line retailers—appear on the scene offering lower prices, consumers quickly switch to them, but the CPI continues to follow the prices in the old outlets. Furthermore, when the CPI finally does rotate outlets, we do so in a manner that does not reflect the price differentials between the old outlets and the new ones. We argue that the way we shift samples undergoing rotation, observing both the old and new samples a one time point, prevents us from missing price change. Many—including the Boskin Commission⁷ and the Conference Board⁸—disagree; in doing so, they are implicitly challenging the underlying assumption of the law of one price. They must feel that when the same item is sold at the same time but at different quality-adjusted prices, that price difference is part of the dynamic of price change and not a reflection of other factors such as the quality of the shopping environment. *Directed outlet rotation with item overlap* would require a mapping between newly-selected outlets and those they will replace. We have not specified how this could or should be done. We do collect demographic as well as geographic information from the POPS respondents. Presumably, this would provide a way to link the POPS respondent corresponding to old outlet to the most similar respondent in the new POPS. In any case this would have to be decided before we could implement this method. Once we had a mapping between the old and new outlets, we could then try to

⁷ Michael J. Boskin et al., *Final Report of the Advisory Commission to Study the Consumer Price Index*, U.S. Government Printing Office, December 1996.

⁸ Paul W. McCracken, James Tobin et al., *Measuring Prices in A Dynamic Economy: Re-Examining the CPI*, The Conference Board, Special Report 1260-99-SR, 1999.

obtain the prices of the old outlets' items in its assigned new outlet. We could do this during the six-month period when we are initiating the new outlet. We would ask the field agent to try to find the exact same item in the new outlet. If they couldn't find it, they would follow our standard replacement procedure (described below under *Regular (forced) item replacement*). They would do the same thing that they do when any outlet stops selling an item we have been pricing. In many cases we would be able to make a price comparison between the price of the item in the new outlet and its price in the old one. Of course, doing so appropriately would require making an informed judgment about the value of any quality differentials between the services offered by the two outlets in question.

- 5 Flexible (targeted) outlet/item rotation:** *Temporarily put a POPS category on a more frequent schedule.* This method is a variation of *Variable (directed) outlet/item rotation*, in which we would decide to temporarily pull a POPS category out of the regular rotation schedule, where it is being collected in approximately 1/8 of the CPI areas each half year. Instead we would collect new outlet and item samples for it in all areas. This is an *ad hoc* procedure. We would presumably like to have some external measure that we could rely on to tell us when to trigger such an action. It is also fairly expensive and potentially disruptive to the POPS to meddle with the schedule and, at best would only bring the new outlets and items into use in the CPI a year after the decision to implement it. For these reasons this method should be reserved for cases where we need to bring in new outlets quickly. If we are just faced with a new item situation, other methods will be much more timely.
- 6 Targeted item rotation:** *Initiate specific new items and drop old ones after an overlap period.* In this method, one determines that we want certain new items in the item sample. We identify outlets currently in the sample where we believe the desired item is sold and conduct an item rotation in those outlets. But unlike *Directed item rotation*, where we allow any item in the category to have a chance of selection, we would predetermine the specific item, or narrow the range of the category for the selection, to guarantee or greatly increase the chance of selection of the desired items. This is a way to bring an important new consumer item into the CPI samples much faster than we normally would. One reason for doing this is a belief that the new item is experiencing unusual price movement that we want the CPI to reflect. Disadvantages of this method include the problem of defining the correct weight for the new item and the usual concerns over *ad hoc* methods.

7 Targeted outlet rotation with item overlap: *Initiate specific new outlets and drop old ones taking the items from the old outlets to the new.* This is for the situation where there are specific new kinds of outlets (the obvious current example is on-line retailers) that we want to bring in quickly. We could skip the whole POPS process and find a new source to select an outlet sample. We would then assign the new outlets to the old ones as best we could and let the new ones take over the old ones' items and item weights.

