Telecommunications Indexes in the U.S. Consumer Price Index

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Paper presented at the Sixth Meeting of the
International Working Group on Price Indices
Canberra, Australia
2-6 April 2001

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I. Introduction

This paper describes the way the U.S. Consumer Price Index (CPI) handles electronic point-to-point communications. The scope of the CPI is the universe of consumer items, which the Bureau of Labor Statistics (BLS) defines as the set of consumer goods and services that people buy for day-to-day living. Point-to-point communication can be accomplished using any of several ways or *modes* of communication. There are three major types of telecommunications services that people purchase for day-to-day living, placing these services in the purview of the CPI:

- Telephone services (including local, long distance, and wireless or cellular)

- The Internet (including electronic mail and instant messaging)

- Cable television

Commercial radio and broadcast television are communication modes that do not charge consumers directly for their services; this places them outside the CPI's scope. Some other communication modes—such as telegraph, citizen-band radio and short-distance "walkie-talkies"—are too minor at the present time for consideration here. Expenditures on these modes, to the extent they are reported in expenditure surveys, have been allocated to more significant CPI item categories. Finally, one relatively important communications category, postage, is excluded from consideration because it is predominantly made up of charges for non-electronic services.

This may be a good place to note also that our attention is on telecommunications *services.* Of course, to use many of these services consumers may have to own or purchase or rent or otherwise gain access to some equipment and supplies. One needs a television to consume cable television service and a computer or other device to use the Internet. These items are complements to communication services and are not the focus of this paper. In some cases the equipment is sold bundled with the service or sold at a very low price when the consumer agrees to a long term contract to buy the service. For example, cellular telephone service often provides a mobile phone, either free or at a very low price, to a customer signing a one-year contract. In

these cases the CPI views the provided equipment as an additional feature of the service. In cases where consumers buy the equipment in a separate transaction—such as televisions, computers, and, in the past 15 years or so in the United States, telephones—the purchase of the equipment is elsewhere in the CPI structure and is not covered here.

In section II below we briefly describe several issues or problems that arise in the construction of indexes for consumer telecommunications. Section III summarizes how the CPI collects and processes price data. Following this background information, in sections IV through VI we discuss each of the major CPI telecommunications indexes in turn. Section VII concludes.

II. Issues in Telecommunications Pricing

Rapid technological change. One can think of telecommunications services as part of a broad component that contains all the methods of point to point transmission of voice or data. Point-to-point contact can be achieved in several ways or modes: mail, telegraph, telephone (fixed or mobile), fax, and e-mail/Internet. These modes of communication are listed in chronological order to show that the evolution of communication services has followed a Schumpeterian path of creative destruction: initial monopoly-like positions were dissipated by the introduction of new methods of communication. Aside from telegraph, all the modes have experienced increases in use (see Odlyzko 2000). This coexistence indicates that newer price-characteristic combinations have not completely supplanted the older price-characteristic combinations.

Increasingly rapid product introduction and technological innovation are distinctive features of telecommunications, and these can pose a potentially severe new-products problems for the CPI. It is therefore crucial to have in place processes that allow for timely incorporation into CPI samples of new service modes and outlet types. Frequent changes in service characteristics or contract features also place great importance on the choice and application of methods used for CPI quality adjustment.

Growth and change in telecommunications industries also has been associated with intense competition among firms. This has sometimes been reflected in multiplying numbers of service plans aimed at different market sectors or niches. In these circumstances, companies may be

reluctant to report their pricing information even to government agencies, for fear of losing proprietary information and market advantage. This has obvious negative implications for CPI construction.

Classification boundaries. As with most services, a critical and sometimes difficult part of telecommunications index construction is defining the item classification. As detailed in section III below, the CPI item structure focuses on the product variety for a specific method of communication. For example, telephone services are not only published separately, but the item structure further distinguishes among several types of telephone service. Fax services are not included specifically, but postal services and Internet services have their own item strata.

The division of products into separate item categories has implications for the way in which the index will handle consumer substitution. In the CPI, a geometric mean formula is used to aggregate prices within most strata, implicitly reflecting a consumer response to changes in relative prices. Across strata, however, the Laspeyres formula holds relative quantities fixed in computing index changes.

A particular feature of telecommunications markets in recent years has been the invasion of services markets by new providers: for example, cable television operators and telephone companies have begun offering Internet access to their customers. This, by itself, should not create a special problem for the CPI, so long as those new providers are brought into the Internet services item category within an appropriate time period.

A potentially more problematic development may be the practice of bundling several telecommunications services together. This occurs, for example, when a cellular telephone contract includes Internet access along with calling services. Traditional CPI processes are not designed to deal with the measurement of prices for combinations of goods or services that cross stratum boundaries.

Network effects. In addition to the variety of modes of communication, one must also consider the role of network effects. These effects arise from the pace of adoption and the establishment of required infrastructures—in the case of mail the establishment of post offices and distribution centers and in the case of telephones and the Internet the wired system. The value of network effects is often computed as some proportion of the number of users, the idea being that each additional user is a complement to past and future users. Another method,

Metcalf's Law, computes the network value as proportional to the square of the number of users. One could also consider the expected number of subscribers or the potential number of subscribers.

