10. Treatment of Specific Products

A. Introduction

10.1 This chapter provides examples of how different national statistical agencies handle different industries. The emphasis is on those industries in which price measurement generally is regarded as difficult; however, examples of routine industries are included. *It should be kept in mind that the presentation of these methods is not intended to convey them as "best practices." In fact, it is recognized that in some cases a country's circumstances likely will necessitate deviations from these methodologies.* To underscore this point at the end of each section, a list of outstanding issues is provided—issues that point to problems in the described procedures.

10.2 A general problem in constructing PPIs is formulating a precise characterization of the good or service to be priced. To some extent, that characterization hinges on the definition of the industry to which the producing firm is assigned. For the purposes of this chapter, the ISIC Rev. 3 will be used as a reference. The linkage between the selection of the products to be priced and their industry assignment is independent of whether there is probability or judgmental sampling.

10.3 After selecting a product or output to be priced, the difficult problem is characterizing the good in a way that not only facilitates repricing but also distinguishes between changes in quality and changes in price. The last aspect is extremely important for an accurate measure of price change. Previous chapters in the *Manual* have provided discussion of the conceptual framework underlying many aspects of constructing PPIs. This chapter will provide some examples of different statistical agency practices.

10.4 Within the context of any economy, there will be some industries for which a relatively straightforward application of these methods and concepts is possible and industries for which that is not the case. In this chapter, both types of industries will be addressed.

10.5 Generally, the industries that allow for a straightforward application of the methods and concepts are ones for which the establishment output is countable. That is to say, a member establishment's output is physically measurable or has physical indicators of output that can be used. In either case, the definition of the output's price is clear. Examples of industries falling into this category and discussed below are agriculture (ISIC 01), steel (ISIC 27), and petroleum refining (ISIC 23).

10.6 However, some industries that produce physical output present difficulties for index number compilers. The construction industry (ISIC 45) and the shipbuilding industry (ISIC 35) are two examples. Though the output is easy to count, the creation of the companion price index is difficult for two main reasons: the output is produced over a long time, and it is an outcome of a contract—the output is usually a custom product. Accordingly, it is difficult to price the output on, say, a monthly basis. Such cases of custom capital goods are discussed below.

10.7 Industries producing goods that experience frequent technological change also present some special problems. Though the output of the computer industry (ISIC 30) may be measurable, constructing price indices for computers is difficult when trying to capture quality change that arises from the technological change. The computer industry and motor vehicles (ISIC 34) are examples provided in this chapter.

10.8 The clothing industry (ISIC 18) presents a similar problem. The output is measurable, but the measurement of price change is complicated by the change in quality of the clothing and the influence of seasons. The case of the clothing industry is specifically considered.

10.9 Because service industries generally do not have easily measurable output, it is difficult to apply the concepts set out in the *Manual* to them. Accordingly, this chapter will consider service industries such as retail trade (ISIC 52), wireless tele-

communications (ISIC 642), commercial banking (ISIC 65), insurance (ISIC 66), software consultancy (ISIC 7220), legal services (ISIC 7411), and general medical hospitals (ISIC 8511). It will show how different statistical agencies overcome these difficulties to compile service sector producer price indices.

10.10 The discussion below will not fully address issues concerning sample design or sampling methodology. These features will be discussed only to the extent that they affect the establishment of a pricing strategy for the product.

B. Agriculture, ISIC 01[1]

10.11 The construction of a price index for agricultural products generally, and crops in particular, is more difficult because of two circumstances that sometimes combine. First, marked seasonal patterns in some commodities' production make prices unobservable during part of the year. Second, volatility in price and production from year to year, and sometimes within a year, is caused by external forces such as the weather or economic influences.

10.12 These two problems have to be accommodated by building into the indices a method for dealing with gaps in the supply of prices and for smoothing volatile elements while reflecting, as quickly as possible, changes in the trend of agricultural production.

10.13 The following description is drawn from the recently redesigned Canadian farm product price index (FPPI) and the procedures introduced to meet these problems, which are representative of the techniques used by other countries.

10.14 The index follows a seasonal basket concept in which the volume shares of the various commodities are different for each month in the year. Thus there are 12 different baskets used in calculating the months of a calendar year in the FPPI.

10.15 The annual index number for a given year is a weighted average of the corresponding monthly indices, rather than a simple average, as is common in other indices.

10.16 The index is an annually reweighted chain price index, so the annual weighting pattern is updated every year. Each annual weighting pattern, or basket, is based on marketing data for the five most recent years available.

10.17 The linking of new baskets each year is done at the annual index number level, not for any one month.

B.1 Seasonal baskets

10.18 The formula for constructing the seasonal baskets in the Canadian FPPI is a variant of what usually is called the Rothwell formula, after Doris Rothwell, an economist with the U.S. Bureau of Labor Statistics, who proposed it in a 1958 paper for the U.S. CPI. However, the formula was originally proposed in 1924 by two economists with the U.S. Department of Agriculture, Louis H. Bean and O. C. Stine, as an index number for farm prices. Thus the formula adopted for constructing seasonal baskets was originally designed as an indicator of farm price movements.

10.19 The Rothwell formula must be used to calculate indices of fresh produce in the harmonized indices of farm product prices of the European Community, so statisticians of those countries are familiar with it. The formula also is used to calculate series for seasonal commodity groups in the CPIs of several countries, including Japan, France, and the United Kingdom.

10.20 The Rothwell formula is

$$(10.1)\quad P^{(c)}_{y,m/0} = \sum_j p^j_{y,m} q^j_{c,m} \Big/ \sum_j p^j_0 q^j_{c,m} \ ,$$

where $p^j_0 = \sum_{m=1}^{12} p^j_{0,m} q^j_{c,m} \Big/ \sum_{m=1}^{12} q^j_{c,m} = \sum_{m=1}^{12} p^j_{0,m} q^j_{c,m} \Big/ q^j_c$.

In the above formula, $p^j_{y,m}$ is the price of the j^{th} commodity for the mth of year y, p^j_0 is its price in base year 0, and $q^j_{c,m}$ is its quantity sold in the mth month of the basket reference period c. Note that in the special case where the basket reference period c is the same as the base year 0, the formula becomes

[1]The following description is based on Baldwin (2002).

(10.2) $P^{(0)}_{y,m/0} = \sum_j p^j_{y,m} q^j_{0,m} \Big/ \sum_j p^j_0 q^j_{0,m}$,

where $p^j_0 = \sum_{m=1}^{12} p^j_{0,m} q^j_{c,m} \Big/ \sum_{m=1}^{12} q^j_{c,m} = \sum_{m=1}^{12} p^j_{0,m} q^j_{c,m} / q^j_c$.

Also note that the average base-year price of each commodity is its base-year unit value. In the special case where $q^j_{0,m} = q_0 / 12; m = 1,2,...12$ for every commodity (that is, quantities sold were the same in every month of the base year for every commodity), this variant reduces to the familiar Laspeyres formula.

10.21 The Rothwell formula for the annual index would be

(10.3) $P^{(c)}_{y/0} = \sum_j p^j_y q^j_c \Big/ \sum_j p^j_0 q^j_c$,

where $p^j_y = \sum_{m=1}^{12} p^j_{y,m} q^j_{c,m} \Big/ \sum_{m=1}^{12} q^j_{c,m} = \sum_{m=1}^{12} p^j_{y,m} q^j_{c,m} \Big/ q^j_c$.

In the special case where the basket reference period *c* is identical with the base year 0, the formula becomes

(10.4) $P^{(0)}_{y/0} = \sum_j p^j_y q^j_c / \sum_j p^j_0 q^j_c$,

where $p^j_y = \sum_{m=1}^{12} p^j_{y,m} q^j_{0,m} \Big/ \sum_{m=1}^{12} q^j_{0,m} = \sum_{m=1}^{12} p^j_{y,m} q^j_{0,m} \Big/ q^j_0$.

Note that even when the base-year prices are unit values, prices for other years are not, since they are weighted according to another period's monthly sales pattern.

10.22 In the Canadian FPPI, the monthly weighting patterns are calculated as follows: For each product, the average quantities sold for the five years from 1994 through 1998 were calculated for each month of the year. The quantities sold of most agricultural products can be measured directly: The availability of measures such as bushels or head obviate the need for deflation. The 12 monthly shares are then calculated. To obtain the monthly revenue weight for a given product, the annual revenue weight for a particular year is multiplied by the relevant monthly share. The sum of these monthly weights yields the annual weight. As described below, the annual weights change every year, but the monthly share patterns are held constant until the next major review, in about five years. This approach allows the relative importance of commodities in the 12 monthly baskets to change from year to year, reflecting the changes in the relative prices of the different commodities.

10.23 A major strength of this approach is calculating highly seasonal products available for only a few months in the year. Using the previous annual basket approach, such commodities had the same basket share in every month of the year. One had to impute prices in months when no quantities were sold. Using a monthly basket approach, if there were no sales for a commodity in a given month from 1994 to 1998, then it simply fell out of the index basket. There was no need to impute a price for it.

10.24 Problems with changing seasonal patterns may remain. If a seasonal commodity had no sales in a given month from 1994 to 1998, but some thereafter, the prices for that month would be ignored. For example, if the season for corn lengthened, perhaps because of global warming, to include sales in November, where before no sales occurred after October. This shift in the overall seasonal pattern of production of an agricultural commodity would not be reflected until the next update of the seasonal patterns. Changes in the length of a season do not occur very often, and it is the *beginning or end* of the season that is being ignored. Ignoring that is much less serious than assuming all months would have about an 8 percent (one-twelfth) share of the annual sales.

10.25 Imputations cannot always be avoided. If you typically have a weight for a product in a certain month, but for some reason, such as early frost in October, no sales of that product occurred that year, an imputed price would have to be assigned to it. This kind of scenario is more likely to occur than the one discussed above. In such situations, the imputed price would be the weighted average price for the in-season months through September. Although one could argue for other solutions, such an imputation is simple, does not depend on price information external to the stratum or the commodity in question, and gives the same annual price as if one simply ignored October in calculating the annual price.

10.26 The problems of imputation, as well as the formation of the seasonal basket, are ones faced by seasonal commodities, such as clothing.

B.2 Annual price index

10.27 The annual price indices are weighted averages of the monthly index numbers. The weights are the monthly expenditure weights. In this, they differ from the simple means of the monthly index numbers. A weighted average is used because the monthly shares of sales of many farm products are highly unequal. Most occur in only two or three months of the year, and in the same two or three months of the year, year after year. One cannot have much confidence in an annual index based on equal weighting of the monthly indices if the different months have such unequal contributions to annual output. This is more so the case since product prices are highly and negatively correlated with sales, being much lower in the months with the largest shares than in other months of the year.

10.28 Although they are close, the annual prices at the most detailed level are not unit values of the commodities. The annual unit value for a commodity is calculated as the total annual revenue divided by the total annual quantity sold. This amounts to a weighted average of monthly prices, weighted by *same-year* quantities. The annual prices in the FPPI are weighted averages of monthly quantities for the seasonal profile reference period, currently from 1994 to 1998.

B.3 Annual chaining

10.29 The index is updated every year, from the receipts for a five-year period. The basket for 1999, for example, is based on the sales from 1993 to 1997, revalued to 1998 average prices.

10.30 Consider the updating done for the January 1999 index. The quantities sold from 1993 to 1997 are evaluated at prices for 1998 to provide a new basket. Using this basket, indices are recalculated for each month from January 1998 onward; the index will automatically be on a 1998 time reference, so the ratio of this index to the previously calculated 1998 index gives the link factor. Indices for the months of 1999 are multiplied by this link factor. In January 2000, the same procedure is followed, instead using quantities sold for the period 1994 to 1998.

B.4 Linking at the annual index

10.31 Linking series that are computed with both monthly and annual measures can be a problem because it is not possible to preserve continuity for both. Most series get linked at the monthly level so that the monthly index changes are not distorted by shifts between the baskets. This can be done by linking in December, so that December and January prices are compared in terms of the new basket.

10.32 For this index, the monthly baskets change anyway, so there is no advantage in linking by the month. Linking at the year preserves the year-to-year movement as a measure of pure price change.

B.5 Analysis of monthly price changes

10.33 Monthly baskets have the disadvantage of no measure of pure price change between months. Even if there is no change in prices from one month to the next, a change in the index is possible because of the change in the basket. However, it is possible to decompose the monthly change in the FPPI into a pure price change component and a residual component for all months except January. The pure price change component measures what the change in the FPPI would be if there were no change in the monthly basket. This calculation may require the calculation of imputed prices for some commodities that may have gone out of season by the next month.

10.34 The decomposition is as follows:

$$(10.5)\quad P^{(c)}_{y,m/y-1} - P^{(c)}_{y,m-1/y-1} = \frac{\sum (p_{y,m} - p_{y,m-1}) q_{c,m-1}}{\sum p_{y-1} q_{c,m-1}} + \frac{\sum p_{y,m} (q_{c,m} - q_{c,m-1})}{\sum p_{y-1} q_{c,m}},$$

where summation is over commodities. Therefore, the monthly percentage change in the Rothwell index can be decomposed between a pure price change component,

$$(10.6)\quad \left(\frac{\sum (p_{y,m} - p_{y,m-1}) q_{c,m-1}}{\sum p_{y,m-1} q_{c,m-1}} \right) \times 100,$$

and a residual component,

$$\left(\frac{\sum p_{y,m} (q_{c,m} - q_{c,m-1})}{\sum p_{y,m-1} q_{c,m-1}} \right) \times 100.$$

(As can be seen, the residual component is not a pure quantity change component since there are different prices in the numerator and the denominator.)

10.35 Where very large basket shifts exist from one month to the next, it may not be acceptable to take the previous month's basket as appropriate for comparing prices between the previous and current month. An Edgeworth-Marshall-type cross should then be calculated

$$(10.7)\quad \left(\frac{\sum (p_{y,m} - p_{y,m-1})\overline{q}_{c,m-1\&m}}{\sum p_{y,m-1}\overline{q}_{c,m-1\&m}} \right) \times 100,$$

where $\overline{q}_{c,m-1\&m} = (q_{c,m-1} + q_{c,m})/2$.

10.36 Equation (10.6) answers the question of what the monthly percentage change in the FPPI would have been if there had been no change in the monthly basket from the previous month, with the previous month's FPPI remaining as published. Equation (10.7) answers the question of what the monthly percentage change in the FPPI would have been if both previous and current month estimates had been calculated using a common monthly basket representing sales in both months. Equation (10.6) thus is more closely connected to the published FPPI than is equation (10.7). Yet the latter may be a better measure of month-to-month price change because it uses quantity weights from two time periods.

10.37 An Edgeworth-Marshall cross has the advantage of being consistent in aggregation and satisfying the property of transactions equality. (If the volume of sales in month *m* is five times larger in month *m* than in month *m* – 1, month *m* will be about five times more important in determining the basket shares of the price comparisons.)

10.38 A Fisher cross is another way to incorporate information from two time periods. However, such an index does not satisfy transactions equality. In a Fisher cross, the price comparisons are weighted using each basket, and then their geometric mean is taken; the two baskets are treated as being of about equal importance, which may be contrary to reality as in the example where sales in month *m* is 5 times the sale in month *m* – 1.