Augmentation: Methods 8 to 12. Augmentation is any process that adds additional members to a sample. The usual reason for an augmentation is that a sample is smaller, or has become smaller, than its original design specified. Another reason for an augmentation is to increase the sample size beyond what its original design called for, to improve the quality of the statistics based on the sample. Sometimes the quality of the statistics turns out to be poorer than we anticipated for the designed sample size, or perhaps decision makers decide to increase the statistical quality by increasing the samples. In the past, regular CPI augmentation has been carried out primarily to deal with samples that are smaller than the design called for. Although the CPI can handle deficient and empty cells, these conditions are clearly undesirable; so we regard the current augmentation process that addresses cell deficiency as a process that is forced by external circumstances. When we select outlet samples from a POPS at the time of rotation, we select additional outlets for each cell; we call these the *shadow sample*. The standard augmentation process, which here is called *Regular (forced) outlet/item augmentation*, (method 12 on table 2) takes outlets from the shadow sample and sends them out for initiation. In some cases a cell is deficient because the POPS failed to produce enough reported outlets. In those cases it is not possible to get additional outlets from the POPS frame, and we must either find an alternative sampling frame to provide a source of outlets or live with the deficient sample.

8 Directed outlet/item augmentation: *Add new outlets (that supplement old outlets) and initiate new items in them.* Perhaps the biggest drawback to the CPI's standard way of augmentation is that the sampling frame is old. If there are new types of outlets (such as on-line retailers) that we feel we must add to the samples, *Directed outlet/item augmentation* may be the vehicle for doing so. It does require a new sampling frame and an accurate estimate of the new outlet types' market shares. The new outlets can be added to the existing sample by giving them a share of the weight that is proportionate to their share of the market at a recent time point.

- 9 Directed item augmentation:** *Add new quotes to existing outlets.* Even when the outlet sample is sufficient, we may feel that the item sample no longer represents the universe. We have used this method occasionally in the past when we determined that the original sample size did not yield the anticipated statistical quality. This is appropriate when there are new items in the marketplace being sold in old outlets. An advantage is that it is fairly quick and inexpensive to add item sample in the existing outlet sample. One disadvantage is that there is noticeable correlation of price change among similar items in a single outlet; this correlation likely arises from the practices of the outlet. Consequently, additional quotes in a given outlet for a cell do not improve the measure of price change for the cell as much as quotes from new outlets.
- 10 Targeted outlet/item augmentation:** *Add new outlets (that supplement old outlets) and initiate new items in them.* The sudden arrival of a retailer or type of retailer may justify an accelerated way to bring a particular outlet. There is some concern that the larger on-line retailers may fall in this category. If we know their market share we can put them in the samples quickly, if not perfectly.
- 11 Targeted item augmentation:** *Add specified unique item.* Similarly the sudden arrival of a new product such as a new prescription drug may beg to get in the CPI item sample. If the outlets in the sample are selling it, there is no need to seek additional outlets.
- 12 Regular (forced) outlet/item augmentation:** *Add new outlets (that supplement old outlets) and initiate new items in them.* As discussed above, this is the traditional way to remedy deficient and void cells. If the frames themselves are not exhausted, we get additional outlets from the old frames and send them to the field for initiation.

Replacement: Methods 13 to 18. Replacement is a method by which a new item takes the place of an item already in the item sample. The advantage of replacement methods is that they generally provide an opportunity to compare the price of a new good or service to an old one. This advantage can be important. When there is a choice of ways to bring new items into a part of the CPI, replacement methods will often be preferable for this reason.

- 13 Directed item replacement:** *Replace unique item or a class of items with new.* Sometimes we decide we want to replace an item in our sample even though the outlet still sells it. A long-standing example is the way we handle model changeover for new vehicles. When the

vehicles for the new model year begin to outsell those for the previous year, we direct the CPI field agents to switch to them. For items that regularly go through such enhancements *Directed item replacement* can make the price change measurement more accurate. Without it the CPI would continue to follow the price of an item as long as its outlet sold it, even well after the arrival of a successor item that had rendered it obsolete. Moreover, when the outlet finally discontinued selling the item the regular replacement rules require the CPI field agent to replace it in the sample with the most similar thing that the store still sells. This could be something almost as obsolete. *Directed item replacement* works best when we have direct quality adjustment values for the change between the new model of the item and its predecessor. We have had a quality adjustment program for vehicles for many years. We are actively extending quality adjustment to other components. For example, building on extensive work in the Producer Price Index (PPI), we now have a hedonic quality adjustment program for computers. Once a quality adjustment program is developed for an item category it may be reasonable to institute a *Directed item replacement* program for it. After all, it does little good to have well-developed quality adjustment values unless there are opportunities to apply them. In this procedure the way we define the item is crucial. The way we are doing this for computers is to define the item we select at initiation as a “high end”, “mid-grade” or “budget” model. If, say, a high end model is selected initially, it will after some time slip down to “mid-grade” or less; likely, it will be pushed down when the newest model arrives and assumes the high-end role. This will trigger a sample replacement. We will drop the old model and bring in the new one, comparing the prices of the two, adjusting the price difference for the quality difference and show the remaining price difference as price change.