Thus point-to-point communications services have two dimensions that complicate the construction of price indexes: innovations in communication methods and network effects. However, the creation of new methods and their diffusion can take a long time and thereby limit the impediment of this dimension to index number construction.[1] Network effects also have a time dimension. The popularity of the fax was linked to the number of people that had the equipment and, in the early stages, a dedicated phone line. As the popularity of faxes increased, the price of both the equipment and the transmission declined, further increasing their use.

The new question here is how to capture network effects in a consumer price index. A simple model can illustrate the problem. Let

$$U = U\left(h(q_1, N), q_2\right)$$

where good 1 is the network-related good (or service), good 2 is a composite of all other commodities, and N denotes the number of subscribers for the network good[2] with $\dfrac{\partial U}{\partial q_1} > 0$ and

$\dfrac{\partial U}{\partial N} > 0$. The specification represents the fact that N serves as a complement to q_1; the utility of any value of q_1 increases with N. (This assumes away the problem that at a high value for N the network may become clogged, increasing the waiting time, reducing reliability, etc., and thereby diminishing U.] The corresponding expenditure function that arises from minimizing expenditures subject to a given level of utility is given by

$$E = E(\mathbf{p}, N, U) \text{ where } \mathbf{p} = (p_1, p_2); \text{ the vector of the prices of goods 1 and 2.}^{[3]}$$

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[1] Odlyzko points out that cell phones took roughly 15 years to catch on.

[2] For simplicity only one telecommunications good is considered. Since other telecommunications goods are substitutes there is no loss in generality.

[3] It should be pointed out that the above model is very simple and ignores how best to measure the quantity of good 1 and its attending price. More specifically, for many telecommunications services there is a two-part price: access and usage charges. Both prices can affect the number of subscribers.

The Konus cost of living index between time periods 0 and 1 is given by the ratio of expenditure functions;

$$(1) \qquad P(\mathbf{p^1}, \mathbf{p^0}) = \frac{E(\mathbf{p^1}, N, U)}{E(\mathbf{p^0}, N, U)}$$

The Laspeyres-perspective COLI is given by:

$$(2) \qquad P_L(\mathbf{p^1}, \mathbf{p^0}) = \frac{E(\mathbf{p^1}, N^0, U^0)}{E(\mathbf{p^0}, N^0, U^0)}$$

Note that (2) allows the quantity of both goods to change in response to price change—unlike the Laspeyres fixed quantity formula. The above illustrates that the proper treatment of network effects must take into account N.

Statistical agencies do not compute indexes such as (2) but rather use a version of the fixed quantity Laspeyres formula

$$P_L(\mathbf{p^1}, \mathbf{p^0}) = \frac{\sum_i p_i^1 q_i^0}{\sum_i p_i^0 q_i^0}.$$

Clearly N does not play a role in such a computation.

A question that naturally arises is whether a way around this problem is to treat N as a product characteristic. However, the consumer does not pay for N as part of the purchase of good 1. The level of N is a market outcome that depends on both demand and supply factors. The demand-side is clear from the above—the consumer takes N as given or forms some expectation regarding its value. He has no control over its value, except for the fact that his purchase increases N and thereby provides some addition to the global network benefit. On the supply side there can be economies of scale in the provision of the service. One can also think of N as being determined by either the current price of good 1 or by its price in the previous period.

From a conceptual perspective, one could treat N as an element of the set of environmental variables upon which the computation of the index is conditioned. To illustrate, the US CPI does not adjust the price of auto alarms according to rate of car thefts. The network analogy follows from the fact that as the number of individuals with auto alarms increase there will be an attending decrease in the number of thefts. Such externalities are not specifically treated in the CPI and that is the stance maintained with respect to network effects.

III. Structure and Calculation of the CPI

Item definition. The U.S. CPI item structure is a hierarchy of levels: major groups, subgroups, expenditure classes, item strata, and sub-stratum entities.[4] The item strata are the basic building blocks of the CPI for sampling, for index computation, and for publication. The CPI item structure partitions the universe of consumer items into 211 item strata and organizes those strata into various aggregates. This structure is central to the entire CPI program, including the functions of item definition, sampling, data collection, quality adjustment, index calculation, and publication and index analysis.

The January 1998 major revision of the CPI introduced a new item classification structure designed to be more reflective of current patterns of consumption.[5] Exhibit 1 displays the relevant parts of the current CPI item structure and shows the various levels of these CPI components along with their relative importance, or share of total CPI weight. Telecommunications indexes are indicated in bold type in the table.