10.39 An Edgeworth-Marshall cross also has an advantage over a Walsh cross, another index that combines information from two time periods, in that it does not remove seasonally disappearing commodities from the comparison. For a Walsh cross

$$(10.8)\quad \left(\frac{\sum (p_{y,m} - p_{y,m-1})\overline{\overline{q}}_{c,m-1\&m}}{\sum p_{y,m-1}\overline{\overline{q}}_{c,m-1\&m}} \right) \times 100,$$

where the average $\overline{\overline{q}}_{c,m-1\&m} = \sqrt{q_{c,m-1} \times q_{c,m}}$.

If a commodity were missing in either month, its mean quantity sold would be zero, and it would have no impact on the measured price change; in the Edgeworth-Marshall cross, all commodities with sales in at least one of the two months would have an influence on the estimated price change.

10.40 In calculating an Edgeworth-Marshall cross using equation (10.7), one must impute prices for commodities unavailable in either month *m* – 1 or *m* (but not both) and not, as with equation (10.6), only for those unavailable in month *m*.

10.41 The December–January change is distorted not only by the switch from one monthly basket to another, but also by the switch from one annual basket to another. As the annual basket changes every year, comparisons of 12-month changes between the same months of successive years do not provide a measure of pure price change. This problem is met by calculating each new index for 24 months, as previously described. Although the monthly index numbers are not used for the first 12 months, comparisons between them and the 12 months that follow can be used as measures of pure price change for 12 periods. In other words, the 1998 indices, on a 1998 base, are not used in the index, only those indices for 1999 are. Since they use the same basket, comparisons of the May 1998 indices (1998 = 100) and May 1999 indices give a pure price change measure.

B.6 Other issues

10.42 *Use of receipts in the absence of quantities sold*. For some products, such as maple products, quantities are not provided, though there are cash receipts. In this index, the price movements are taken from the movement of the total crops index.

This ensures that each kind of product is represented in the index with an appropriate weight.

10.43 *Choice of time reference*. The FPPI is referred to 1997 = 100. As the index is a chained fixed-basket index with the basket changing every year, the choice of time reference has nothing to do with the estimated price movements over time. The base was chosen to correspond with Canada's choice of 1997 as the reference for most of its economic series, including the *System of National Accounts*.

10.44 The Canadian approach raises issues that some countries may want to avoid or come up with alternative methods. As described earlier, the seasonal basket combines information from annual and monthly data, creating issues about (i) how to select the market basket and (ii) how to interpret the switch between annual and monthly quantity data. Relatedly, one also must choose the appropriate base year. A fuller discussion of seasonal adjustment is provided in Chapter 22.

C. Clothing, ISIC 18

10.45 As measured by the ABS, the output of the Australian clothing industry covers the production of a wide range of garments, from basics to high-fashion items. The output can be categorized in a numbers of ways, but industry and commodity classifications generally adopt the traditional split of

- Women's and girls' clothing,
- Men's and boys' clothing,
- Infants' clothing, and
- Clothing not elsewhere classified.

10.46 A further dissection by functional type of clothing can be made within these categories. For example, women's and girls' clothing could be divided into women's dresses, girls' dresses, women's skirts, girls' skirts, women's sleepwear, girls' sleepwear, and so on.

10.47 Alternative classifications may focus on aspects such as formal or fashion wear, business wear, casual wear, or sporting wear, or on the type of material used, including cotton or polyester.

10.48 Having selected the items to be covered by the index (for example, women's dresses), the respondents to be included in the index and the specific items to be priced need to be selected. The selection of respondents will normally be based on data from surveys or censuses of manufacturers.

10.49 Selection of the actual specifications to be priced will require contact with the manufacturers and may be complex. Key principles in selecting the actual specifications from any particular manufacturer are

- Specifications should provide adequate coverage of the types of garments produced by the manufacturer within that item category. In particular, they should represent the pricing practices adopted by the manufacturer. That is, the factors that cause prices to move differently across specifications should be taken into account. These may include type of material used (for example, cotton fabric shirts may move differently in price compared with polyester fabric shirts) and type of customer to whom items were sold (for example, if the manufacturer produces its own brand of underwear sold to up-market retailers and a "house brand" of underwear sold to major discount chains, then specifications for both categories will need to be selected since their prices are likely to move differently).
- One should be able to price the specifications on an ongoing basis to maintain constant quality. To do so on an ongoing basis, full details of the specification need to be obtained (see below).

10.50 A general problem in pricing clothing is the distinct seasonal variations in the clothing produced in most countries as manufacturers switch from summer to winter clothing. Since some garments are produced for only part of the year, some technique is required to handle the period when these seasonal items are not produced. The most common technique is to simply repeat prices for the out-of-season items.

10.51 As was mentioned regarding agricultural products, the problem of missing items is common when dealing with seasonal commodities. Imputations are therefore necessary. Section B.5 of Chapter 9 discusses imputations.

10.52 Another problem is finding the same items to price in the new season (for example, this winter) as were priced in that season of the previous year (that is, last winter). Items will often change be-

cause of fashion and style changes and the changing relative costs of different fabrics (for example, wool versus synthetics). Where the same item cannot be repriced and a different item is priced instead, it will be necessary to assess what price movement should be shown.

10.53 Quality change can be identified by any changes in the characteristics that incur costs. For a type of clothing, the quality change associated with a substitution of polyester for cotton can be handled by valuing the different cost. A wide range of factors can affect the quality of these garments. Major factors include

- Type of fabric used, for example, pure cotton, cotton blend, polyester;
- Quality of fabric, for example, weight, thread count, type of dyeing;
- Quality of make, for example, type of seams, buttonholes, collar, pleats.

10.54 With clothing, a natural question is what to do about fashion changes that are generally tied to seasonal variation. Opinions differ on whether a specific quality change should be made for fashion. Some might argue that a quality adjustment should be performed because the fashion element is the key price-determining characteristic. Others might argue that fashion changes manifest themselves in changes in other characteristics, such as fabric, and therefore do not require additional adjustments. If there are no changes in any of the measurable characteristics of the article of clothing, then some imputation for the cost of design, which would be quite difficult, may be necessary. Furthermore, no such adjustments typically are made for other products traditionally redesigned every year, such as automobiles. (The quality adjustment procedures for automobiles are discussed below.) Finally, although manufacturers devote considerable efforts to establish their designs as the fashion of the season, there is no certainty of success. Accordingly, the validity of computing a quality adjustment for fashion rests to some extent on whether the fashion can be deemed successful.

10.55 The practical problems for the price statistician are, first, to detect these changes and, second, to place a value on them. To detect quality changes, it is necessary to list on the prices questionnaire the actual specifications being priced from particular respondents, for example:

"Brand X, Men's dress shirt, style No. xxxx, 100% cotton, size 38–43, long sleeves, single cuffs, etc., sold to major retail customer."

10.56 In addition to the detailed specifications respondents specifically should be asked on the questionnaire whether there have been any changes in the quality of the specifications being priced.

10.57 Seasonal dimensions can be handled by creating checklists that are seasonally based. Thus, an item selected would be Women's summer dresses, fall dresses, and so on.

10.58 There are three prominent issues that arise with measuring price change for clothing. First, as mentioned above, is how to impute missing prices and quantities. Second, there is an issue concerning the price reductions that result from seasonal clearances. Since such clearances sometimes result in drastic reductions in price, and they occur after the commodity is out of season, it is not clear that they should be considered. Third, there is a question of whether changes in fashion should be considered as a quality change. Earlier it was argued that such changes should not be considered quality change.

D. Petroleum Refining, ISIC 23[2]

10.59 Petroleum refining is a manufacturing activity that converts crude oil into various petroleum products. The primary outputs of petroleum refineries are refined petroleum products, including fuels, lubricants, and petrochemical products.

10.60 Crude oil is a complex mixture of hydrocarbons, water, salts, sulfur, metals, dirt, and other impurities. The crude oil must be cleaned and separated into various products. Often the molecular structure must be altered to improve its properties. Different products must be blended to produce usable mixtures. The major steps in a refinery include

- Desalting—removing salt, water, dirt, and other impurities;
- Crude and vacuum distillation—separating the crude oil into separate products;
- Conversion—modifying the composition of the products; and

[2]The following description was provided by Suzanna Lee of Statistics Singapore.

- Blending—putting together measured amounts of products.

These steps are called process units because they process the crude oil directly.

10.61 To compile a PPI for oil refining in Singapore, the price movements of commodities produced for sale by oil refineries are measured. Motor gasoline, jet fuel, kerosene, diesel fuel, fuel oil, lubricating oil, naphtha, liquefied propane gas (LPG), and asphalt are the primary outputs of oil refineries. Oil companies had been successful in selling motor gasoline to consumers under unique brand names like Shell, BP, Exxon, Mobil, and so on. Despite the differentiation, the products produced by refiners are essentially the same. It is simple in terms of data requirements and respondents' burden to construct a price index using sales revenue.

10.62 The weighting pattern in the PPI for petroleum refining is based on the relative importance of the commodities' production value in the base year. The production value is the sale value received by manufacturers for the sales of their output.

10.63 Before conducting a regular price survey, it is necessary to conduct a preliminary survey to identify the actual product, specification, brand, and grade of items produced by oil refiners. The survey frame for conducting the preliminary survey is usually obtained from the Census of Industrial Production register. A list of establishments classified by manufacturing activities, the products manufactured (at seven-digit Standard International Trade Classifications, SITC), and the corresponding sales values of these products were extracted from the Census. In most countries, oil refining is concentrated mainly in a few very large petroleum refineries. If the number of companies is few, no sampling is required, and the coverage of the establishments that engaged in oil refining can be exhaustive. For the preliminary survey, customized forms with the major commodity items (at seven-digit SITC) preprinted were sent out to respondents requesting them to provide the top-three-selling product brands under each of the commodity items listed. In addition they were requested to delete items that were no longer manufactured and to add new items not listed in the customized survey forms. They were requested to rank the various brands in order of importance and to provide a detailed specification or description pertaining to brand, grade, size measurements, frequency of production, unit of measurement, and actual ex-factory prices at which they were sold.

10.64 The returns from respondents were reviewed and verified through telephone inquiries to ensure that the products or brands reported fell within the commodity items requested. The final selection of products for the monthly price survey was based on how often and how regularly the product was produced, how specific and detailed the specifications were for pricing, and how significant was the product's share of the establishment's production. Based on these selection conditions, items that were made to order or were produced on project or ad hoc basis were excluded. This helps reduce problems posed by the substitution of such items in the future for price monitoring.

10.65 In Singapore, customized survey forms preprinted with the description of each selected brand item and unit of measurement are then sent to the refiners for monthly prices collection. Respondents are directed to quote ex-factory prices that exclude outward transport charges and excise duties, if any. The prices on the 15th of the month or the closest date are to be provided. Respondents are encouraged to give transaction prices, not list prices that can be substantially different. If ex-factory prices were not available, respondents were requested to state the basis of the quotation. The prices reported must be consistent and comparable from one reporting period to the next. Although spot prices of oil products are published on a daily basis in the newspaper, spot prices often reflect only a minute proportion of total production. It is more accurate, as well as quite cost-effective, to obtain actual transacted prices directly from the small number of oil refiners involved.

10.66 In many countries, the government is concerned with protecting air quality in the environment and has enacted laws to reduce the level of air pollution caused by the emission of pollutants from motor vehicles. The production of cleaner motor gasoline (unleaded petrol), as mandated by the government, raised the production cost for refiners manufacturing the clean gasoline. Manufacturers faced with additional production costs increased the price for the clean gasoline. Cleaner gasoline represents a quality improvement because the characteristics of the gasoline have changed. Therefore, the price increase in the unleaded gasoline mandated by the government should be subjected to an appropri-

ate quality adjustment, since price change for motor gasoline should track only pure price changes.

10.67 A preferred way to handle quality adjustments is to estimate the value of the quality change directly. The quality adjustment for cleaner gasoline could be estimated directly if information could be obtained on the additional production cost incurred by manufacturers having to produce cleaner gasoline. Besides requiring data on the additional production cost, the proportion of clean gasoline produced in relation to total gasoline production is another consideration. Refineries could manufacture gasoline both for local consumption and for exports to other countries. The vehicular emissions standards of other countries may not necessarily be the same as those required within the refiners' country. Furthermore, government control of fuel emission from vehicles also may be gradually introduced over a long time frame, say, over 5 to 10 years, implying that the proportion of the unleaded to leaded gasoline manufactured could vary substantially from year to year, depending on both internal and external demand. While keeping the more aggregated index weight constant, the more detailed weights of leaded and unleaded gasoline may need to be adjusted on the basis of information on the volume of leaded and unleaded gasoline produced by refiners.

10.68 Often, information on additional production costs and volume changes is not available from refiners or product knowledge experts. In such cases, price compilers may have little choice but to resort to using indirect quality adjustment methods such as overlap pricing or class mean imputation. The decision on which method to adopt for quality adjustment depends on the information available to price compilers.

10.69 Essential fuel products such as petrol may be subjected to price controls that prohibit any price increases. In such a situation, it may be necessary to accept the official controlled prices reported by respondents. Nevertheless, a black market for the commodity might exist, and if it is possible to measure the black market price increases of the controlled items, such prices should be included in the index. Price controls greatly complicate the task of measuring price changes, and price statisticians must be aware of the problem so as to alert users of the more detailed category index that includes the price control items.

10.70 An issue that arises in the case of petroleum products is the potential irrelevancy of a fixed-weight index. As the discussion above makes clear, it is relatively easy for a refinery to switch from one product to another in anticipation of changes in demand—the largest and most common source of which is seasonal changes. In such a situation a fixed-weight index may have an incorrect set of weights for the period being considered. This problem can be solved by frequently updating the weights or using one of the superlative indices discussed in Chapters 1 and 15.

E. Steel Mills, ISIC 27[3]

10.71 The primary output of the steel mill industry is the production of steel shapes, such as sheet, strip, plate, bar, rod, pipe, and tube, from molten metal. Steel is generally produced by either the blast furnace/basic oxygen mill process or by the electric arc furnace process. The first process involves converting a charge of iron ore, coke, and other components into molten metal. The metal may be poured into any of several semifinished products, such as ingot, billet, and slab. The primary output of the industry includes semifinished products that leave the mill. Most semifinished steel is converted internally into higher-value forms such as sheet, plate, and bar. Blast furnace/basic oxygen mills also may use a continuous casting process, in which the molten metal instead is converted directly into more finished shapes. Electric mills convert steel scrap, pig iron, and other charge components into molten metal, which is then usually converted directly into sheet, plate, rod, or bar.

10.72 The primary output of the steel mill industry also includes various products such as forgings, nails, and wire when they are made at the steel mill for shipment to other establishments. The following describes the methods underlying the U.S. PPI for steel mills.

10.73 Items should be selected at the company level for the desired product aggregation, which are the publication cells. Item selection within publication cells is based entirely on probability proportionate to size sampling. Such sampling within companies has been based, whenever possible, on value of shipments or sales data. Value-based figures are preferred and are usually available for

[3]For more information, see Bestock and Gerduk (1993).

higher levels of aggregation. Quantity measures, usually tonnage, are viewed as acceptable at the more detailed levels. For example, there is little difference in value between several diameters of pipe of the same carbon steel grade. Yet there is a significant difference in value between carbon steel and stainless steel grades.

10.74 Prices are collected from each reporter based on basic shapes—sheet, plate, bar, rod—and on the type of steel—carbon, stainless, or alloy steel. Providing such specificity helps to align the products with revenue statistics. Additional specifications also are collected to further identify the product. These might include some sort of item identification, order or part number, the specific grade (there are hundreds of them), dimensional information, and other features, such as shipments to various types of buyers. The types of transactions include contract sales, multiyear sales to manufacturers, and distributor sales. Discounts, if applicable, are reflected in the price. Surcharges also may be included in the price. Steel companies have at times imposed temporary surcharges to cover sudden increases in the cost of scrap metal, and nickel, molybdenum, and other alloys.