14 Directed outlet replacement: *Replace an outlet for any reason.* If we had success with the previous method, there is no reason we couldn't extend outlet replacement to cases where the old outlet hasn't gone away, but we feel it's appropriate to replace it with something else. This approach would have limited value, of course, if no source were available for comparing the quality of different outlets. Under this method we would refresh the outlet sample by drawing new outlets from the old frames and then taking the items from the old outlets into the new ones, comparing prices across the outlets to the extent possible.

- 15 Targeted item replacement:** *Replace unique item with a new item.* There are times when we want to bring a new item that is in some way a successor to an item in the sample. Perhaps the new item is rendering the old one obsolete. We may not have any quality adjustments ready but still wish to act. This method would not trigger work throughout the item category. There is a new thing and we just direct the field to sample between the new and old item, replacing the old item with the new one if it is selected. As described below, we have used this method to bring in new types of prescription drugs.
- 16 Targeted outlet replacement:** *Replace an outlet we deem obsolete.* If we can do it for an item, there is in principle, no reason not to follow the same process for an outlet. A new outlet takes away much of the business of an old one. We could replace the new for the old, continue to price the same items and let the CPI reflect any price differences between the two. This differs from method 14 (Directed outlet replacement) in the way the replacement outlet is found; in method 14 the statisticians get it from the sampling frame. Here the field agent decides what is the best replacement. One advantage here is that brand new outlets could be brought into the sample.
- 17 Regular (forced) item replacement:** *Find a replacement for a sample item whose price we can no longer follow.* *Forced replacement* is replacement when external circumstances (usually the outlet stops selling an item) requires us to find something from among the items still selling in that outlet—this is something we’d rather not do, but it currently happens in about 3 percent of pricing situations. The replacement item is compared to the old one, and an economist makes a judgment as to how comparable the two items are. If possible s/he will make a quality adjustment, otherwise we will treat them as either *comparable* (the replacement is essentially the same as the old item) or *non-comparable*. The price change for the non-comparable replacements will be imputed from the price change of an appropriate set of other items.
- 18 Forced outlet replacement:** *Find a new outlet to proxy for one we lose.* Currently, when an outlet in our sample goes out of business we continue to send the quote out for 6 months or so to see if a new outlet moves into the location. If this should occur and the new outlet sells anything in the ELI, we will select an item for pricing there. This doesn’t happen often. Suppose we were to develop some analog of the item replacement procedure for outlets: that

is, design some kind of outlet replacement checklist for each type of outlet. (Recall that we classify all the outlets in our sample by type of outlet.) Then we could tell the data collector how to choose a replacement outlet when circumstances force us to do so. They would price the old item in the new outlet (or find a replacement) and, if appropriate, we would reflect any difference in prices between the outlets as price change.

Reinitiation: Method 19. Reinitiation is old method, and none of the proposed new ones are variants of it. In the future we should minimize the use of this is a method.

19 Regular item reinitiation: *Replace entire item sample for an ELI.* Under this method the CPI data collectors resample the items in the outlets during the time that they would normally be collecting the next price observation. They collect only the price of the new item so there is no chance for overlap pricing. The newly-selected item is not related to the old item so it is not possible to make any form of quality adjusted price comparison between them; reinitiation does not provide a means for comparing the prices of old to new. The CPI usually reinitiated a category as part of a refining how we structure it. For example, we have revamped the approach to hospitals, extensively revising our collection instruments, this led to a reinitiation of all the hospital observations. Once a reinitiation is done there will be a more accurate measurement of price change, but there may be a temporary loss of accuracy during the transition.