Exhibit 1. Telecommunications indexes in the U.S. CPI			
Item Structure Level	**Code**	**Component**	**Relative Importance as of December 2000**
Major group		Education and communication	5.311
Sub group		Communication	2.510
Expenditure Class	ED	**Telephone services**	**2.150**
Item stratum	ED01	**Telephone services, local charges**	**1.104**
Item stratum	ED02	**Telephone services, long distance charges**	**1.003**
Sub stratum		**Interstate toll calls**	**NA**
Sub stratum		**Intrastate toll calls**	**NA**
Item stratum	ED03	**Cellular telephone services**	**0.043**
Expenditure Class	EE	Information and information processing other than telephone services	0.163
Item stratum	EE03	**Computer information processing services**	**0.017**
Major group		Recreation	5.908
Expenditure Class	RA	Video and audio	1.646
Item stratum	RA02	**Cable television**	**0.903**

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[4] The United States does not employ the COICOP item structure used in many other countries.

[5] The December 1996 *Monthly Labor Review* includes a series of articles on the 1998 CPI revision, including Lane (1996), which discusses the new item structure.

The above relative importances reflect spending patterns as reported in the Consumer Expenditure Survey during the period 1993-95, evaluated at December 2000 prices. (Because they are by-products that are not needed to calculate the CPI, substrata indexes have no weight assigned to them and, therefore, no published relative importances.) It should be noted that the CPI weighting structure will be updated in January 2002 to reflect 1999-2000 spending patterns. This is likely to result in significant increases in the relative importance values for Cellular telephone services and Computer information processing services.

The new item structure created the new CPI major group, *Education and communication*, and its subgroup *Communication*, which contains the item strata for almost all the CPI telecommunications modes. The expenditure class *Telephone services* comprises most of the weight within Communication. Telephone services is composed of three strata: *Telephone services, local charges*, *Telephone services, long distance charges*, and *Cellular telephone services*. The structure further divides the long-distance stratum into two substrata: *Interstate tolls calls* and *Intrastate toll calls*; the indexes for these are special calculations, which cover less than a whole stratum of consumer spending. International toll calls are part of that stratum, but not part of either of its sub-strata; the BLS currently is working on a special index for international toll calls.

Information access service (Internet service providers and the like) makes up most of the small stratum *Computer information processing services*, part of the expenditure class *Information and information processing other than telephone services*, which also includes personal computers. The Computer information processing services stratum is where most Internet service fees reside in the CPI structure, but the stratum includes other computer services such as technical help and repair services. Like Cellular telephone services, Computer information processing services was included as a CPI stratum for the first time in January 1998.

Finally, in the *Recreation* major group, the *Video and audio* expenditure class contains the *Cable television* item stratum. At this time, cable television in the United States is used almost exclusively for one-way transmission to the consumer; this accounts for the fact that the stratum is outside the Communications major group.

Altogether, the table demonstrates that telecommunications strata make up approximately three percent of the CPI. Telephone services account for roughly two-thirds of that weight.

Sampling. The movement of the CPI is the average of the price changes of a sample of consumer items. CPI sampling uses multi-stage probability methods to assure that all eligible items have the proper chance of selection. This makes it possible to measure and minimize the CPI's variance, which is a gauge of sampling error in the CPI. BLS statisticians use a model that assigns the optimal number of observations to each CPI item stratum, subject to a budget constraint. The objective of this model is to allocate the CPI's data collection budget so as to yield the most accurate CPI for the available money to spend on it.

Outlet samples. For most CPI item strata, including all under discussion here except for cellular telephone services, the CPI selects a sample in each of the 87 CPI pricing areas of retail outlets that sell items in the strata.[6] The selection is proportional to expenditures for items in the stratum as reported in the Telephone Point of Purchase Survey (TPOPS) of households. The observations assigned to each stratum are then distributed among its selected outlets in proportion to the reported expenditures in those outlets. The BLS replaces approximately 1/8 of the TPOPS-based outlet samples in each CPI pricing area every six months. As a result, all of the TPOPS outlet samples are replaced on a regular four-year cycle.[7]

Item samples. Once a new outlet is selected in a CPI area for an item stratum, BLS must select the unique items whose prices will be followed over time. In some strata the national office performs the first step of item selection, choosing what we call the *entry level item (ELI)* for that outlet. An ELI is a category of consumption that constitutes a subdivision of an item stratum. ELI selection is made using ELI expenditures as reported in the Consumer Expenditure Survey. ELIs, as their name suggests, are the level of structure that the data collectors work with when they enter an outlet for the first time. The final steps of item sampling are the responsibility of the data collector, working with the respondents in the outlets. Consequently, in the U.S. CPI sampling blends into data collection.

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[6] Of the 87 pricing areas, 31 correspond to large metropolitan areas. The remaining 56 pricing areas represent the rest of the urban United States. The pricing areas are grouped into 38 index areas for index calculation; a CPI basic index, or elementary aggregate, is computed for each combination of the 38 index areas and 211 item strata.

[7] The TPOPS rotation pattern is overlapping or "rolling" in both the area and item dimensions. For example, in any six-month period the cable television samples are being updated in some CPI pricing areas. Also, in each six-month period every pricing area is updating approximately 1/8 of its samples.

Data Collection. Like almost all CPI prices—the exceptions include used cars and airline fares—telecommunications observations are initiated and priced by CPI data collection staff, based either in BLS's central office in Washington or in one of the CPI's 87 pricing areas.