10.75 The collected prices should be transaction prices. Reporters sometimes prefer to provide list prices to shield their pricing strategy. However, list prices in this industry can be especially nonrepresentative of price movements because of the potential impact of imports on market prices. One way to overcome this concern, as practiced in the United States, is to define the transaction price as an average and have a one-month lag. Because the industry firms typically set the transaction price at a discount from list prices, which yields widely varying prices of similar products based on different transaction characteristics, price averaging across all customers for a specific product each month provided the most representative transaction price obtainable. In addition, average pricing proved popular with reporters since it required no additional formatting of price records and avoided revealing any buyer-specific details. The major drawback was having to accept the one-month lag.

10.76 Quality adjustment in this industry is a less critical issue than for many others because the nature of the products rarely changes. However, if a product made of one alloy of steel is altered to be made with another alloy of steel that enhances strength, then a quality change would be made based on the cost differential for the alloy. This procedure is described in Chapter 7.

10.77 New products are introduced slowly by the industry, and therefore there is little problem with new and disappearing goods. The sheet metal that covers a new car is substantially lighter and stronger than 40 years ago, but it probably did not change much from that used several years ago. Given this pace of product change, the regular resampling process is sufficient. However, one possible issue with product change in the steel industry is that, when a certain grade or type of steel starts to become obsolete, output may be reduced as buyers slowly switch to a better product. The type of buyer may change as well. As with production cost data, diligent and reliable reporters provide the best means to maintaining index quality. Fortunately, the very limited and gradual rate of product change in the industry probably minimizes this problem.

10.78 The most common quality improvements in the steel industry usually are associated with the production process and often embodied in the building of a new mill, since it is hard to substantially redesign a mill once it is built. Changes in the production process, however, are not the type of change for which quality adjustments are made. The introduction of a new, lower-cost way to produce an existing good without changing any of its characteristics can result in lower price that should properly be treated as a price change. However, care must be taken to ensure that the new process does not alter the characteristics of the good. In that case, some adjustment in the observed change in price should be made. Ideally, reporters who are in the sales or accounting divisions will check with engineers.

10.79 Since steel prices collected are an average from the previous month, the published index is the measure of price change from two months previous. Although this inconsistency in timing was accepted to overcome reluctance to report transaction prices, some statistical agencies may have an alternative means of addressing reporter concerns.

F. Electronic Computers, ISIC 30[4]

10.80 The U.S. PPI program developed a computer price index that has served as a model for many countries. The methodology of that index is described below.

10.81 The primary output of the computer industry is the assembly of components into general-purpose computer systems that process data according to a stored set of instructions. These instructions are contained in the computer software (operating and application) and are often included in the computer system by the manufacturer. Establishments that primarily manufacture machinery or equipment that incorporate computers for the purpose of performing functions such as measuring, displaying, or controlling process variables are classified based on the manufactured end product.

10.82 The output of the computer industry can be disaggregated into several product categories. These categories should be broadly defined because the rapid pace of industry technological change can render narrowly defined categories obsolete. The PPI publication structure for computers is based on product detail collected by the U.S. Census Bureau in their Current Industrial Report (CIR) survey, which is described below:

- Large-scale;
- Midrange, excluding PCs and workstations;
- Personal computers and workstations, excluding portable computers;
- Portable computers with attached displays; and
- Other computers.

10.83 Note that the large-scale and mid-range product designations are problematic. These two Census product categories were originally intended to include computer host or server systems that were differentiated by memory size. Systems with 64 megabytes (MB) or more of memory were considered large, and systems with fewer than 64 MB were considered midrange. As mentioned above, any technologically based characteristic used to define product categories can quickly be rendered obsolete by rapid changes in computer output. Because PPI sample intervals average six to seven years, if 64 MB were maintained as the dividing point, then the advances in memory and corresponding fall in price quickly would make the midrange category obsolete. It would force all computer servers, including PC servers, into the large-scale category. When the PPI resamples the computer industry, it will avoid descriptors such as large-scale or midrange and use higher-level and more stable classifications such as host or multiuser computers. The U.S. Census Bureau recently adjusted its classification of computer servers and describes them as "Host Computers (multiusers)."

10.84 Rapid changes in computer output can create the classification problem of new product classes that do not fit neatly into an existing product classification structure. For instance, handheld devices such as the Palm Pilots are the fastest growing product segment in the computer industry. This product category did not exist when the PPI completed its last sample of the computer industry. The best fit under the current publication structure for handhelds is portable computers. However, index users, including producers, have come to view the portable computer designation as including only laptops or notebooks. If handheld devices were to be introduced into the PPI through a targeted sample augmentation, then the publication structure should be flexible enough to adapt. User needs and agency resources hinder the degree of flexibility. At a minimum, the PPI would revise the product title "portable computers" to "portable computers, including handhelds." If revising the title of an existing product classification does not satisfy analytical requirements, then a more aggressive adaptation could include the introduction of a new, more specific product category into the publication structure, such as "handheld computers, including personal digital assistants (PDAs)."

10.85 Both of the product classification issues described above are related to rapid post-sample changes in output. Similar adjustments at the disaggregate level may be required for the output of other high-tech industries such as semiconductors and telecommunications.

10.86 In the U.S. PPI program, computer producers were selected with a probability proportionate to size, and then individual products representing current output were selected based on their relative importance to a producer's value of shipments. Establishments that report to PPI provided detailed product specifications for each of the items (com-

[4]For more information, see Holdway (2001).

puters) that were sampled for which the producers provide monthly price updates. (The average number of computers sampled per producer was 4 but ranged from 2 to 12, based on the producer's size.) Because of rapid technological change, producers generally are unable to maintain a matched model for more than three or four months. Therefore, new computers or updated versions of predecessor computers are continually introduced into the PPI as sampled products become obsolete. Product substitution caused by rapid product displacement, in effect, provides an automatic sample update mechanism. However, new technologies or changes in characteristic quantities embodied in computer replacements challenge a statistical agency's ability to publish constant quality indices.

10.87 The PPI is based on a Laspeyres formula that is designed to approximate a FIOPI. The FIOPI defines a theoretical framework that is approximated by measuring changes in industry revenue-holding inputs, including technology fixed. The assumption of fixed inputs in a dynamic economy is problematic but generally can be addressed through adjustments for product attribute changes that are valued by the attending changes in the marginal cost of the product.

10.88 This resource-cost approach to valuing quality change is often difficult to apply to high-tech products directly because of insufficient information.

10.89 The PPI program has developed alternative valuations of quality change when resource-cost data are not available from computer producers or when technology enables higher quality at a lower unit cost.

10.90 Hedonic methods have been used to estimate quality change valuations for computers in the PPI since 1990. The hedonic function is based on the premise that the characteristics that make up a complex product can be unbundled and their influences on price measured.

10.91 The correct specification for a hedonic model is often a technical issue that is more dependent on product- and market-specific knowledge than econometrics. If appropriate data, including transaction costs, are available to support a model, then regressions can provide estimated coefficient values (implicit prices) for each of the independent variables described in a specification. Discussion of hedonic models was provided in Chapter 7, Section E.4.

10.92 When cost data are unavailable, then the implicit prices from a hedonic model can be used to value changes in the quantities of characteristics reported to the PPI.

10.93 The mechanics of quality-adjusting price relatives when computer characteristics change are described below:

ICP = Implicit characteristic price from hedonic model,
P_0 = Price of predecessor computer in reference period,
P_c = Price of replacement computer in comparison period,
PR = Price relative, and
$PR = \dfrac{P_c - ICP}{P_0}$.

10.94 The above example is based on an increase in the quantity of computer characteristics such as system memory or hard drive capacity. If the quantity of computer characteristics declines in period c, then the value of ICP is added to rather than subtracted from P_c.

10.95 Many of the primary inputs to computer production such as microprocessors, memory, and disk drives exhibit extraordinarily rapid price declines. For example, the PPI's index for microprocessors has declined at an average annual rate of about 20 percent. Information from trade journals indicates that disk drive prices, on a price per unit of storage capacity, have dropped at a rate at least as fast as microprocessors.

10.96 The independent variables specified in the PPI's hedonic models include all of the inputs mentioned above and many others. Because the costs of these components change rapidly, the PPI has opted for frequently updated cross-sectional models rather than less-frequent updates of pooled data.

10.97 Ideally, the PPI would update its cross-sectional computer models on a monthly basis, but resource constraints limit the PPI to quarterly updates. Nevertheless, the PPI has greater confidence in the constant quality measures provided by quarterly cross-sectional updates relative to a pooled

model. Frequent updates of cross-sectional models also help the PPI estimate implicit prices for new characteristics shortly after they are introduced. The availability of a large amount of computer-related data on the Internet has aided the updating of the hedonic regressions.

10.98 Regularly updated cross-sectional models provide implicit prices that are based on market conditions at or close to the point at which a product replacement actually occurs, thereby enabling an improved approximation of constant quality indices in the PPI's real-time monthly production environment.

10.99 Because a longitudinal analysis of the relationship between prices and characteristics is the preferred way of basing quality adjustments, an issue that some agencies may want to address concerns the manner in which a sequence of updated cross-sectional regressions approximates a longitudinal regression.

G. Motor Vehicles, ISIC 34

10.100 The primary output of the broad motor vehicle-building industry is the manufacture of motor vehicles and the manufacture of engines and parts for motor vehicles. The discussion below describes the PPI for the Australian automobile industry and the methods of the ABS.

10.101 The output can be defined by the main activities of the industry, such as

- Motor vehicle manufacture,
- Motor vehicle engines and parts,
- Motor vehicle body manufacturing,
- Automotive electrical and instrument manufacturing, and
- Other automotive component manufacturing.

10.102 The first requirement in attempting to measure price change for this sector is to establish a clear understanding of the industry. In particular, one must determine the major categories of motor vehicles.

10.103 The following discussion focuses on complete motor vehicle manufacture. The concepts discussed also will be of assistance in considering issues involved with pricing other motor vehicle activities.

10.104 The next stage is to select respondents representative of these activities. In the case of motor vehicle manufacturers, this normally will be relatively straightforward, since there are usually only a few motor vehicle manufacturers in most countries. This may result in the sample actually including 100 percent coverage of manufacturers.

10.105 According to the *1993 SNA* the correct pricing basis for output producer price indices is basic prices, that is, to capture prices at the factory gate, where possible, excluding any taxes, delivery, or wholesaler margins. The prices also should be transaction prices that allow for discounts or incentive adjustments.

10.106 The prices also should reflect market values in cases where the manufacturers are vertically integrated with sellers. In such cases, cross-subsidization may make it difficult to obtain the proper price. However, this situation has become increasingly rare, since vertically integrated enterprises accounting systems usually require market valuations on transactions to manage monitoring effectively and to satisfy stricter taxation requirements.

10.107 In the case of motor vehicles, large fleet operators may be able to bypass the normal distribution chain. If this type of purchase is significant, it may be necessary to separately price such transactions. In some cases, government may be an important customer, as well as large taxi chains, or large motor vehicle hire chains. These customers may be able to deal directly with the manufacturer and could attract particular discounts.

10.108 Usually match pricing on a particular day of the month (such as on the 15th) will be adequate for monthly indices, because motor vehicle prices tend not to be as volatile as some commodities.

10.109 A major issue for producing an index for any technologically advanced commodity, such as motor vehicles, is quality change. While vehicle manufacturing tends to follow models that will be on the production run for at least a year (giving some opportunity to assess more fundamental technological change), motor vehicle suppliers are constantly offering packaged deals on these models. Given the array of options available for automobiles, price statisticians have the challenge of pricing to constant quality. However, because either manufacturers or distributors (wholesalers and re-

tailers) can add options, it is important to consider only those offered by the manufacturer for a PPI for the auto manufacturing industry.

10.110 Examples of motor vehicle features that may be relevant for item selection and assessment of quality change include

- Make and model,
- General type of vehicle (for example, sports, 4-wheel drive, limousine, sedan, wagon, etc.),
- Engine size,
- Exterior dimensions,
- Interior dimensions,
- Torque,
- Antilock brake system (ABS)
- All-wheel drive,
- Fuel consumption (high consumption regarded as a negative attribute, while the type of fuel used has differing assessments depending on relative fuel costs and efficiencies),
- Air bags,
- Traction-control systems,
- Safety rating,
- Acceleration,
- Brake horsepower,
- Curbside weight,
- Air conditioning,
- Cruise control,
- Compact disk (CD) player and stacker,
- Global positioning system (GPS),
- Keyless entry,
- Security system,
- Power windows,
- Electric sunroof,
- Electric mirrors, and
- Metallic paint.

10.111 One method commonly employed for change of specification is the overlap method of pricing, discussed in Chapter 7. To undertake this method, prices must be available for the old and new model at the same time, which often may not be possible. The price comparison uses the old specification price in the earlier period and the replacement specification in the next period. Implicitly, the price difference is said to represent the market's evaluation of the quality difference between the two items.

10.112 An adjustment for changes in quality also can be made by valuing the difference in production cost attributable to the change in characteristics. This method has conceptual appeal in the case of PPIs, because assessments of quality change are best made on production cost estimates of differences in models. This method is frequently employed in the quality assessment of motor vehicles. A great deal of costing information that can be used for this purpose often is available from manufacturers. Similar sources of information may include motoring magazines or assessments made by motoring clubs or insurance companies.

10.113 Another approach is to use hedonic methods for quality adjustment purposes (see Chapters 7 and 21 for an in-depth explanation of hedonic methods). This will require an extensive data set of motor vehicles' prices with the quantities of all characteristics influencing price, preferably on the correct pricing basis (that is, basic prices), from which to calculate the hedonic function. The implicit prices of the motor vehicle characteristics from the hedonic function are used to value the differences in new and replacement motor vehicles within the ongoing sample. Alternatively, if complete time-series data sets of prices and characteristics are available, then the time dummy method could be used to directly estimate a price index from the hedonic function. It is important that the hedonic function on which these implicit characteristic prices are based should be updated at least annually. An excellent reference on the use of hedonic methods for constructing constant quality price indices for motor vehicles is that of Bodé and van Dalen (2001).

10.114 A number of private companies collect and collate pricing data on motor vehicles. Such sources often are used for detailed hedonic analysis of quality change. Whatever the quality assessment technique used, price statisticians may find it useful to refer to websites that provide reliable and free comparisons between different models and makes. An example of such a site is www.autobytel.com.

10.115 It should be noted that the set of characteristic changes also should include those mandated by governments. Some typical examples include

- Catalytic converters to limit pollution,
- Seatbelts or airbags,
- Systems that prevent ignition without the use of seatbelts, and
- Speed-limiting or warning mechanisms.

Legally mandated features should be seen as a quality improvement because they cost extra to produce and reflect a greater volume of production. Manufacturers usually can supply estimates of the extra production costs imposed by the addition of these features.