Work on new goods. The CPI program has used money received as part of the CPII to test some of these methods on selected item strata. Table 3 is a report on what we have done to date. Also shown in the table are two activities in the recent past that constituted applications of one of the proposed new procedures—although they were not carried out as part of an explicit New Goods project. These activities were judged successful so even before the CPII we had some reason to believe we could make the CPI more reflective of new items.

Directed item augmentation for apparel. The first past activity occurred during the 1998 CPI Revision process. We added additional quotes for apparel in the existing apparel outlets. The method we used was what we now are calling *Directed item augmentation*, which is method number 9 in table 2. Although adding new goods wasn't the reason for this augmentation (the old apparel sample sizes were too small by certain criteria), this activity certainly gave new apparel products an opportunity to enter our samples.

Directed replacement for generic drugs. The second activity from the recent past was specifically directed at a new goods problem. *Prescription drugs* is a particularly difficult stratum to deal with, largely because of the rapid flow of new items. One important situation in this stratum is that generic equivalents of successful brand name drugs enter the market as soon as patent protection expires. The Federal Drug Administration (FDA) deems many generics as “therapeutically equivalent,” which we take as justification for treating them as equal in quality. So in 1995 we began using the process that we now call *Directed item replacement* (method number 15 in table 2) to give the generic version of a drug formulation a chance to replace its brand name predecessor. When a new generic drug enters the marketplace, we instruct the field to disaggregate each exiting quote for its brand-name predecessor to give the new generic and the old brand-name drug a chance of selection. If this probability-selection process leads to choice of the generic, we treat this as a comparable replacement, showing the price difference, if any, as price change in the CPI. We will continue to use this process as new generic drugs arrive. Since we can track when a successful branded drug will lose patent protection, we have a way of being ready and knowing when we need to move.

Heartening as these two successful activities were, the current new goods project can’t really claim credit for these successes. We have undertaken efforts to try some of the proposed new procedures for items or in item strata where we thought they would be useful. This may provide an immediate benefit to the index in a limited area and a way for us to test out each procedure in the field before extending it many areas.

Targeted item augmentation for Viagra. The first real attempt we made as part of the new goods project was to bring the new drug Viagra into the CPI. Viagra was a new brand-name drug that in the terminology of Table 1 is a *new approach*. We used method 11 from Table 2, the *targeted item augmentation*⁹, to bring this unique item, which had quickly captured a significant market share, into our prescription drug samples. This effort was successful in that we did bring a new, important (and highly visible) item into the index quickly and cheaply. Within the program, there was some dissatisfaction with this process. We carved the weight for the new quotes out of the weight for all the other drugs in the stratum, using available information on aggregate U.S. market share. This gave the drug the appropriate U.S. weight but may have

⁹ For more on this, see Frankie Velez, “Viagra in the CPI”, *CPI Quality Quarterly*, Spring 1999, pp. 1-3. (The *CPI Quality Quarterly* is the internal newsletter of the U.S. CPI program.)

distorted the weight for prescription drugs in some of the 38 individual CPI index areas. There also were many legitimate questions as to why we chose to work on this particular item and what objective criteria could be used for future selections. So although we count this as a success, the lesson seems to be that we shouldn't use *targeted augmentation* unless we feel we have a situation that clearly justifies it.

Directed item replacement for personal computers. During 1999 we began a more elaborate new goods project. This one is to try out *Directed item replacement* (Method 13 in table 2) in the *Personal computers and peripheral equipment* stratum. There were a number of reasons for selecting this stratum for this method. First, we recognized that the range of models that people buy in this stratum changes so fast that the current computer sample was out of date. This is despite the fact that we may have obtained a representative sample at the time of initiation. We now have virtually no high-end computers or the new budget computers; instead we have mostly items that are near the end of their product life. When the field substitutes to a new item because its outlet has discontinued selling it, our replacement procedures cause the field, in effect, to select to the next most obsolete item the outlet sells.

A second reason was that starting in January 1998, CPI began using hedonic quality adjustments for computers. The computer hedonic work was largely conducted by the Producer Price Index, which began hedonic-based quality adjustment of computers¹⁰ in 1991. Hedonic quality adjustment makes it possible to compare the prices of older and newer models directly in index calculation. Put another way, once we have these regression-based quality adjustment values, we need replacements to take advantage of them. Traditional CPI procedures discourage replacements to minimize use of the linking method. The direct replacement procedure will assure that we get these replacements in a timely manner. To the degree we are successful with this project, we will likely extend it to similar high-tech items for which we have hedonic quality adjustments.