Initiation is the data collection process in which CPI staff seek information from a selected respondent for the first time. During initiation they determine the sample of individual items that the outlet sells whose prices the CPI will follow over time and whose price changes will represent all price changes over a range of items. The sampling uses probabilistic methods to assure that all the in-scope items have their proper chance of selection so that the chosen sample is representative of all these items.

Pricing is the data collection process in which the CPI staff returns or re-contacts the outlet to get the current price of the items selected during initiation. Telephone companies in the CPI samples are priced once a month. In most CPI areas the other telecommunications outlets are priced every other month.[8] An important part of pricing is the set of procedures to handle situations in which the outlet no longer sells the initiated item, or the initiated item is no longer what many people are buying. In these cases the staff must work with the respondent to find the most acceptable replacement item. The following section explains how the CPI's Washington Office experts evaluate the replacements to determine how they should be used in index calculation.

Quality adjustment. The CPI is computed from the price changes of the sampled items. Of course, in some cases the quality of the item as well as its price has changed. The CPI has various methods to handle those cases. If no direct means of quality adjustment is available, we can deem the observation unusable, and use the so-called linking approach; this is tantamount to assuming that its price changed at the same rate as all other items assigned to its basic index. Since, for many kinds of items, price change is likely to happen when there are other changes, the linking method may miss some price change. To counter this effect, the CPI adopted the *class mean* method for estimating the price change of goods that are changing.[9] The class mean method is not used for telecommunications services, however.

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[8] All items are priced and published monthly in three areas: New York, Los Angeles, and Chicago.

[9] See, for example, Armknecht, Lane, and Stewart (1997).

A preferable way to handle price adjustments is to estimate the value of the quality change directly. When we are able to derive quality change values (either positive or negative, in the case of quality deterioration), we add them to the previous price creating an estimate of what the old version of the item would have cost in the previous period had it been of equivalent quality to the new version. One of the most difficult problems for the CPI is to accurately quantify value of changes in the quality of an item in order to factor these quality changes out of the item's price movements. This can be even more difficult for services than for goods, because services may have quality characteristics that are less easily observed and quantified on a monthly basis.

Index Calculation. Greatly simplified, the index is calculated in two steps: *basic indexes* and *aggregate indexes*. In the basic-indexes step, BLS computes the current month's basic index for each item/area. The aggregate-indexes step combines the basic indexes to produce the aggregate indexes, including the All Items CPI. The classification structure defines the border between these major steps.

Since January 1999, the U.S. CPI has used a geometric mean formula for all but 15 of the 211 basic indexes. The traditional Laspeyres arithmetic formula was retained both for the remaining 15 and for index aggregation. In this "hybrid" index the placement of the stratum/aggregate border is all the more important. The choice of whether the index for an item stratum should use a geometric mean formula or a Laspeyres formula was based on how easily consumers are assumed to be able to switch among different items and sellers of the items in the stratum. For example, the CPI rent indexes use a Laspeyres formula because it would be difficult for consumers to switch their housing arrangement each month in response to relative price shifts. Food strata, by contrast, employ the geometric mean.[10]

The telecommunications indexes provide examples of each situation. The indexes for *Telephone services, local charges* and for *Cable television* use the Laspeyres formula. The reason for this is that in most of the United States at the present time, consumers have little choice when purchasing these items. In most cases they face a limited choice of services from a single monopoly provider. (There is perennial talk of deregulation and consumer choice, but there has been little actual movement toward it.) The other communications elementary indexes

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[10] Both the Laspeyres averaging formula and the geometric mean averaging formula are weighted averages, employing sampling weights reflecting the distribution of consumer spending within the item-area cell.

use a geometric mean formula. As market conditions change in the future, BLS may change the choice of formula for communications or any other strata.

Index Publication and Analysis. Every month BLS publishes indexes for each of the CPI components in Exhibit 1. These aggregate indexes are for the urban United States as a whole; each index is the aggregation of 38 basic indexes, one for each CPI index area. In addition, BLS also publishes indexes for *Education and communication* and for *Recreation* for each of the CPI publication areas on the areas' publication cycles. Local-area indexes are not published for the individual telecommunications strata.

IV. Telephone Services

Item stratum definitions. The *Telephone services, local charges* (or, more simply, Local Telephone) stratum covers monthly consumer expenditures for services received from local telephone companies. The item definition includes charges for all types of local residential service. This includes, but is not limited to, dial tone service charges, line maintenance charges, access charges, 911 charges, directory assistance charges, touch tone service charges, and other special features and mandatory charges for local calling, installation, and coin-operated pay phones.

The *Telephone services, long distance charges* (or, Long-distance telephone) stratum includes charges for all domestic residential calls where there is a specific toll per call, or per group of calls. International calls that originate in the United States are also eligible for the CPI, as are international calls to the United States that are billed to the U.S. party.

The *Cellular telephone services* stratum includes charges for domestic personal consumer phone services where the telephone instrument is portable and it sends/receives signals for calls by wireless transmission.

Business telephone services and equipment are not in scope for the CPI. Telephone equipment rental and portable radios and pagers are in scope but the CPI does not price these items at this time. As noted earlier, of telephone instruments are covered elsewhere in the CPI sample (with the exception of cellular phones that are included in some priced cellular packages).