10.116 The price statistician needs to be concerned with some issues in implementing quality adjustments for automobiles. For example, automobile purchasers often order models with options—that is, the purchased model differs from the standard model. If such options are popular in a time period, then a high percentage of the cars purchased may have those options. If, on realizing the option's popularity, the manufacturer decides to make the option standard, then care must be taken in estimating the quality adjustment. To illustrate, suppose that all of the automobiles purchased in a given time period were ordered with the option and that in the next time period the option becomes standard. In this case, no quality adjustment should be conducted in the month that the option becomes standard, because in the previous month the value of the option should have been accounted for. When dealing with options, care must be taken to recognize the market penetration of the option before performing a quality adjustment, should the option become standard. Another caveat applies when performing quality adjustments for changes in features that can return to the original level. For example, suppose that because of relatively stable fuel prices, engine horsepower starts increasing and quality adjustments are performed for the increase. If fuel prices rise sharply and induce reductions in horsepower to the level of the reference model, then a decision must be made on how to treat horsepower change. One the one hand, a quality erosion could be recorded (relative to the last model), but, on the other hand, there is no quality change relative to the reference model.

H. Shipbuilding, ISIC 35

10.117 Many industries produce what can be described as custom capital goods. These are goods for which the buyer contracts with the producing firm to provide a capital good made to specific requirements. The goods would not be produced otherwise. Two examples are shipbuilding (discussed below) and construction (discussed in the next section). These examples describe the methods of the Australian Bureau of Statistics.

10.118 The primary output of the shipbuilding industry is the construction and repair of ships (vessels 50 tons and more in displacement), manufacture of submarines, and manufacture of major components for ships and submarines.

10.119 The output can be defined further by the main activities of the industry:

- Dry dock operations,
- Hull cleaning,
- Ship repairing,
- Shipbuilding, and
- Submarine construction.

10.120 The prices statistician is faced with many problems when attempting to measure changes in prices for the output of the shipbuilding industry. Ships take a long time to build, and, as a result, there may be no sales in a particular period. A significant proportion of the output of the industry relates to ships that are "unique," in that the same ship (for example, specialized naval ships) will not be produced again in the near to medium term, if ever. However, in some sectors of the industry the same general type of ship may be produced on an ongoing basis (for example, high-speed passenger ferries), although the actual specifications of each vessel are different, reflecting the needs or preferences of the particular buyers. That is, while the basic hull design may be the same, the fitout of each ship is markedly different: engines, propulsion systems, different layout of passenger space (cabins versus sit-up lounges), amount of cargo space, and type of navigation equipment fitted.

10.121 These features mean that it is difficult, if not impossible, to price the same specifications over time.

10.122 Possible approaches to measuring price changes are

- Escalated contract prices,
- Input or component prices, and
- Model pricing (also referred to as quoted prices).

10.123 In the case of escalated contract prices, the contract for the sale of the ship specifies a base price, which is subject to escalation over time according to movements in costs (that is, of labor and material inputs). This may be a common industry

practice for very large contracts, such as naval contracts for a number of ships of the same design (for example, a class of destroyers) where the contract may have a long life (for example, 10 years or more). Under this method, the use of escalated input costs provides a simulated output price for the base-period item each month (or quarter) for the life of the contract.

10.124 This method requires a reliable technique for escalating the input costs. This may require the use of other proxy indices (for example, for labor and material inputs), which must match those used in the actual contract for the pricing method to be representative. The major problem with this pricing method is that it provides only a basis for measuring prices for the life of the contract. For example, if shipyard A finishes building naval patrol boats, and the next navy contract is for frigates to be built at shipyard B, how can the two series be reliably linked? Forming a link could be a problem, especially if the base contract price for the frigates implicitly includes an allowance for price changes in the intervening period (because of productivity in the industry, for example) not fully reflected in the escalation provisions of the patrol boat contract.

10.125 The input or component price approach is commonly used because of its relative ease. The basis of this approach is the concept that the price of an item can be viewed as a function of

- Cost of direct inputs, that is, materials, major components, labor, energy, and so on;
- Cost of indirect inputs and overheads, that is, depreciation, administrative expenses, and so on;
- Productivity—efficiency with which inputs are put together; and
- Profit margins.

10.126 At its simplest, the input prices approach uses movements in the cost of the major direct inputs as a proxy for output prices. For example, using a breakdown of the major materials and types of labor used in building the ship, the major inputs and their relative weighting can be determined. Using this approach, a ship is viewed as a bundle of standardized components, for example, main engine(s), gearboxes, navigation equipment, hull, and so on, which are combined together using various amounts and types of labor. Actual specifications (for example, specific make and model of engine, aluminum plates) can then be selected and priced over time.

10.127 Such a simplistic approach is unlikely to be satisfactory over the long run, because it assumes that all other factors remain constant. In particular, it does not consider the profit margin and may not capture substitution toward more productive inputs.

10.128 The solution most widely adopted for handling the problem of unique products such as ships has been model pricing.

10.129 The model pricing approach requires the respondent to quote a price each period for a standard product with specifications that are held constant. For example, a shipbuilder is asked to select a representative ship that was constructed in the past, and to quote each period what the price would be to undertake that project if it were up for contract.

10.130 The obvious problems with this approach are

- The workload imposed on the respondent. To accurately reprice a ship on an ongoing basis represents a major task. Most respondents will be reluctant to do so.
- Getting the respondents to take the exercise seriously and to reflect market conditions. This is especially a problem when market conditions change dramatically, and, as a result, margins change. In periods of recession, respondents may not have undertaken any work in that area in the recent past and are not tendering for any such work. This adds to the hypothetical nature of the exercise. As a consequence, it is crucial to pay particular attention to the prices obtained and to maintain regular contact with the respondent to ensure that the prices being obtained are representative of actual market transactions.

10.131 For a particular respondent, there are two main methods of model selection that can be used:

- An actual ship sold in some recent period, which is representative of the respondent's output, can be selected and specified in detail as the model to be priced.
- A hypothetical model that is representative of the types of products produced by the respondent can be established. While this model may never have been (or never will be) produced, it

must represent an item that could be produced readily.

10.132 Whatever type of model is selected, it is essential that the model be specified in sufficient detail so the respondent reports prices for that defined model, and no variation from the model occurs over time without notification to the statistical agency.

10.133 The model should be broken down into the individual material and labor components. The following example illustrates the level of detail required:

(i) Materials used (with types of materials and quantities used listed)
  a. Hull construction
    i. Aluminum plates—type(s) × number
    ii. Aluminum beams—type(s) × number
(ii) Major components
  a. Main engines
    i. Makes and models
  b. Gearboxes
    i. Makes and models
  c. Propulsion system(s)
    i. Water jets—make and model
(iii) Fabrication labor (with type of labor, for example, skilled, semiskilled, and numbers of hours listed)
(iv) Design and drafting costs
(v) Overhead
(vi) Profit margin (the representative margin that would apply if contract were signed today, in current competitive climate).

10.134 For each pricing period, the respondent will need to recost each component. The respondent must understand that the profit margin quoted should reflect actual business conditions in the pricing period, and, therefore, this component is expected to fluctuate with market conditions (that is, be higher in boom periods and lower—even negative on occasion—in recessionary periods).

10.135 The model pricing procedure is thus equivalent to the respondent preparing a competitive tender (bid) each month to supply the model. Using model prices amounts to an attempt to reflect, each month, the real conditions prevailing in the marketplace, that is, the conditions that the respondent would take into account if submitting a competitive tender for a real project.

10.136 Model pricing is prone to error, particularly where market conditions are changing dramatically or the contact officer completing the form changes.

10.137 To minimize the potential for error the following steps need to be taken:

- Respondents supplying model prices should be subject to an annual interview. At such interviews the representativeness of the model should be reviewed and the prices supplied should be checked to ensure they reflect market conditions.
- Whenever a contact changes, the new contact should be visited personally and the basis of the model pricing explained.

10.138 For the shipbuilding industry (and the construction industry, examined next) the validity of the method used to derive a monthly price is a fundamental issue. More specifically, care must be taken to ensure that the derived monthly price is a good estimate of a transaction price—in other words, it responds to market conditions that the producer would have faced in the month if a project were being directly priced.

I. Construction, ISIC 45[5]

10.139 As will be described below, many of the aspects of the approach to the shipbuilding industry are applicable to the construction industry.

10.140 This industry includes only activities concerned with the actual construction of a building—it does not include the value of land or the development of land. The latter activities would be included in ISIC 701, Real Estate Activities with Owned or Leased Land.

10.141 The output of the building construction industry is the construction of buildings and the alteration, addition, renovation, or general repair of buildings. Building outputs are diverse, not reproduced over time, and often unique. Even with the same type of building (for example, an office build-

[5]For further information on this price index, refer to Australian Bureau of Statistics (2004).

ing) outputs can differ according to design, floor area, building materials, and construction method.

10.142 Furthermore, projects differ according to the underlying tasks. Projects entailing mostly renovations and repair will be quite different from those concerning new buildings. The scope of projects may vary in terms of the elements of construction required. Some services that are project-dependent include demolition and design.

10.143 The location of a project also can have a major impact on the price. In many countries, building prices may reflect urban, suburban, and regional factors.

10.144 Although the building price may reflect all the characteristics of the construction service, the fundamental problem is comparing building output prices from one period to the next.

10.145 There are many concepts of building price. The basic price, the preferred valuation of output in the *1993 SNA,* is the amount receivable by the producer from the purchaser for a good or service produced, calculated as output minus any tax payable, plus any subsidy receivable.[6]

10.146 The ABS uses the basic price of building output, which covers the amount receivable by the prime contractor from the client for the building, excluding taxes, subsidies, the value of land, design, and other professional fees.

I.1 House building

10.147 The ABS compiles a price index for house building using the matched-model method. More information on the matched-model method can be found in Chapter 1, Sections I, K, and L, and in Chapters 7 and 8. This approach is used for houses because of the great degree of regularity in their design, size, construction materials, and construction methods, and the fact that most home-building companies in Australia specialize in the construction of a range of well-specified models. A representative sample of home models is selected in each city, prices obtained for each period, and the price movements for each model weighted together.

10.148 Constant quality is preserved by calculating price movements on a matched-sample basis, that is, the price movements between adjacent periods are based on the same models in each period. If the specification of an individual model changes substantially or a price cannot be obtained, then that model is excluded from the calculation of price movement. Adjustments are made to raw prices to compensate for any minor changes in specifications. For example, if a particular model is essentially the same as in the previous period but the current price reflects a new addition or special feature, then the price of the model is adjusted using standard quality adjustment principles so that the model can be matched directly with that in the previous quarter.

I.2 Residential building other than houses and nonresidential building

10.149 The building output can be defined as a whole final structure or as a collection of particular elements that constitute the construction process. These elements should be narrowed down to include only those that would generally be covered in a standard construction contract between client and builder. Examples of excludable elements are any site works (such as demolition, land clearance, roads), external services (such as drainage, water and electricity connection), and design and other professional services.

10.150 Of the several compilation methods available, the ABS has chosen a method based on a breakdown of building construction into a set of common components. This so-called component-cost method treats building output as a set of standardized homogeneous components representing subcontracted work-in-place. This and other methods for compiling building price indices are described in OECD and Eurostat (1997).

10.151 Typical projects were selected to represent construction activity in a range of functional categories, such as office buildings, shops, and factories. Each project was broken down into a set of

[6]Other concepts of building price include the producer's price, the purchaser's price, and the seller's price. The producer's price is the amount receivable by the producer minus any value-added tax, or similar deductible tax invoiced to the purchaser. The purchaser's price is the producer's price plus the value of any nondeductible value-added tax payable by the purchaser. The seller's price reflects all the elements that contribute to the price paid by the final owner (Organization for Economic Co-operation and Development and Eurostat, 1997, pp. 14–22). It would include the purchaser's price plus the value of land, design and other professional fees, the client's profit margin, and other costs.

standard well-defined components, each component consisting of a quantity, a unit rate, and a value (quantity multiplied by rate). The selection and analysis of projects was undertaken by a firm of quantity surveyors.

10.152 Projects are priced each period by updating the unit rate of each component while holding the quantity constant. The resultant component values are aggregated to produce a current-period project value. Project indices are weighted together to produce index numbers for strata, such as building function, region, and total industry.

10.153 Not all components need to be directly priced each period. First, pricing can focus on a subset of components that contribute to the bulk of the building cost. Second, it may be possible to use one item to represent several components that fall under the same building trade or that exhibit similar price behavior. The unit rate (price) collected, for example, for one specification of the formwork to a suspended slab could represent several formwork components (say, formwork to slabs, columns, and beams). Finally, because the components are standardized, it will be possible for one specification to be applicable to several building types. Thus, instead of collecting a distinct set of prices for every component of each project, it may be possible to greatly reduce the number of prices collected by arriving at a group of representative items. For example, an office building, a shopping center, a hospital, a hotel, and an apartment building will share a set of common components (the components will have different quantities and values for each project but share the same definition). For some of these common components, just one price may suffice for all of the projects. The items will need to be specified in considerable detail to enable consistent pricing from quarter to quarter. These element prices will then have to be aggregated to form the price of the building.

10.154 The ABS has contracted with a consultant to provide the unit rates for the building indices. The consultant, a large national quantity surveyor or cost consultant has access to up-to-date market prices for work-in-place and inputs. The consultant first builds up the unit rates from scratch, using prices and ratios for labor, materials, and plant. Profit margins and overheads are added. The rate is then modified according to up-to-date information on prices tendered for current projects. Every quarter the consultant provides 62 unit rates for each of nine geographic regions.

10.155 The ABS decided to obtain rates from a consultant, rather than collect rates through a survey of builders. This decision was based on economic considerations. The establishment of a collection for more than 550 items, with at least three different respondents per item, would have involved setting up more than 1,650 specifications, most of which would have been complex models. This would have required significant time and resources. In addition, the maintenance of such a collection would be relatively complex and costly, ideally requiring the services of in-house building industry experts.

10.156 The advantages of the component cost method are (i) the index captures changes in productivity and subcontractor profit margins (unlike the simpler factor inputs method) by pricing work-in-place; (ii) it can be used for a range of structures, selected to best represent building activity; (iii) pricing is relatively simple and less resource intensive than the quoted price method (in which respondents provide prices for whole hypothetical structures), and consequently promises more plausible results; and (iv) it requires less information than hedonic methods.

10.157 The component cost method used by the ABS does not measure changes in the prime contractor's profit margin—it is fixed at 5 percent. On the basis of information gained from interviews with contractors, the ABS determined 5 percent to be representative of a reasonable margin under normal conditions. This course of action was taken because the options for estimating the margin were judged to be highly subjective, or they involved the collection of very sensitive figures from respondents who are traditionally quite guarded about divulging such information. Work on developing a reliable measure for prime contractors' margin is continuing, and if a reliable measure is developed it will be incorporated in the index.

I.3 Construction of roads and bridges

10.158 Roads and bridges are simpler structures, compared with buildings, in terms of the number of elements in their construction and the variability of their design. The price of roads, however, still can vary considerably because of considerations such as

pavement type, pavement area, location, terrain, and soil quality.

10.159 The ABS has adopted a method that breaks down road and bridge construction into a set of common components. The components and their weights were derived from an analysis of cost and tender documentation relating to a selection of representative main road and highway projects in most states of Australia. The broad-level road construction components are preliminaries, drainage, earthworks, pavement and surface, and furniture and landscaping. The bridge construction components are piling and columns, substructure, bearings, girders, and completion of superstructure. Representative specifications are chosen for these components and prices are collected on a quarterly basis, mostly through survey methods.

10.160 The earthworks component has been the most troublesome because it is a major contributor to the cost of road construction, but its cost can be highly variable (and unpredictable) since it depends on location, terrain, and soil quality. Since the cost of earthworks is dependent mainly on the use of operated equipment, hire rates for earthmoving equipment (including machine, operator, fuel, maintenance, overheads, and profit) are being used as a proxy measure.