For this project, a new “modified tiered” checklist that has two tiers was designed and tested. In the first tier is a specification for “Computer configuration classifications”; the elements of this spec are “B1 high end”, “B2 mainstream”, “B3 economy”, “B4 entry-level”, and

¹⁰ Michael Holdway, “Quality-Adjusting Computer Prices in the Producer Price Index: An Overview,” internal BLS paper, forthcoming on the BLS Web-site. See also James Sinclair and Brian Catron, “An Experimental Price Index for the Computer Industry”, *Monthly Labor Review*, Bureau of Labor Statistics, October 1990, pp.16-24.

“ B99 other”. Every six months (January/February and June/July) we will send a directed replacement instruction for Personal Computers to the field stating what computer configurations are in what classifications. We expect that a given configuration will drop to a lower classification over time.

The team conducted a field test of the new checklist in August 1999. After incorporating the changes based on that test, we sent the new checklist to the field in January/February 2000 for re-description of the current quotes. We will inaugurate the first directed replacement instruction at that time. Since the directed replacement instruction won't include obsolete configurations, some of the quotes will be replacements. In June/July 2000 we will issue the new directed replacement instruction and direct the field to substitute to new configuration. As we rotate in new TPOPS samples in the next few years we will bring in the latest computers and keep those new samples current with the directed replacement procedure.

Targeted item replacement for anti-arthritis drugs. One sign that we are making progress is when new procedures become institutionalized to the point that people start using them on their own. The arrival of a new class of anti-arthritis drugs led the CPI Commodity Analyst and supervisor to decide that we could bring them into the sample quickly following the generic drug model (*Targeted item replacement* method 15 from table 2) rather than the Viagra model. The plan is to have the field substitute current quotes for current anti-arthritis drugs and give the new and old anti-arthritis drugs a chance of selection. When a new drug is selected to replace an old one, we will not directly compare the prices, because the new and old drugs will not be comparable in quality and we don't have any quality adjustment values for it.

Directed Item Rotation for prescription drugs. Finally, we come to the biggest project currently under way. Again we're working on *Prescription drugs*, a stratum with significant new goods problems; this time applying Method 3 from Table 2. We started TPOPS rotation of *Prescription drugs* in February 2000; as the new outlet samples get initiated we will create multiple item samples for them. The first item sample will be initiated in the ordinary way when the outlet is initiated. The second sample will be initiated two years later. If the outlet is to remain more than four years (which can occur because of changes to the TPOPS PSU schedule), a third sample will start after four years. Once we have a new item sample ready for use in the index, we will drop the old one. There will be one month of overlap in the same way there is

with new and old outlets. This process will take several years to become completely operational, after which the item samples for *Prescription drugs* should be much more current than they otherwise would be. The detailed procedures for this project are now undergoing review.

The final table summarizes our efforts so far on the new goods project. You can see we have some promising work underway, but it will take additional effort and further endeavors before the new goods problem is licked.

Table 3		Endeavors to Bring New Items into the Index	
Target item:	Index Technique from Table 2	Issues	
1. Apparel strata	9 Directed Item Augmentation Add new quotes to existing outlets		
2. Generic drugs (Part of the <i>Prescription drugs</i> stratum)	15 Targeted item replacement Replace unique item with a new item	Need a good secondary source of current market shares	
3. Viagra (Part of the <i>Prescription drugs</i> stratum)	11 Targeted item augmentation Add specified unique item	May violate sampling methods.	
4. Personal computers (Part of the <i>Personal computers and peripheral equipment</i> stratum)	13 Directed item replacement Replace unique item or a class of items with new	Must have quality adjustment values	
5. Anti-arthritis drugs Part of the <i>Prescription drugs</i> stratum)	15 Targeted item replacement Replace unique item with a new item	Need a good secondary source of current market shares	
6. Prescription drugs (entire stratum)	3 Directed item rotation Initiate items in old outlets and drop old items after an overlap period	No way to compare new item to predecessor	