Telephone Samples. The CPI uses the TPOPS to select the samples of local telephone companies for the Local telephone index and select the samples of long distance telephone companies for the Long-distance telephone index. The TPOPS does not cover Cellular telephone service at this time. The CPI uses Federal Communications Commission data to select a sample of cellular phone service providers of this index. One reason for not using the TPOPS for Cellular telephone services is that the lead time required was too great relative to the urgency of bringing this new category into the CPI in 1998. A second reason is that, to save cost and to reduce the burden on respondents for these outlets, the CPI is working jointly with the Producer Price Index (PPI), the other major BLS price program, to share data collected from these respondents. The PPI has a different approach to sampling outlets. The Cellular telephone services outlet sample does not rotate in the way that the TPOPS samples do, but will be replaced in its entirety at one time.

All telephone companies that supply local telephone service are eligible for the Local telephone index. Similarly, all companies that supply Long distance telephone service are eligible for the Long-distance telephone index and all telephone companies that supply Cellular telephone services are eligible for that index.

Data collection. Some telephone service quotes are initiated and priced by CPI central office staff, others by regional staff in the CPI's 87 pricing areas.

Since the U.S. telephone industry was deregulated in the early 1980's, it has become extremely competitive. Many telephone companies are very reluctant to supply various data, due to proprietary concerns that the data will fall into the hands of their competitors. Particularly sensitive are the data needed at initiation to select the sample of representative items and at pricing to find the best replacements for discontinued or obsolete items. Even though the CPI has very explicit confidentiality policies, the CPI data collection staff frequently must negotiate with the telephone companies to determine if any usable data may be obtained for these situations.

Initiation of Local telephone. For sampling and pricing purposes, Local telephone is divided into two sub-categories, or clusters:

- main station charges
- coin-operated local pay phones

Each CPI observation for Local telephone is for either main station charges, or coin-operated local pay phones, but not both. Most of the weight and nearly all observations are found in the main station charges cluster, which prices the general services provided each month by a local telephone company. The smaller cluster, coin-operated local pay phones, prices the cost of pay phones for local telephone calls. Long distance calls made from pay phones are not in this cluster or this stratum; if they are billed to a long distance account, they are part of the long-distance stratum.

At initiation, when CPI field staff seek prices for local telephone service from a telephone company for the first time, they define the characteristics of the observations (called quotes) that they will follow over time. Using probability sampling techniques, they first determine the proportion of assigned quotes that the company will report for main station charges and for coin-operated local pay phones. Once this has been established, the field staff can use different methods for selecting the specific characteristics of each telephone quote, depending on what is acceptable to the company. For main station charges, one method is to have the phone company supply a sample of bills showing what local services customers actually pay for. Another method is for the phone company to supply measure of size data for each way—these are often called "plans"—that the local telephone companies offers service to their customers in a given location; the field agent then can use probability methods to select among the plans and note the characteristics. If neither of these method is acceptable to the phone company, the field agent queries them as to what alternative methods of data selection could be employed.

If the telephone company provides sample bills, the data collector will use the local calling characteristics from the bills to establish the types of customers for each quote. For confidentiality reasons the data collector will exclude personal information such as customer name, address and telephone number.

When the telephone company provides measure of size data, probability sampling techniques are used to determine specific characteristics for the customer being priced, such as rate group, jurisdiction, and area code/exchange. Once these data have been selected, the many characteristics associated with the selected customer are identified to ensure that the same bill characteristics are priced each collection period, or if there is a change in the priced characteristics, that change can be identified readily. The following is an example of

characteristic information that might be identified for particular sample observations in each cluster:

Number of parties -- two lines / one party line each

Type of service -- flat rate

Limits of local calling area -- Washington, DC; Montgomery County, MD; Prince
George's County, MD; Fairfax County, VA

Mandatory charges -- 911 charge; line access charge; dial tone line charge;
municipal charge

Installation charges -- none (existing customer)

Special features -- line maintenance charge; call waiting; call forwarding;
conference calling; unlisted number

Surcharges/credits -- handicap services surcharge; billing credit

Taxes -- federal, state, local, municipal included in total price

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Sampling of Telephone services, long distance charges. For sampling, pricing and publication purposes, Long-distance telephone is divided into two sub-categories, or clusters. The first cluster, interstate toll calls, comprises toll calls whose origin and destination are in different states. The second cluster is intrastate telephone services, which prices toll calls where the origin and destination are in the same state. (In the United States, interstate and intrastate calls are regulated and priced very differently.) Each long distance service quote will price either interstate toll calls, or intrastate toll calls, but not both. The CPI calculates and publishes monthly U.S.-level special, substratum indexes for interstate toll calls and for intrastate toll calls.

Initiation and pricing of Long-distance telephone are accomplished using one of two procedures. Some companies choose to supply data from their head offices directly to the CPI in Washington, D.C. Most of these organizations have centralized their product pricing and can supply pricing data for any location in the United States from one office. All other long distance service quotes are initiated and priced by CPI field staff.