I.4 Other nonbuilding construction

10.161 Apart from buildings, roads, and bridges, a diverse range of construction output includes those associated with telecommunications; electricity generation, transmission, and distribution; railways; harbors; pipelines; recreation; and heavy industry. Although the output in these categories can be unique, like buildings, roads, and bridges, the output also can be composed of standard components or processes, suggesting that an index compilation method that focuses on the pricing of the components rather than the entire structure can be used.

10.162 The ABS is experimenting with an index for telecommunications construction in which the output consists of about two hundred well-defined work activities, grouped into broad categories such as cable laying, optical fiber cable laying, aerial works, installation of new telephone services, general civil works, broadband services, and mobile networks.

10.163 For electricity-related construction, research conducted to date has shown that the construction of transmission and distribution networks is the most promising in allowing pricing to constant quality. The construction of transmission and distribution networks is frequently an ongoing activity, or at least regular activity, rather than infrequent or irregular as in the case of generation plants. As with other areas, more frequent transactions provide a better opportunity for repeat measurement. Further, transmission and distribution networks have some standard elements, such as towers, lines, and cabling, for which it is more likely that prices will be collected over time to a constant quality.

10.164 The ABS has done little work to date on compiling producer price indices for other components of nonbuilding construction.

10.165 Currently, in the ABS Stage of Production PPIs, the price movements in road and bridge construction are used to represent those occurring in other nonbuilding construction. As indices for the various components of other nonbuilding construction are developed they will be incorporated. Statistics Canada currently produces indices for electricity utilities construction, covering distribution systems and transmission lines. The indices are compiled from a combination of output and input prices.

10.166 Aside from the issues mentioned above in the case of shipbuilding, an issue regarding the pricing of construction projects is whether to include the price of land. As mentioned at the outset, activities that include land development are included in another ISIC category. One might argue that the price of a construction project is dependent on the land, or that the building and the land are bundled together.

J. Retail Trade, ISIC 52[7]

10.167 The primary output of retail trade industries is the provision of the marketing functions necessary to allow consumers access to various goods. In other words, the retailer acts as an intermediary between goods producers and consumers. As opposed to wholesale trade industries, customers

[7]The details presented in this section were provided by staff in the Producer Price Program at the U.S. Bureau of Labor Statistics.

are able to make unit purchases of items (that is, not required to buy in bulk) that are generally packaged in some manner. Basic functions involved in retailing include standardization or grading of goods, storage and transportation, buying, risk bearing, financing, selling, and product planning. The selling function is probably the most obvious one seen by the consumer. Selling includes the pricing of the product and the presentation, which includes activities such as tagging, packaging, display, space allocation, advertising, and promotion.

10.168 The U.S. PPI program has developed a method of constructing the retail trade services provided by grocery and department stores. Major service lines are defined by type of store within each industry, as shown below in the examples for grocery stores and department stores:

(i) Grocery stores
    (a) Supermarkets
    (b) Convenience stores
(ii) Department stores
    (a) Discount or mass-merchandise department stores
    (b) National chain department stores
    (c) Conventional department stores

Within each of these, there may be further disaggregation according to the services provided. For example, in the case of supermarkets, disaggregation is by department: meat, bakery, fresh produce, and so on. Such disaggregation of activities is determined by the organizational unit and is taken to refer to homogeneous units of activity.

10.169 Once the products are selected, price-determining characteristics associated with the product are identified. These include the type of product, size or weight, and, often, material composition. In addition, store characteristics associated with providing the service also are collected or assigned based on secondary source data. Store characteristics include area, number of available product choices, hours of operation, and the existence and age of scanners and software for processing customers.

10.170 In most cases the price collected is a margin price (with the exception noted below). The margin price captures the intermediary nature of the retail service and is calculated by taking the selling price and subtracting the purchase price of the last shipment received (less all rebates and allowances) for a specific good. Furthermore, it is consistent with national income accounting conventions that define the output of retail trade as the margin. However, the U.S. Bureau of Economic Analysis (BEA) defines the margin as the selling price of a good in the retail market less the cost of replacing the good in the store's stock. This definition is difficult to implement because it requires collecting the replacement cost of the item. It is far easier to use a last in, first out (LIFO) accounting methodology, that is, using the last shipment received for pricing the acquisition cost of the sold item.

10.171 For a limited number of cases, the selling price of the good is used instead of the margin price. These cases occur when the value added by the retailer in preparation of the product for sale is large, or when there is a fee for a service where the customer is clearly paying for something incidental to the sale of goods. Examples include sales from in-store restaurants run by the retail establishment, alterations of purchased goods, and delivery charges incidental to the purchase of a good.

10.172 Two approaches have been used in implementing the margin pricing methodology. The first looks at the margin price of a unique product. This sample of goods approach is used to represent the output of the entire store. One concern with this approach is that the marketing of the selected sample of goods may not always be representative of the marketing of other goods sold in the store. Using this approach, changes in store characteristics may not explain changes in margin for the selected sample of products. The second approach looks at the average margin value of a relatively homogeneous grouping of products. Though this approach may allow store characteristics to better explain the margin, the average margin might be overly affected by differences among the products in the group.

10.173 There are three potential problems with using a margin price: setting the base price, negative margins, and weighting.

10.174 Base prices are established as the price received in the first month before index calculation. Sale prices are common in retail trade industries, and if a sale price is used as a base price then a permanent bias is introduced in the indices. However, if sale prices are not used in the base period, the price movement from the base month to the next month is incorrect because the index methodology requires that the base be the first month’s price. To

solve the sale price problem, the most recent nonsale price before the month of the base price is used as the base price. To solve the price movement problem created by the use of nonsale prices as the base price, the first six months of calculation are not published, and the index is reset to begin calculation in the seventh month. This sixth-month interval is necessary because new indices are introduced only every six months in the U.S. PPI program. Although six months of pricing data are lost, the bias is eliminated from the index. The base price problem is related to the Laspeyres formula bias problem in the sense that it is actually a weighting problem that derives from the price movement of items based on sale prices being overrepresented (having too large of a weight) in the index.

10.175 The negative price problem derives from the fact that some retail trade establishments, for example, supermarkets, drug stores, and gasoline stations, will, on occasion, sell individual products at a loss. This is done to draw customers with the expectation that they will purchase not only the product being sold at a loss but also products with positive margins. Since the index calculation system used in the U.S. PPI program does not allow negative or zero prices to be used, a procedure was implemented that uses a Dutot index (the ratio of average prices) to calculate price indices in the retail trade industries. This procedure can be briefly described as an unweighted summation of margin prices for three relatively homogeneous products. The monthly percentage change for these three products is used in index calculation instead of the price for a single product. The Dutot methodology also decreases the variability of index movement that is often a characteristic of margin-priced indices.

10.176 The weighting problem is concerned with the aggregation of margin and nonmargin goods. Industry definitions in retail trade industries include not only selling merchandise but also, in certain cases, the manufacture and sale of products. Consider a bakery that manufactures bread for resale or in-store consumption and carries other prepackaged bakery products for resale. Since all production is given a chance of selection, prices for some of the manufactured goods and some of the prepackaged bakery goods for resale may be collected. The prices for the manufactured goods are the retail price, while the price of the prepackaged bakery goods is the margin price. Combining retail prices and margin prices in the same product category creates item weighting problems. Suppose the bakery sells two loaves, one manufactured on-premise and the other a prepackaged loaf bought from another bakery. One might suppose that the selling of the two loaves should have equal weighting. However, the retail-priced loaf should have a larger weight than the margin-priced loaf because the output associated with the former is manufacturing and selling, while with the latter it is just selling.

10.177 The easiest solution to this problem is to create two properly weighted product categories separating the margin-priced goods from the nonmargin-priced goods. However, if budget allocations are not large enough to support a separate sampling of the two transaction types, an alternative solution needs to be developed. Separate data on manufactured and resold goods must be acquired and used to derive or reapportion the sample unit weight among transactions that are margin priced versus those that are not. It should be noted that for the United States, Canada, and Mexico, this problem will disappear when the NAICS is fully implemented. Under NAICS, all combined manufacturing and selling transactions are classified in the manufacturing sector and not in the retail trade sector.

10.178 A fundamental issue in pricing retail trade industries is adjusting for changes in the quality of the service, which is assumed to be dependent on a store's characteristics. If store characteristics change, all items being priced from that location have to be adjusted to account for changes in the service, provided they are related to a change in store characteristics. A retail store is considered to be providing the same service activity when slight modifications are made to the products being sold. Major changes to products could require changes in the retail service—different displays or different inventory requirements.

10.179 Hedonic models should quantify the correlation that exists between store margins and store characteristics. Store characteristics include

- Total store area,
- Selling area,
- Checkout scanners,
- Age of scanner software,
- Number of stock-keeping units,
- Number of full-time-equivalent employees,

- Type and location of store,
- Hours of operation,
- Total sales volume, and
- Time since last renovation.

10.180 These characteristics are readily available, and, instead of using them directly, it may prove more effective to transform them into ratios. For example, forming a ratio of checkouts to store traffic yields a measure of checkouts per customer that may indicate better or faster service with all else remaining equal. Other possible ratios to include are checkouts to sales, employees to sales, stock-keeping units to store area, employees to store area, and checkouts to store area.

10.181 A key aspect of retail trade services is the services that can be linked to the maintenance of an inventory. However, the valuation of inventories is difficult to incorporate in price indices.[8]

K. Telecommunication, ISIC 642[9]

10.182 This section examines the compilation of the U.S. PPI for a relatively new and difficult component of the telecommunication industry—wireless communication.

10.183 The primary output of wireless telecommunications is that of placing parties in communication through a radio network, parallel to the traditional wire line network of the telephone system. The U.S. PPI program has developed an index for this industry. Cellular telephone services include Traditional Cellular Service, Personal Communications Services (PCSs), and Enhanced Specialized Mobile Radio (ESMR) and are defined as being "voice-grade" and interactive. Paging is defined as "less than voice-grade" because it involves only the sending of characters or numbers. Paging services, however, can include customer notification of voicemail messages waiting at a voice mailbox provided by the paging company.

10.184 There are three types of voice-grade wireless services: Traditional Cellular Service, ESMR, and PCSs. The primary distinction among these is in how they are licensed and in the frequency and power level used in transmitting and receiving. To the buyer, the technical differences among the three are not noticeable. The services can be augmented with add-on features, including services such as voicemail.

10.185 In the United States, licenses for Traditional Cellular Service are granted by the federal government according to geography. In the 1980s, about 300 licenses were distributed for urban areas and about 400 for rural areas. There were only two licenses available for each Metropolitan Statistical Area (MSA) or Residential Service Area (RSA).

10.186 ESMR systems operate at a lower frequency and higher power setting than cellular service. ESMR uses an improved "push-to-talk" technology previously used only by dispatch services for taxicabs and mobile repair operations.

10.187 PCSs are provided in the same manner as conventional cellular systems, except that license areas are much larger. These systems work at a higher frequency and lower power setting, which require more cell stations in a given area. There were about five licenses auctioned per MSA, which greatly increased competition in each area.

10.188 Paging services allow messages to be sent to a subscriber. Messages can be delivered or stored for later delivery. The messages can be just numbers or characters and numbers.

10.189 In the United States, the item classification is associated with the regulatory designations that are, in turn, related to the various technologies used to provide the service.

10.190 The fundamental issue in developing a pricing methodology was to define a net transaction price that would reflect discounts, new service plans, and new service features.

10.191 The price measure for all wireless telecommunications services was chosen to be the unit value and is defined in terms of minutes for each applicable rate for all similar services in the reference period. All minutes for a particular service are included in the measurement each month. A unit value is calculated for that service and represents the average cost per minute of that service for all customers. The average cost per minute is multiplied by the reference period weight of that service and then aggregated with other services to yield the final average billed price for the overall service.

[8] See, for example, Diewert and Smith (1994).
[9] See Deuchars, Moriya, and Junko Kunihiro (2001).

10.192 The unit-value method captures the universe of transactions within the entire service line (publication category) each month. There may be many (hundreds) of different service plans in existence for a particular type of service offered by a company. The unit-value approach provides an easy and inexpensive way (both in terms of cost to the agency and respondent burden) to capture new plans and thereby includes yet another source of price variation. This method also captures price change resulting from bundling and unbundling service features in much the same manner as it captures the introduction of new rates. The unit-value approach is operationally easier than trying to price a few specific plans and then trying to substitute to new plans each month.

10.193 The shifting of the weights inherent in the unit-value method is another of its advantages because it provides a straightforward way to obtain an accurate price through the automatic adjustment for the changing popularity of various service characteristics. Furthermore, because no single product is priced—in effect a series of product varieties is priced—the need and subsequent use of quality adjustment is greatly reduced.

10.194 However, the unit-value approach does not remove the concern about new-item bias. Such a bias arises with the use of the Laspeyres index because of the fixed-quantity assumption. New services in this industry are expected to be introduced frequently and to become popular quickly. The unit-value approach can handle the introduction of new service characteristics that attach to existing services—for example, the provision of a voicemail option to standard cellular service. When *completely new* services are introduced, there is concern about when to include them and how to adjust for their weight.

10.195 Cellular, PCSs, and ESMR are tracked similarly. Differences are based on the price of the total service package, including the monthly access, usage charges, and features. The reporter begins participation in the index by filling out the attached worksheet (see Figure 10.1). Part I of the worksheet includes three steps: (i) determine all of the different types of charges possible, including all optional features, whether they are billed or free; (ii) enter the total number of units used of each type of service; (iii) enter the total number of access lines or subscribers and divide the total units by the number of subscribers. This gives the average number of charged units per subscriber. Part II of the worksheet calculates the average revenue per unit for each service. First, the reporter enters the total billed revenue for each type of charge. The billed revenue is divided by the total number of units to give the average revenue per unit. Part III of the worksheet computes the average revenue bill. The average number of units per subscriber is multiplied by the average revenue per unit to produce a total weighted average.

10.196 Only six basic services for paging are offered. These are the combination of the two types of paging (numeric and alphanumeric) and the three types of service areas (local, regional, and national). The first step is to ascertain the ratio of revenue represented by the six categories of service for each company. The next step is to determine the ratio, in billed units, of all the billed components to each of the six services.

10.197 The Sample Worksheet (Figure 10.1) at the end of this chapter illustrates the implementation of the methodology.

10.198 The telecommunications industry is a very dynamic industry, which raises the issue of how best to capture the effects of new goods and changes in the quality of the service. Many approaches can be undertaken to address these issues. For example, in some countries it may be preferable to rely on a comprehensive set of bills from providers; this would be true if there is rigidity in plans and the ability of consumers to switch among plans. Such an approach also would require frequent updating of the sample to ensure the capture of both new plans and new services.

L. Commercial Banking, ISIC 65

10.199 Financial institutions explicitly and implicitly charge their customers for financial services, as recognized in the recommended methodology for compiling their aggregate value in the *1993 SNA*. The challenge for price index compilers is to account for these and other components of the price of financial services in the construction of producer and consumer price indices. This section briefly considers valuation and price concepts and then turns to the anatomy of a financial services price index and the attending compilation issues. In addition, a presentation of the U.S. PPI for the banking

industry is provided, which implements the framework discussed.

L.1 Output of the banking industry

10.200 The primary output of the banking industry is the provision of financial services, including financial intermediation. For this industry, financial intermediation can be defined as the provision of services associated with the matching of savers and investors. In the course of providing these services, banks provide various transaction and credit services. Because the focus is on the financial service transactions, these are the basis for the identification of a bank's output.