When telephone companies choose to supply data directly to the CPI Washington Office, they generally choose to provide some type of average revenue figures from their company's internal computer system. Many telephone companies feel average revenue is a good pricing measure since it encompasses many different customers, and a wide array of toll calling characteristics. These data may be supplied as average revenue per minute, per customer, per bill, or per account. Generally the figures are supplied separately for each sampling area, local calling area, or state. Probability sampling techniques are applied to measure of size data that is obtained from one or more of these companies in order to determine if interstate toll calling or intrastate toll calling will be priced for each quote. Currently a majority of the long distance quotes priced for the CPI reflect average revenue figures.

When a CPI field representative initiates a quote, he or she uses probability-sampling techniques to determine whether the quote will be for interstate toll calling or intrastate toll calling. Once this has been completed, the field staff can use different methods for completing each telephone quote. The method employed will depend on what is acceptable to the phone company. One method is to have the phone company supply sample or 'dummy' bills that actually reflect what customers are paying for toll services. Another method asks the company to supply measure of size data reflecting what toll customers are actually purchasing in a given location. If this is not acceptable, the field staff queries the phone company as to what alternative methods of data selection could be employed.

If the telephone company provides sample bills, the data collector will use toll call characteristics from the bills to establish the long distance quotes. After consultation with the priced telephone company, each quote may price as many as all of the calls on the bills, or as few as one call from each of the bills.

When the telephone company provides measure of size data, the telephone company usually opts to price only one representative toll call for each quote. Probability sampling techniques are used to determine specific characteristics for the customer being priced, such as duration of call, destination city, day and time of call, service charge usage, and discount plan usage. Once these data have been selected, the field staff identifies ensures that the same bill characteristics are priced each collection period or, if there is a change in the priced characteristics, that the change

can be identified readily. The following is an example of characteristic information that would be identified:

    Call distance -- 250 miles

    Duration of call -- 10 minutes

    Origination city and exchange -- Baltimore, MD/410

    Destination city and exchange -- Pittsburgh, PA/412

    Day of call – Monday

    Time of call -- 10:00 AM

    Rate period for call – Day

    Service charge -- Calling card; customer dialed

    Call discounts -- Member of one-rate plan

        Surcharges/credits – None

    Taxes -- Federal, state, local, municipal included in price

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Sampling of Cellular Telephone Services. Most of the initiation and repricing of Cellular telephone services are handled by CPI staff in Washington, DC. Washington obtains most data either directly from the cellular providers or from their Internet home pages. The Producer Price Index (PPI) also has a cellular telephone index, and the PPI and CPI share initiation and repricing data from some cellular providers.

Each selected cellular provider is contacted by the CPI Washington office. Whether each provider participates in the CPI, and how each company participates, are determined by agreements established with appropriate respondents at each organization.

Data supplied by some cellular providers to the CPI (as well as the data shared by the PPI) are types of average revenue figures from the company's internal computer system. Some cellular companies feel average revenue is a good pricing measure since it encompasses many different customers, and a wide array of cellular calling characteristics. These data may be supplied as average revenue per minute, per customer, per bill, or per account. Generally the figures are supplied separately for each sampling area, local calling area, state, or region. After

the data for each quote have been initiated, respondents are asked to supply subsequent average revenue figures on a regular basis for repricing.

Most of the data that cellular providers supply to the CPI are the prices and characteristics of the cellular calling plans they offer. At initiation, we ask the respondent to supply either data for the most popular consumer cellular plan in each area, or data for a number of popular consumer cellular plans in each area. In the second case the Washington office uses probability sampling techniques to narrow the selection to one plan per quote. Characteristics captured for the selected cellular plans may include service charges, free calling minutes, charges per calling minute, plan options, activation, and sometimes cellular phone instruments. Since most plans involve contracts, the respondents are also asked to supply contract requirements as well. The following is an example of characteristic information that could be identified:

Service priced -- cellular plan

Plan name -- Cellular 100

Type of service – regular

Included in plan -- limited free peak/off-peak minutes

Number of free minutes included - 100 (peak or off-peak)

Options included in plan -- call waiting, call forwarding

Phone instrument -- not included in plan; $50 extra

Activation -- not included in plan; $25 extra

Cost per extra peak calling minute -- $.30

Cost per extra off-peak calling minute -- $.20

Contract -- required for minimum of one year

Promotional -- free weekends until end of year

For ongoing quote pricing, BLS asks the respondents to supply data for the selected plans on a regular basis, including plan changes or promotional offerings, if any exist. The CPI attempts to price the same plans in each collection period. If there are changes in the priced characteristics, the CPI attempts to identify what specific aspects have changed. When the

selected plans lose significant market share, the respondents are asked to substitute to new comparable cellular plans.

Basic Index Calculation for Telephone Services. As noted above, Long-distance telephone and Cellular telephone services use a geometric mean to calculate the average price change. The Local telephone indexes employ an arithmetic mean or Laspeyres index formula.

Telephone quality change. For Local telephone and for Long-distance telephone many price changes from respondents are not accompanied by resulting causes. When this occurs, and the characteristics for the identified telephone service items remain unchanged, the price changes are reflected in the local telephone charges index. If an item's characteristics change, a quality improvement (such as improved telephone clarity) or deterioration may have occurred.

For Cellular services, in many cases it is possible to quantify changes in quality and factor these quality changes out of the service's price movements. Many cellular providers substitute newer plans that have either a different amount of free calling minutes or free options while holding the cost constant, or the same package is offered for a different amount of money. We have used data from some respondents, corroborated by some hedonic analysis, to develop factors to adjust for many of the quality or quantity differences between these plans.

Some quality improvements may not qualify to be factored out of the item's price movements. Quality improvements, such as fiber optic cable, may make operations more efficient for the telephone company, while the company's customers may see little change. Other quality improvements, such as extended area service, may only benefit a limited number of people in the customer base.

Phone cards. The competitive marketplace for telephone services that emerged after deregulation led to a variety of new ways to purchase telephone service. One example is that some long distance providers now offer toll free number (called 1-800 numbers in the U.S.) that allow customers to place calls and charge them to their credit cards. Another innovation is a card, popularly known as a "phone card," that is similar to a debit card. These provide a number of minutes of long distance (or local) telephone service at a fixed price. For example, one might purchase a card for 10 dollars that provides 100 minutes of calling to anywhere in the United States except Alaska and Hawaii.

Phone cards present some issues for the CPI. If they were just pure debit cards, which provide a new way of paying for the same services at the same prices, the CPI could safely ignore them. More commonly, however, they are structured to provide service at different prices from the conventional ways of selling the service, as is the case with the 100 minutes for 10 dollars. They may provide a linkage to a credit card or even merge into a credit card. Although they provide both long distance and local service so that one could argue that there is not a clear CPI home for them, we place the expenditure for them in the long distance stratum as we feel that this is where most of their expenditure lies[11]. We are working on ways to price them.

V. Computer Information Processing Services

Item stratum definition. *Information access service* is an unpublished ELI within the Computer information processing services item stratum. The remaining part of this stratum covers computer consulting and repair services. Information access service covers charges for information from all sources for non- business use. The fees may be for installation and set-up and for periodic charges for services. Periodic charges may be either flat fee per month regardless of use, by the hour or minute of actual use, or some combination of these (for example, $7 including 5 free hours each month and $3 per hour thereafter). Separately-billed expenditures for access to individual Internet sites (such as adult content sites that are billed to consumers' credit cards) are covered in the weight for this item but are truncated from pricing at present.

This group includes charges from Internet service providers (ISPs), online service providers (OSPs), and bulletin board systems (BBSs). This may cover some traditional telephone service companies, and cable TV companies, excluding any telephone or cable TV charges not specifically related to obtaining information services. There are many variations and much overlap in the services that different providers offer. For this reason we rely on the respondents to classify the company and to assist in pricing. The main types of companies providing information services are:

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[11] Standard CPI practice for items that straddle item strata is to make a judgment and place them in one or the other. This is far preferable to leaving them out of the structure entirely until the next opportunity to redefine the structure and accommodate them. These opportunities occur infrequently due to their cost and disruptive effect.

- An ONLINE SERVICE COMPANY (OSC) offers numerous databases, news groups, chat areas and services to its members only. An Internet connection may also be available.

- An INTERNET SERVICE PROVIDER (ISP) primarily provides connection to the Internet. These may be national in scope, although most are local or regional companies.

- A LOCAL CABLE COMPANY may provide connection to the Internet or other communication services. If subscribers must purchase or rent a special "cable modem" to use this service, the CPI includes this in the reported price.

- TELEPHONE COMPANY ONLINE SERVICE - National or regional telephone companies may offer Internet and other online services. Only the charges directly related to Internet or information services are in this part of the CPI.

- A BULLETIN BOARD SYSTEM (BBS) is, most commonly, a local information system run for and by computer hobbyists, possibly providing time-delayed access to Internet news groups. If such a system provides "real time access" to the Internet, we view it as an ISP.

Internet service samples.   Movements in the Computer information processing services index reflect price changes in a sample of approximately 150 price observations that provide service in the 87 CPI pricing areas. The observations are in outlets selected from the TPOPS. For most observations BLS regional staff located near the headquarters of companies collect prices for that company for a number of CPI pricing areas.

Item samples. When CPI data collectors seek retail prices for Internet service, they already know the type of outlet. They then use probability sampling to select the type and level (basic or high-speed / broadband) of services and the method of charging for them. They identify the need for a cable modem and its rental fee.

Quality changes. At times the information service companies make changes to the service they offer. More commonly the companies add new connection features at an additional charge. For example, they may offer high-speed Internet at a higher fee and continue to offer the basic service at a lower fee. The CPI adds these to its pricing specifications at various times without showing any price change. During the regular on-going sample rotation, new items are selected

and service with a new feature, like high-speed Internet, may be added at that time. There is also an augmentation program that may add sample observations when the sample size is below the target; although its primary purpose is not for bringing in new service items, it often provides that additional benefit. The CPI may, on an *ad hoc* basis, reinitiate the item sample as a mechanism for adding the new features.