10.201 One of the primary challenges in this industry is to measure financial intermediation services implicitly measured, or FISIM, as defined in the *1993 SNA*. Banks often provide services for which they do not explicitly charge. Paying or charging different rates of interest to lenders and borrowers covers the cost of providing these services and provides an operating surplus. As pointed out in the *1993 SNA*, this scheme of interest rates avoids the need to charge customers individually for services provided and leads to the pattern of interest rates observed in practice. Thus, the price measure must capture both direct and indirect charges for the provided services.

10.202 According to the financial firm model of a financial institution, the price of services is given by the user cost of money. The user cost of money is analogous to the more familiar user cost of capital in the sense that it provides a way for valuing the flow of services emanating from a stock of a nonfinancial asset; either one may be viewed as a rental rate. Interested readers can reference Barnett (1978, 1980), Diewert (1974c), Donovan (1978), Fixler (1993), Fixler and Zieschang (1992b), and Hancock (1985) for an in-depth treatment of the user cost of money concept. The sign of the user cost indicates the role of the product in the financial operations of the firm; a positive user cost indicates a financial input and a negative user cost indicates a financial output. Given that the indicators of account activity are positive, the convention is to take the negative of the user cost, which hereafter is called the user cost price.

10.203 For financial assets such as loans, the user cost price is the margin between accrued payments to the owner of the asset, *including expected holding gains*, and the opportunity cost of money. As its name implies, the opportunity cost of money is a concept akin to the reference rate discussed in the *1993 SNA*. For a depositor or lender to a financial institution, the user cost of money is the difference between the opportunity cost rate and the rate payable by the institution to the lender.

10.204 The user cost price captures both the implicit and explicit charges for services associated with an account and thus is an appropriate measure of the price of those services. The explicit charges would comprise all overt service levies in monetary units against the customer's account for transaction processing and the like, and the implicit charges would be based on the user cost.[10]

10.205 In this formulation, the amount of (deflated) dollars in each account is an indicator of the financial service activity. Using deflated dollars would be necessary if the price index is based on a constant quantity assumption.

10.206 The price of services attached to an account i is given by the following sum of implicit and explicit components, based on our previous discussion:

$$p_i^t = \left[\left(r_i^t + h_i^t - \rho_i^t\right) + s_i^t\right],$$

where

p_i^t = the price of services at time t on account I,

r_i^t = the average rate of return payable on account i during period t,

h_i^t = the average rate of gain (loss) on holding account i during period t,

ρ_i^t = the reference rate, and

s_i^t = the rate charged for explicit service charges payable on account i during period t.

10.207 It should be noted that the user cost price can be discounted by the factor $1 + \rho$; this may be important in volatile countries where the risk-free rate is relatively high. In addition, the user cost

[10] In December 2003, as part of its comprehensive revision to the national accounts, the U.S. Bureau of Economic Analysis implemented a user cost method to value the implicit financial services provided by commercial banks. The change and its impact on GDP are discussed in Moulton and Seakin (2003) and Fisher, Reinsdorf, and Smith (2003).

prices can be deflated by a general price index; this would be necessary to adjust nominal interest rates and service fees for changes in price movements, and again might be important in countries experiencing relatively high rates of inflation.

10.208 The computation of *h* does not include the value of any "write down" arising from a reassessment of the credit risk of the borrower. Unlike a holding gain or loss generated as a result of exposure to exchange risk, accumulated write downs appear on the institution's balance sheet as a liability counter-entry to the contract value of the loan asset, rather than a direct "mark (down) to market" of the value of the compromised asset. The write down increases the liability recorded against booked loan assets and is shown as an "other change in the volume of assets" rather than a revaluation of holding gain or loss.

10.209 Using the above, the price relative for an individual financial product that is an asset to the issuing or creating financial institution (such as a loan) is to have the following form:

$$R_i^{t,t-1} = \frac{p_i^t}{p_i^{t-1}} = \left[\frac{\left(r_i^t + h_i^t - \rho_i^t\right) + s_i^t}{\left(r_i^{t-1} + h_i^{t-1} - \rho_i^{t-1}\right) + s_i^{t-1}} \right].$$

Thus, the price relative for services attaching to an asset account represents the relative change in the total service charge rate.

10.210 The computation of the various interest rates is done by dividing income data by corresponding balance sheet items. For example, the interest rate received on loans would be computed as interest received on loan divided by the amount of outstanding loans on the balance sheet. Instead of using the balance sheet entry at a point in time, one could use an average over two time periods—this would be an estimate of opening and closing values and allow for some loans to be paid off while new loans are made.

10.211 All of the other components of the user cost price would be computed in a similar manner.

10.212 For liability products, the price of financial services again comprises an implicit and explicit component, as

$$p_i^t = \left[\left(\rho_i^t - r_i^t + h_i^t\right) + s_i^t \right],$$

which yields a relative of the form

$$R_i^{t,t-1} = \frac{p_i^t}{p_i^{t-1}} = \left[\frac{\left(\rho_i^t - r_i^t + h_i^t\right) + s_i^t}{\left(\rho_i^{t-1} - r_i^{t-1} + h_i^{t-1}\right) + s_i^{t-1}} \right].$$

10.213 The holding gain *h* is interpreted in the liability case to be an increase (decrease) in the size of liability through time, possibly because of a feature of the contract forming the liability.

10.214 In principle, the reference rate should be some risk-free rate. However, the selection of an actual rate is more complicated. For example, should only short-term government securities be used, or should the rate represent a weighted average of government security rates, where the rates reflect the holdings of such securities by banks? An additional question concerns the time period to be used. As indicated, the computation of interest rates is based on historical data. If one were to use current-period market rates for the reference rate, then one may find that the differences between the reference rate and the computed interest rate are volatile. One solution would be to compute the reference rate as the other interest rates; the reference rate would be the interest income from government securities divided by the balance sheet entry for such securities.

10.215 For both asset and liability products, it also may be useful to collect indicators of activity, such as number of accounts, number of automated teller machines (ATMs), or indicators of the average utilization of specific service dimensions on each account, such as transaction processing, statement generation, assessment of creditworthiness via loan applications, and applications for letters of credit, as applicable to the type of account. Variations in these other indicators of service would indicate variations in the quality or nature of service across accounts and institutions, to the extent that these variations are correlated with the explicit and implicit service charges on accounts to adjust service fees and interest rates to enable adjustments for quality of services.

10.216 In fact, one could consider the account as the primary unit of output for a financial institution; the output would be expressed in terms of the numbers of accounts, and the user cost prices above

would be multiplied by the average balance in each type of financial product.

10.217 Because the financial services industry generally is regulated, the data needed to construct weights in a PPI should be available, often from administrative reports such as those required of depository institutions by central banks. Other financial intermediaries, such as insurance firms, in general also must complete regulation forms. Since most countries monitor their financial institutions, and there are international agreements regarding reporting requirements and accounting methods, the data elements from financial institution regulatory sources will be at least somewhat comparable internationally.

L.2 U.S. PPI commercial bank index (not yet in production)

10.218 The U.S. PPI program has developed an implementation of the above-described approach to measuring price change in banking. The details of that index are described below.

10.219 The specific types of services provided by banks can further define the output. For example, in the United States, the major service lines are

- Loans,
- Deposits,
- Trust services, and
- Other banking services.

10.220 In many countries, universal (one-stop) banking is allowed, so additional services such as insurance, brokerage, and travel may be added.

10.221 Loans are assets of a bank defined as funds advanced to a borrower to be repaid at a later date, usually with interest. Included in the loan category are residential real estate, nonresidential real estate, home equity, commercial and industrial, agricultural, new and used auto, and credit card loans.

10.222 Deposits are liabilities of a bank defined as funds placed with a bank in an account subject to withdrawal. Because the focus is on financial services, the services associated with deposit products are viewed as outputs of the bank. Included in the deposit category are demand, time, and savings accounts.

10.223 Trust activities involve the bank's acting in a fiduciary capacity for an individual or a legal entity, such as a corporation or an individual's estate. This typically involves holding and managing trust assets for the benefit of a third party.

10.224 Other banking services include standby letters of credit, correspondent banking, sale of securities, and cash management.

10.225 Account selections can be made within account classes defined by the institution or from the reports required by the regulatory authorities. A model list of account classes would include

- Mortgage loans,
- Agricultural loans,
- Commercial loans,
- Consumer and other loan services,
- Retail (deposits),
- Trust services, and
- Other banking services.

10.226 Once an account is selected, the next step is to specify the services to be priced. In some instances, account classes are sufficiently homogeneous, and it is unnecessary to select a sample of individual account numbers within the class. For example, for loans and deposits, the unique item to be priced is represented by a homogeneous group of accounts (for example, all 15-year fixed-rate residential mortgages or all 1-year certificates of deposit). On the other hand, trusts and other banking services could be priced by selecting an individual transaction and tracking the cost of the profiles through time.

10.227 Once the actual service is selected, its price-determining characteristics are identified to permit monthly repricing of the same unique item. The following characteristics are common for most services:

- Type of service; for example, mortgage loans, money market savings account, corporate trust;
- Term of service; for example, 15-year loan, 5-year certificate of deposit; and
- Type of fees; for example, late payment, automatic teller machine, early withdrawal penalty.

10.228 The U.S. PPI program has implemented the user cost framework described above. A key feature of valuing the implicit component of the financial

service price is the reference rate, or the opportunity cost rate of money, which does not include any intermediation services. As shown above, the user cost prices for assets and liabilities differ. The price of an asset (for example, loan) is equal to the asset holding rate less a reference rate. The asset holding rate is the interest received plus service charges. For liabilities (deposits), the price is equal to a reference rate less the liability holding cost rate. The liability holding cost rate is the interest paid to depositors less service charges.

10.229 In measuring the prices for both loans and deposits, the same reference rate is used. Possible reference rates include the central bank lending rate (discount rate), interbank lending rate (federal funds rate), or a weighted average of the interest rates on all banks' securities holdings where the weights are shares of the different securities in a bank's security portfolio.

10.230 In practice, the price of these services can be expressed as shown below. Again, both services are priced at the portfolio level.

$$\text{Loan Price} = \left[\left(\frac{\text{Earned interest income} + \text{Fees}}{\text{Average loan balance}}\right) - \text{Reference rate}\right] \times \$1{,}000\,.$$

10.231 Earned interest income includes all interest actually received in a given month for the portfolio of loans being priced. This includes interest earned on both old and new loans. The average loan balance is calculated by averaging the ending daily balances of the loans in the portfolio over the month.

$$\text{Deposit Price} = \left[\text{Reference rate} - \left(\frac{\text{Interest payments} - \text{Earned fees}}{\text{Average deposit balance}}\right)\right] \times \$1{,}000.$$

10.232 Interest payments include all interest actually paid to depositors on the funds held in the portfolio in a given month. Earned fees should include all fees, such as those for ATM withdrawals or insufficient funds, that are actually collected by the bank. Again, the deposit balance is calculated by taking the average of the ending daily balances of the portfolio.

10.233 For both equations, the calculation within the outer brackets results in a rate. This rate is multiplied by $1,000 to yield a service price used in the index calculation. When the price is positive, the service will be considered on output. However, whenever the price is negative, the service will be considered a financial input, and the price will be excluded from index calculation until it becomes positive again. In other words, the influence of that particular good is excluded; in effect its price is imputed to be that of other members of its group until it becomes positive again.

10.234 For trust and all other banking services, the price is equal to the actual fee charged for performing the service. These fees can be a percentage of assets or a flat fee.

10.235 The PPI program uses bank revenue data collected by the U.S. Bureau of the Census and the Federal Deposit Insurance Corporation, the U.S. agency that takes the lead in compiling income and balance sheet data for U.S. depository institutions.

10.236 Net interest revenue will be allocated between loan and deposit products by using the reference rate. Intuitively, the net interest rate can be decomposed into borrower and depositor components using the reference rate

$$\begin{aligned}\text{Loan rate} - \text{Deposit rate} &= (\text{Loan rate} - \text{Reference rate}) \\ &\quad + (\text{Reference rate} - \text{Deposit rate}).\end{aligned}$$

10.237 For individual products, there will be an adjustment for changes in the purchasing power of money in the volumes of assets and liabilities. In the case of asset products, the PPI will deflate by a price index that corresponds to the asset. For example, for a portfolio of car loans, the PPI Auto index will be the deflator. For deposits and any asset not associated with a particular price index, the GDP chain-linked price index will be the deflator.

10.238 Another fundamental issue in pricing banking services is the ability to maintain constant quality. One can view the deflation described above as maintaining the constant quality of the money volumes. However, just as in any other service or product, there are observable service characteristics that can be monitored, such as access to ATMs, ability to use Internet banking, debit cards, and so

on. When such changes are observed, quality adjustments should be performed.

M. Insurance, ISIC 66[11]

10.239 The provision of insurance is another financial service that presents conceptual problems in compiling a producer price index. In this section, the construction of an index for the property and casualty insurance industry is examined.

10.240 The primary output of the property and casualty insurance industry is the assumption of risk (transfer of risk from the policyholder) and financial intermediation.

10.241 The U.S. PPI program has developed a producer price index for the property and casualty insurance industry. The service output is measured by the policies underwritten by the insurer.

10.242 A given policy lists the events for which restitution would be made to the policyholder and the attending payment levels. These can be viewed as the amount of risk being transferred to the insurer.

10.243 The output can be further defined by the specific types of property and casualty insurance coverage. The major service lines in the United States are

- Private passenger auto insurance,
- Homeowner's insurance,
- Commercial auto insurance,
- Commercial multiple peril insurance,
- Worker's compensation insurance,
- Medical malpractice insurance,
- Product liability insurance,
- Inland marine insurance,
- Surety insurance, and
- Fidelity insurance.

10.244 A policy is selected by sampling from a frame of previously selected (via sampling) lines of service for an insurer.

10.245 The following policy characteristics are common in most property and casualty insurance lines:

- Type of property or casualty description—characteristics of the insured property;
- Type of coverage—including physical damage coverage and liability coverage;
- Dollar limit of coverage—the maximum amount of money the insurer is legally obligated to pay in the event of a claim;
- Coinsurance clause—percentage of the value of the property to be reimbursed by the insurer;
- Deductible—the insured bears the first part of any loss covered by the policy up to a specified amount;
- Length of policy period—time frame for which the policy is in effect;
- Perils covered—specific risks that the insurer assumes;
- Location of the insured property—risks vary by geographic location;
- Past loss experience—premiums generally are lower if the insured has a past record of making fewer claims;
- Valuation of insured property—either the actual cash value of the property, which adjusts for depreciation, or the replacement cost; and
- Valuation of risk exposure—a valuation for liability coverage.

10.246 In addition to assuming risk, insurers act as financial intermediaries. They receive a flow of premiums on the policies they sell, a liability, and transform those premiums into earning assets by investing them, chiefly through the purchase of safe investments such as government bonds. This investment income is crucially important to the industry and greatly affects their pricing decisions. Companies may well reduce premiums when the rate of return increases and raise premiums when the rate of return is lower.

10.247 The price of assuming risk and providing financial intermediation is defined to be the sum of premium plus the rate of return on investment. Or,

$$\text{Price} = \text{Premium}\,(1 + r),$$

where r is the annual return on the invested portion of the premium for the particular line of insurance that is being priced. This rate is stated as a percentage of all premiums paid.