The most important phenomenon is the rapidly growing scope of the Internet itself. The range of material available and the means of locating material of interest is akin to an environmental improvement. There is no charge for this and the CPI takes no account of it, but as discussed above in section II it is the equivalent of a quality improvement.

VI. Cable Television

Item stratum definition. Cable television is an item stratum in the *Video and audio* expenditure class, which in turn is part of the *Recreation* major group. It includes subscriber's fees for installation and/or periodic charges associated with the use of cable television, community antenna television (CATV), or satellite television. Periodic charges can include all levels of basic service, and basic service combined with premium channel options. Pay-per-view movies and events are part of the weight of the stratum but are not priced in the index, because they are ephemeral items, which do not consistently appear on a monthly basis for proper comparison.

Cable television samples. Movements in the cable television index reflect price changes in a sample of approximately 850 price observations that CPI data collection staff follow over time. The observations are outlets selected among those that provide service to the 87 CPI sampling areas as reported in the Point of Purchase Survey.

Item samples. When CPI data collectors seek retail prices for cable television, they first select either installation charges combined with periodic charges or just periodic charges. The selection is made using probability sampling. If the selection is installation and periodic charges, then the type of installation (original or additional), the number of connections, the need for a converter box, and the number and type of stations included in the minimum basic service are identified. If the selection is periodic charges, then the data collector, using probability sampling methods, selects the level of service to be priced. Periodic charges may include such options as

minimum basic, expanded basic, and expanded basic plus premium channels. After a level of service is selected, the data collector uses probability sampling to select the number and type of television channels included in the service. The final step is the selection of optional items, such as a remote control. Once the characteristics to be priced have been selected, then the appropriate charges, franchise fees, and taxes are obtained and reported.

Quality changes. The cable service companies frequently make changes in the service they offer; these changes are often accompanied by price change. In some cases these are added with no additional charge. In that case, CPI staff evaluates the change and if we deem it of significant value, we will make some adjustment to the observation. Most commonly, if there is a change in the number of channels offered, a linear quality adjustment amount is derived from the change in the number of channels.

Another occurrence is for the Cable companies to add new features at an additional charge. For example, they may offer high-speed Internet service. The CPI adds these to its pricing specifications at various times. During the regular on-going sample rotation, new items are selected and Cable service with the new feature, like Internet service, may be added at that time. There is also an augmentation program that may add sample observations when the number is below the target. Although its primary purpose is not for bringing in new items, it often provides that additional benefit. The CPI may, on an ad hoc basis, reinitiate the item sample as a mechanism for adding the new features.

When the seller of services in one stratum offers new features—like the Internet—that have their CPI home in a different stratum, we deal with it by allowing it to occur in both strata. Although we do not have any at present, in the future we may have some Internet service included in Cable television stratum. We do have some cable TV providers in the Computer information processing services stratum, which is primarily for Internet service providers. If this becomes the standard practice to blend two services such as these, the long run solution is to merge their strata, but this would be both expensive and disruptive to do in a timely fashion.

VII.   Conclusion

Exhibit 2 shows the price movements in the basic CPI telecommunications indexes since the January 1998 CPI revision. For comparison, the aggregate CPI for Services also is included in

the table, along with the index for Postage, a non-electronic communications mode. One is struck by how differently the prices of the different modes have moved over these three years. Of the telecommunications series, only the Local telephone index showed an overall index increase. By contrast, prices for consumer services in general rose each year. The Postage index also rose overall. (The U.S. Postal Service imposed another rate increase in January 2001.)

Exhibit 2. Annual Percent Changes in Telecommunications Indexes			
Component	12 months ending December 1998	12 months ending December 1999	12 months ending December 2000
Telephone services	0.3	0.4	-2.3
Telephone services, local	1.3	2.8	5.5
Telephone services, long distance	-0.1	-1.3	-9.2
Interstate toll calls	-0.8	-0.7	-11.2
Intrastate toll calls	1.5	-1.6	-6.0
Cellular telephone services	-8.3	-11.6	-12.3
Computer information processing services	3.0	-7.1	-0.3
Cable Television	-4.8	-7.3	-10.7
Services	2.6	2.6	3.9
Postage	0.0	3.0	0.0

It is likely that both competitive and technological effects have driven these index movements. To the degree that telecommunications modes are substitutes—however imperfectly—for one another, consumer response to any relative price change can enforce a similarity in index movements. For example, there is a trend in the U.S. toward consumers using cellular telephones as their primary if not their exclusive mode of telephone service—both for local and for long distance. On reason for the drop in the price of local telephone service in 2000 and the acceleration of the decrease in long distance service is the response of those more traditional modes to the inroads from cellular service. It is noteworthy that Cable television prices fell significantly each year, despite the relatively monopolistic structure of that industry.

The foregoing discussion also has demonstrated that current CPI methods have not solved all the problems created by new consumer telecommunications sectors. Difficulties of including

new goods and of managing quality adjustment remain, and there is a significant non-response issue in some parts of the telephone sector.

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