10.248 In the case of mutual companies where policyholders also are the stockholders of the company, there is an additional consideration. Because

[11]The U.S. approach to constructing an insurance price index is described by Dohm and Eggleston (1998).

these companies typically pay out a dividend rebate to the policyholders on an annual basis, such a dividend would be subtracted from the premium to obtain a net transaction price. Accordingly the price is expressed as

$$\text{Price} = \text{Premium}\ (1 + r) - \text{Dividend}.$$

10.249 To track premium movement in the property and casualty industry, companies provide estimated premiums for frozen policies. In other words, the premium's price determining characteristics are held constant while the policy is repriced on a monthly basis.

10.250 The insurance company estimates the current premium for this frozen policy by applying current charges to its characteristics. This premium remains unchanged until the policy is priced again the following year.

10.251 The cost of freezing the policy is that it does not capture modifications in the policy over time. Policyholders can change the level of liability, reduce the deductibles, or change the nature of the risk—for example, the addition of a teenage driver dramatically changes the risk associated with an automobile policy.

10.252 To hold inflation-sensitive characteristics constant, periodic adjustments are made to account for inflation. For homeowner's insurance, the dollar limit of coverage is adjusted annually to account for construction price inflation. The assumption is that the policyholder is insuring to secure a constant flow of services from the insured property. If price inflation affects the cost of repair or replacement of the damaged property, the coverage limit should be escalated to reflect this increase. This adjustment is made on the anniversary date of the policy. This procedure reflects the actual coverage adjustments made by insurers at the time of policy renewal.

10.253 Because the index tracks several thousand policies selected on a probability basis, policy anniversary dates are spread throughout the year. This yields a smoother-behaving index than making this adjustment for all repriced items at one time.

10.254 The source for the inflation adjustment depends on the insurance company. If the company cannot make a recommendation as to how the inflation-sensitive policy characteristics should be adjusted, the analyst decides the appropriate index to use. For example, the E. H. Boeckh Building Cost Index is used to escalate the coverage limits for homeowner's insurance. For adjustments to worker's compensation insurance, the workforce in the group is held constant (same number of people in the same jobs), and the wage rates are adjusted to account for general wage inflation by using the U.S. Bureau of Labor Statistics' Employment Cost Index.

10.255 The investment rate of return is calculated by all insurance companies as a percentage of the premium. An annual report is prepared by all companies that includes this calculation. The report provides the investment rate of return by insurance line calculated as a percentage of premium. As with the inflation-sensitive policy characteristics, the rate of return is updated annually for each priced item on the policy anniversary date.

10.256 The fundamental issue in pricing insurance services over time is the ability to identify and adjust for changes in risk. For changes in explicitly endogenous risk factors such as changes in coverage or deductibles, companies have suitable cost data to allow for meaningful cost-based quality adjustment.

10.257 However, for changes in exogenous risk factors that go beyond the scope of policy negotiations, such as an increased incidence of theft or a severe hurricane season, company-specific data would be not be sufficient to definitively quantify risk. Only outside data sources will be able to identify short-term versus long-term changes in risk.

10.258 Such an outside data source is used in the quality adjustment of private passenger auto insurance, where risk changes occur even though the age of the insured auto remains the same. To keep the age constant, the model year of the auto is updated once a year to the next model year. For example, in a policy that insured a three-year-old car in year t, the model year of the car would be upgraded by one year in year $t + 1$ to maintain the three-year-old car status. However, changing the model year also can move the auto into a different risk category known as a symbol group. This can occur because the characteristics of the auto may have changed, or it may occur because the risk associated with the car has changed without any characteristics change, such as the car is now more popular among thieves. Insurance companies are unable to assess this risk change on their own, but a valuation can be ob-

tained from outside sources. In the United States, there are third-party firms (Insurance Services Office) that assemble and evaluate risk information and provide risk ratings used industrywide. Changes in this risk rating are used to explicitly adjust the premium.

10.259 Although both frozen policy and the annual resampling of policies approaches to repricing are susceptible to new-item bias, the problem is greater when using a frozen policy. Over time, a frozen policy may no longer be representative. Mandated coverage may change, or new insurance products may be introduced.

10.260 Although bias may not be as prevalent when following an actual policy, it can occur if the general population has changed its preference for the type of insurance product it purchases or if the policy represents a smaller portion of the company's business.

10.261 The U.S. PPI program has developed a directed substitution procedure to reduce new item bias. This procedure captures evolutionary changes to a current product or a service that did not exist when the sample was selected. Periodically, each company will be contacted in order to review the insurance products included in the sample. Evolutionary changes in the industry will be identified and disaggregation will be performed to determine whether a substitution should be made from the current product to an evolutionary product or whether to add the new feature to the description of the current product. Producer cost-based quality adjustment will then be attempted to adjust for these changes.

10.262 The measure of insurance output in national accounts (see, for example, *1993 SNA,* Annex II) is based on a premiums-less-claims concept. Accordingly, some might view that the proper measure of the price of insurance services should be based on such a net premium concept. Others might argue that because insurance services are a type of financial services, the price of insurance services should be analogous to the price of banking services described above—that is, a user cost price approach should be used.

10.263 Regardless of the measure of price, any approach must address the issue of how to address changes in the risk being assumed by the insurer. There is both an identification dimension and a measurement dimension to this issue. The first concerns that ability of the price statistician to identify the changes in risk that are properly assigned to the insurance service, and the second concerns the ability to measure the change in risk in a way that a quality adjustment can be performed.

N. Software Consultancy and Supply, ISIC 7220[12]

10.264 The compilation of PPIs for the output of the software consultancy and supply industry is challenging because of the diversity of the output and factors such as rapid obsolescence, frequent quality improvements, and increasing productivity.

10.265 Software output includes custom software produced on order from specific users, computer programming services provided on a fee or contract basis, and ready-made or prepackaged software sold on license to a number of users. There also is interest in developing price indices for deflation of expenditure on own-account software.

10.266 The output of the industry is highly diverse. Prepackaged software covers a large heterogeneous range of software, including systems software, applications software, and other types of software such as games. Output also includes documentation, maintenance, and training services. Custom software and contract programming are client specific and will vary depending on the requirements of the client.

10.267 When compiling a price index for prepackaged software one must take account of the fact that products change fairly frequently and then make adjustments for changes in quality. Matched-model methods (see Chapters 7 and 8) have been used for this output; however, they do not capture quality improvements such as enhanced power and performance, and as a result they "understate quality-adjusted price declines" (Bureau of Economic Analysis, 2000). The difficulties of making adjustments for changes in quality are identifying the quality change and then estimating its monetary value. Hedonic analysis is seen as the most promising method for producing a constant quality price index for prepackaged software (see Chapters 7 and 21).

[12]See O'Rourke and McKenzie (2002).

10.268 Function point analysis has been identified as a potential means of pricing comparable units of custom software and own-account software. By breaking up software into components that can be measured according to functionality provided to users, function point analysis can be used to analyze the unit cost of software, making possible the comparison of heterogeneous output. This approach can be problematic since these metrics themselves can be both subjective and difficult to estimate (Gartner Group, 1999).

10.269 Because of difficulties in pricing comparable software over time, input cost indices have been used for own-account software and charge-out rates have been used for computer programming services. These methods are comparatively easy to develop; however, they are problematic in practice. Input cost indices for own-account software do not take into account improvements over time in the productivity of information technology (IT) professionals, arising from substantial improvements in other IT products used as inputs in providing the service (for example, computer hardware, software applications for debugging code in creating new softwares) (O'Rourke and McKenzie, 2002).

10.270 Custom software is produced to meet a diversity of clients' needs and consequently is not a standard output for which constant quality price changes can easily be measured over time. As custom software "consists of a mixture of new programming and existing programs or program modules, including prepackaged software, that are incorporated into new systems," PPIs for this output have been made by weighting indices for prepackaged software and own-account software (BEA, 2000).

10.271 As noted above, a major issue with the construction of software price indices is selecting a method of quality adjustment. It also may be necessary to set up a rule that allows for a distinction between a quality change that can be said to create a new good and a product change that would fit into the modification of existing products. Such a distinction enables the use of different methods—in the case of a new product it may not be necessary to perform any price change for the existing product. Setting the criteria for such distinctions is a task that must be confronted by all goods and services that experience rapid technological change. Software has an additional problem in that much of the work is performed on a contract basis, and in such cases the ability to measure the extent of quality change is likely to be very difficult.

O. Legal Services, ISIC 7411[13]

10.272 The legal services industry is a difficult area in which to apply conventional price index techniques, and at present only a small number of countries have established indices. The methods described here have been discussed by the Voorburg Group on Services Prices and have been implemented by the ABS.

10.273 There are many ways to list the activities that might be included as output of legal services firms. One way would be according to products as classified by the CPC system of the UN. Accordingly, legal services products are

CPC	Description
821	Legal services
8211	Legal advisory and representation services in the different fields of law
82111	Legal advisory and representation services concerning criminal law
82119	Legal advisory and representation services in judicial procedures concerning other fields of law
8212	Legal advisory and representation services in statutory procedures of quasi-judicial tribunals, boards, etc.
8213	Legal documentation and certification services
8219	Other legal services

10.274 In most countries, this industry is generally composed of large firms primarily serving large corporate clients and small firms primarily serving households and small businesses. It is important to seek assistance from industry bodies in the sample design process. These associations provide splits of the main revenue-earning activities of the industry (for example, corporate and personal law, activities relating to patents, real estate) to aid in deciding which services to price and what may be an appropriate stratification. Industry associations also may be able to provide lists of organizations within the industry from which to sample, or at least have information to supplement a statistical organization's business register. Probability proportional to size sampling (should a measure of size variable exist)

[13]See McKenzie (2001).

or judgment sampling to best represent the spread of activities undertaken in the industry and the largest revenue-earning firms are key aims of the sample design. Because of the large number of small firms in the industry, stratification by size of firm may also be required with a small sample of small firms chosen to represent this sector.

10.275 The most common forms of charging within the legal services industry in Australia are summarized below. Note that combinations of these charging methods often may be used, depending on negotiations with the client and the range of services required.

10.276 ***Hourly rates.*** The basis for most forms of charging within the legal services industry is derived from an analysis of the time involved for the staff (for example, partners, associates, juniors) to provide the service required. The hourly charge-out rate is a common form of billing in most countries. Lawyers, whether on their own or in large firms, tend to keep precise time sheets to determine billable hours.

10.277 ***Fixed fees.*** Fixed fees are common for more routine legal matters, such as drawing up a simple will, closing a title on a house, or patent registration. A fixed rate is typically employed when both the time and staffing level needed to complete the project are known in advance, and thus an analysis of relevant charge-out rates would be the basis for the fixed-fee schedule.

10.278 ***Ad valorem pricing.*** Ad valorem pricing is the term used when the price is a proportion of the value of the subject of the legal work; for example, the value of a property being conveyed or the amount recovered in court action. For the second example, the actual fee is subject to risk and may have little relation to hourly charge-out rates, since an amount is payable only if the case is won, and this may not bear a strong relationship to the time spent working on the case.

10.279 Determining product specifications for the price of legal services is difficult because each legal case involves a different mix of professional staff levels and can involve different combinations of component services. This absence of product standardization complicates price statisticians' ability to track the price for the same service provided over time. For lawsuits, especially when ad valorem pricing is used, the concept of a constant quality service is particularly difficult to define because every case is different, and the price for the service depends on the outcome of the case. Despite these problems, legal service organizations tend to keep detailed records on each client, in terms of the type of work performed and time spent by level of staff member. Obtaining access to such records can greatly assist in arriving at a suitable pricing method for surveyed businesses.

10.280 Three main methodologies are used by countries currently pricing legal services: repricing of fixed fees, charge-out rates, and model pricing.

10.281 ***Repricing of fixed fees.*** There are a number of services within the legal industry for which fixed fees, or fees based on some form of scale, apply. Identifying major revenue-earning items for which this form of pricing applies, and tracking a sample of fixed fees charged by respondents, can be an effective way of representing price change for a portion of the legal services industry. Examples of the types of services that can be priced using this approach are

- Preparation of simple wills,
- Settling simple divorces,
- Patent registration (for a range of patent services such as standard patents, trademarks, designs, etc.),
- Registration fees for property, and
- Transfer of real estate.

10.282 In the latter examples, the price may be dependent on the value of the item being registered or transferred. In such cases, it is important to keep this value constant when repricing the fees associated with these activities, for example, fees applying to the transfer of a property worth a certain fixed amount (for example, $200,000), depending on the most representative value(s) for the relevant transaction(s) applicable to the country. These representative values should be subject to some form of indexation (or possibly a moving average) over time to represent changing prices in the value of items subject to the legal services, since this has a major influence on the actual price change for the associated legal services.

10.283 ***Charge-out rates.*** Respondents could be asked to report a selection of hourly charge-out rates by level of staff for a specific type of project (for example, in servicing a major corporate client,

criminal representation), depending on the firm's major revenue-earning activities. The assumption is that changes in hourly charge-out rates will approximate changes in the final charges paid by clients for the various services the firm provides.

10.284 ***Model pricing.*** Specifications are developed (in consultation with legal professionals) for a range of legal services provided by the industry (see examples 10.1–10.5) for the type of the detail required in specifying certain types of legal services for model pricing). These specifications are then sent to respondents each sample period for repricing.

10.285 The fixed-fee method is appealing in that it is relatively low cost and should be effective in pricing to constant quality. It is, of course, important to ensure that the respondent is reporting for the identical service in each period. However, the fixed-fee method may cover only a small proportion of the revenue-earning activities of the legal services industry in most countries and therefore may be of little use if this percentage is very low for the country concerned.

10.286 Proper implementation of a model pricing strategy is likely to result in reliable price indices. However, this method is particularly costly to the statistical organization, because considerable liaison with industry associations and potential respondents is required to set up appropriate models. These also must be maintained over time as the nature of services provided within the industry evolves. Of equal importance is the burden placed on respondents in using this approach. Repricing the precise model each period will be time consuming, and there is the danger that a respondent will refuse to cooperate or not take the exercise seriously (that is, not provide prices that relate to current market conditions).

10.287 Charge-out rates by classification of lawyer tend to be readily available from law firms; they are adjusted to reflect market conditions and form the basis for the prices charged in a large range of legal services. Therefore, charge-out rates can be a relatively cost-effective way (for both the statistical organization and respondents) of measuring price change in the industry. However, the collection of a charge-out rate schedule may not adequately account for the impact on prices resulting from changes in labor productivity within the industry (for example, when the amount of labor inputs required for legal services in general may decline because of more effective use of technology).

10.288 It should be noted that a similar approach could be adapted to many types of business services, such as accountancy and advertising.

10.289 Although the method presented above does provide a means for monthly repricing, the method does not overcome the difficulty of maintaining constant quality. This difficulty in part derives from the custom nature of the services being provided.

Example specifications for model pricing of legal services from Australia

Example 10.1 Standard specification for obtaining an injunction

1. You are contacted by the managing director of a client company. He advises that the company has been served with a Section 218 notice and requests an urgent appointment to see you.

2. Preliminary interview with managing director in which he
   a) Gives you a brief outline of the circumstances giving rise to the issue of the notice,
   b) Hands you relevant documents, and
   c) Inquires what steps should be taken.

3. You first check the Section 218 notice to see when the time expires after which the creditor can issue a statement of claim.

4. Having ascertained the date, you then advise the managing director that, with the short time available, you will study the documents and give him your advice shortly.

5. Over the ensuing 48 hours you spend time studying the documents and then write to the solicitors who issued the Section 218 notice. The purpose of this letter is
   a) To point out that the debt is disputed and therefore a Section 218 notice is inappropriate;
   b) To advise them that, in any event, your client has a claim that exceeds the amount of the disputed debt;

c) To ask them whether, in view of the above, they still intend proceeding; and
d) To advise them that unless you hear within seven days that they do not intend proceeding, you will apply to the court for an injunction.

6. Within seven days you receive a reply advising that they do not consider your client's position to be financially strong, that they do not consider that the debt is genuinely disputed, and that they do intend proceeding if the money is not paid or security given.

7. Following this, there is a lengthy consultation with the managing director to prepare the documentation necessary to obtain an injunction. As it is necessary to persuade the court that the dispute over the debt is a matter of substance and not simply a smokescreen designed to put off the evil day, full details of the dispute must be given.

8. The following documents are then prepared for filing with the court:
   a) Statement of claim and notice to defendant asking for
      i) A declaration that the alleged debt is not owing,
      ii) Damages for breach of contract, and
      iii) Costs.
   b) An ex parte application for injunction restraining the defendant company from issuing or advertising a winding-up petition on the grounds that
      i) The debt is disputed,
      ii) There is a claim that exceeds the amount of the disputed debt, and
      iii) The presentation and advertising of the petition will do irreparable harm to the plaintiff company.
   c) An affidavit from the managing director of the plaintiff company setting out full details of the disputed debt and its background.

9. These documents are then filed with the court. The motion is ex parte because of the urgency of the situation and the fact that when the proceedings are filed, the time for the expiration of the notice almost has arrived. If there were ample time, then the motion would inevitably have to be served on the other party.

10. In the first instance, the papers are placed before the judge, who makes an order after perusing the papers. The judge does not call counsel for further clarification of the issues.

11. You arrange to have the order sealed in the court and served on the defendant company forthwith to prevent the statement of claim for winding-up proceeding.

Example 10.2 Standard specification for registration of debenture

Assume: Your client company is asked to give a debenture to its trading bank to see fluctuating overdraft and other banking accommodation up to $25,000. The bank's debenture is to take priority over an existing debenture to a finance company securing a $10,000 fixed item of plant.

1. Receive letter of instruction from lending institution. Check
   a) Level of accommodation and
   b) Interest and finance rate (servicing ability).

2. Search company, including Memorandum and Articles. Check that company has power to give such a security. Obtain full details of prior charge.

3. Confirm lending institution's instructions and conditions with client.

4. Peruse trading bank's debenture (standard form).

5. Complete details in debenture form.

6. Prepare Declaration of Due Execution and company resolutions, including Disclosures of Interest. Ensure that the same conform with the company's Articles of Association.

7. Prepare Deed of Modification of Priority and obtain confirmation form on debenture holders to the terms thereof.

8. Attendances on execution of the following documents:
   a) Resolutions incorporating appropriate Disclosures of Interest,
   b) Debenture,

c) Declaration of Due Execution, and
d) Deed of Modification of Priority.

9. Attendances on Disclosure.

10. Arrange noting of appropriate insurance policy.

11. Forward priority document to other debenture holder for execution and return.

12. Register a copy of debenture with the Companies Office.

13. Forward certificates to lending institutions to confirm compliance with requirement and request drawdown of funds.

14. Report to client.

15. Uplift funds and disburse.

16. Attend to stamping of Deed of Priority.

17. Forward final solicitor's certificate to lending institutions together with debentures, security documents, including Section 105 certificate, Deed of Priority, and insurance policy.

18. Final report to client.

Example 10.3 Standard specification for estate administration

Work involved in approximate chronological order

1. Preliminary interview with executor, discussion of terms of the will, the nature and approximate length of time of the administration of the estate, and likely cost.

2. Written report to executor, supplying copy of will and summary of administration.

3. Drafting affidavit to Lead Grant of Probate, Affidavit of Death where necessary, Notice of Application to the court for Grant of Probate.

4. Attendance on executor and having affidavits sworn.

5. Filing application and affidavit(s) at High Court Registry.

6. Preparing and sending letters to post bank, life insurance company, and trading bank seeking particulars of derived and accrued interest for tax purposes and amount payable to estate.

7. Receiving responses form them.

8. Searching certificate of title to house property.

9. Obtaining two death certificates (and birth certificate if age is not admitted by the insurance company).

10. Receiving minute of court's order on application for probate, preparing formal Grant of Probate, and declaration in value of estate.

11. Sealing Grant of Probate and filing declaration at High Court Registry.

12. Preparing Transmissions by Survivorship of jointly owned house property.

13. Preparing taxation returns to date of death.

14. Reporting to executor, supplying Schedule of Assets and Liabilities.

15. Attending on widow/er for execution of transmission.

16. Advising rates authority/Valuation Department, insurance company, electrical supply authority, and Telecom about telephone of transfer of joint house property to widow/er.

17. Attending at Land Transfer Office with transmission (death certificate annexed) and certificate of title for registration.

18. Receiving release of probate from High Court.

19. Completing life insurance discharge, specimen signature, and withdrawal forms for post bank and trading bank accounts.

20. Arranging execution of discharge and withdrawal forms by the executor.

21. Forwarding life insurance policy, death certificate (and birth certificate) discharge, and probate to life insurance company requesting payment.

22. Receiving return of probate from life insurance company together with check in settlement. Arranging for payment into trust account.

23. Forwarding specimen signature and withdrawal forms and probate to trading bank and arranging for closing of account, final bank statements, and payment.

24. Receiving return of probate from trading bank and check in settlement. Arranging for payment of check into trust account.

25. Forwarding specimen signature and withdrawal forms and probate to post bank and requesting payment to the estate.

26. Receiving return of probate from post bank together with check in settlement. Arranging for payment into trust account.

27. Payment of debts, including funeral expenses.

28. Reporting to executor and beneficiary and arranging payment of interim distribution to beneficiary if required.

29. Receiving, checking, and paying assessment from Inland Revenue Department in respect of taxation return to the date of death.

30. Preparing final estate accounts.

31. Preparing a trustee's tax returns from date of death to date of distribution.

32. Final report to executor and beneficiary supplying final statements.

33. Attendance on executor to discuss final accounts and make payment of the balance held in trust.

34. Sundry telephone attendances (say, five) during administration.

Example 10.4 Standard specification for incorporation

Assume: You are consulted by a husband and wife who have purchased a suburban bookstore. They wish to operate the business as a limited liability company with a nominal capital of $10,000. The husband and wife wish to be the shareholders and directors, and they wish their accountant to be the secretary.

1. Preliminary discussion canvassing
   a) Reason for incorporation,
   b) Concept of limited liability,
   c) Level of paid-up capital and reasons why,
   d) Selection of proposed name,
   e) Shareholders, Directors, and Secretary,
   f) Type of business,
   g) Registered office, and
   h) Bankers.

2. Name approval. Forward application for name approval to Registrar of Companies, Wellington, including disbursement.

3. Receive name approval.

4. Draft company documents, including
   a) Articles of Association,
   b) Memorandum of Association,
   c) Notice of Situation of Registered office,
   d) Particulars of Directors and Secretary,
   e) Consents to Act as Director,
   f) Consents to Act as Secretary, and
   g) Minutes of first meeting of Directors.

5. Order Common Seal.

6. Collect funds from clients to cover disbursements, including approval fee, registration costs, and Common Seal.

7. Attendances pertaining to explanation of Articles, Memorandum, powers and rights pursuant thereto, obligations of officers, accounting method, opening of banking accounts, and payment of capital.

8. Attendances on execution of documents.

9. Submit documents to Companies Office for registration.

10. Receive advice as to incorporation.

11. Report and account to clients and advise of incorporation and forward incorporation documents, including
    a) Certificate of Incorporation,
    b) Articles of Association,
    c) Memorandum of Association, and
    d) Minutes of first meeting of Directors.

12. Forward minutes of first meeting to Directors.

13. Forward copies of Articles and Memorandum of Association to nominees.

Example 10.5 Standard specification for a traffic offense

1. Preliminary interview—charge of dangerous driving against stock agent involving a noninjury collection. Instructed to defend the charge.

2. Attending at court when information adjourned for a defended hearing.

3. Interviewing defense witness (passerby) and defendant to prepare a hearing.

4. Speaking to Ministry of Transport to obtain details of prosecution evidence. If necessary, making a request under the Official Information Act 1983.

5. Attending at court to conduct defended hearing in which traffic officer in charge of prosecution and other driver give evidence for prosecution, as well as defendant and passerby for defendant. Total time involved at court: one and a half hours.

6. Preparing application for limited license involving affidavits from defendant and employer representative.

7. Attending at court to obtain limited license against opposition from Ministry of Transport.

P. General Medical Hospitals, ISIC 8511[14]

10.290 Establishing a price index for health services is challenging because of the complexity of measuring service output.

10.291 Many countries do not encounter the problem because hospital expenditures are part of government expenditures and usually valued at factor cost.

10.292 However, for countries like the United States, which have privately and publicly provided health services, it becomes necessary to price them. The U.S. PPI program has developed a price index for hospital services, described below.

10.293 The primary output of the hospital industry is the complete service patients receive during their stay or visit to the hospital. The hospital's output is represented by the full content of the patient bill. Any items or services included on the patient bill were treated as part of the output and were included in our repricing effort. This output is classified in one of two ways:

- Inpatient treatments and
- Outpatient treatments.

10.294 For an inpatient, the output is obtained using all items or services rendered during the patient's length of stay (that is, admission to discharge). These items or services may include room, board, medical supplies, drug treatments, medical and surgical procedures, or ancillary services.

10.295 For an outpatient, there is not an actual admission to the hospital (that is, length of stay is zero), therefore, the services an outpatient receives will occur on a single visit to the hospital. Outpatient services may include treatments for minor injuries, minor surgical procedures, or ancillary services.

[14]For further information regarding the U.S. PPI for General Medical and Surgical Hospitals, see Catron and Murphy (1996). This article describes the original survey sample and design, analyzes hospital price inflation as measured by the PPI, summarizes the results, and briefly compares the hospital industry measures of the PPI with those of the CPI.

10.296 There is no distinction between the inpatient and outpatient services below the industry level.

10.297 After the hospitals were selected, the hospital services needed to be identified for collection. Because of the endless combinations of hospital services, a method was devised to eliminate a time-consuming process of item selection at the hospital. Instead, the services to be priced were preselected using data from the U.S. Agency for Healthcare Research and Quality.

10.298 The following characteristics were used in preselecting each service:

- Type of Patient (inpatient or outpatient),
- Type of Payer (Medicare, Medicaid, Commercial Insurance, etc.), and
- Assigned Diagnosis-Related Group (DRG) (for inpatients only).

10.299 DRG is a coding system in which patient categories are defined by diagnoses or procedures and modified by age, complications, coexisting conditions, or discharge status. Each DRG groups like patients with like ailments and anticipates the level of care required during hospitalization. DRGs are prospective in nature, in that they are based on expected costs rather than actual costs.

10.300 For each inpatient stay at a hospital, patients are assigned one of 497 DRGs. For example, a patient may be assigned DRG 127 *Heart Failure and Shock,* depending on what the principal diagnosis and procedures are. Other factors such as complications, comorbidities, age, and discharge status also play a role in DRG assignment. The DRG, along with diagnosis and procedures, will be listed on the patient bill. However, the payment a hospital receives may or may not be based on the assigned DRG. The payment will depend on the payer and the type of reimbursement. Both are covered in the next section.

10.301 This output is represented by the full content of the patient bill. Each hospital sampled for the PPI was asked to provide a representative patient bill for each of the preselected services. For each patient bill selected, the information necessary for pricing purposes was recorded (payer information, diagnosis information, reimbursement, etc.).

10.302 Because of the importance of third-party payers, the public and private insurers, it is important to distinguish between the price and reimbursement within the hospital industry. The term price usually refers to the total charges that appear on the patient bill. Reimbursement would be the actual amount that the hospital receives as payment.

10.303 What a hospital charges and what it receives are usually two very different amounts. The PPI program is interested in what a hospital actually receives (reimbursement) for its services, not what it charges (price). Differences arise from many sources, but chiefly, discounted prices for various services are frequently negotiated with third-party payers. Thus, the PPI's primary purpose is to capture reimbursement as the net transaction price.

10.304 The most common types of reimbursement for hospitals are per diem rates, DRG/case rates, and percentage of total billed charges. These are not all inclusive, and many methods may be used. However, these three, or variants of them, are seen in the majority of cases.

10.305 The simplest reimbursement method for a hospital is total billed charges. However, it is rarely used. In most cases, a percentage of total billed charges is paid. This percentage is negotiated before services are rendered and is often in effect for a year or more for a given covered population.

10.306 Per diem rates also are very common. This type of reimbursement involves a per day payment for each day of stay in the hospital, regardless of actual charges or costs incurred. This per day rate depends on a number of factors, the two main ones being the number and mix of cases. Many times, multiple sets of per diem rates will be negotiated on the basis of service type (for example, medical-surgical, obstetrics, intensive care, neonatal intensive care, rehabilitation). The per diem rate is multiplied by the length of stay to calculate the total reimbursement. As with DRGs, the hospital keeps any overpayment but has to absorb any underpayment.

10.307 The fundamental difficulty in measuring price changes in the hospital industry is that no identical transactions occur for each repricing period. A patient generally does not repeatedly visit the hospital for the same episode of an illness or ailment. As such, each patient stay or visit to a hospital can be defined as a custom service.

10.308 Each patient represents a unique combination of age, gender, lifestyle, sensitivity to drugs, allergies, medical history, genetics, mental attitude, and so forth.

10.309 Actual treatment paths, as represented by the randomly selected patient bills, formed the basis of the repricing effort. These treatment paths cannot be directly observed in subsequent months (as stated above); however, the hospitals are able to report reimbursement based on identical inputs (payer, diagnosis, length of stay, etc.). This procedure removes any price variability resulting from a direct comparison of different patient bills.

10.310 Another issue is new-item bias. This occurs when repricing is based on inputs that are not current. Over time, treatment guidelines and protocols change. In addition, some hospital services change from being treated as an inpatient to an outpatient or vice versa.

10.311 The PPI program will try to overcome this problem by periodically evaluating the most current, widely accepted treatment protocols for a select set of DRGs. By utilizing data from an outside source, if it is determined that a new or alternate treatment has become prevalent and has begun to replace an old method, then particular items with the old treatment method will be replaced with the newer method. The proportion of new or alternate procedures introduced in our sample will reflect that of the population as a whole. This procedure should allow the index to reflect the most current treatment problems.

10.312 An obvious issue with the repricing of complex services such as health care is quality adjustment. Because objective measures of quality change are difficult to construct, it may be tempting to use changes in resource costs as an estimate (see the discussion in Chapter 7). However, it is much more difficult to draw a relationship between resource costs and quality change for services in which quality has a significant subjective component.

Figure 10.1. Sample Worksheet

WIRELESS TELECOMMUNICATIONS (EXCEPT PAGING) WORKSHEET

PART I: AVERAGE UNIT PER ACCESS LINE

List all types of charges assessed by company for the selected area in column 1. Enter the total number of units for each type of charge in column 2. Enter the total number of access lines in column 3. Divide column 2 by column 3 and enter in column 4. The reporter may be reluctant to provide data for columns 2 and 3. If the reporter will calculate the percentages, it is only necessary to fill out columns 1 and 4.

Column 1	Column 2	Column 3	Column 4 (Column 2/ Column 3)
Type of Charge	**Total Units: Billed and Free**	**Total Number of Access Lines**	**Average Number per Access Line**
ACCESS LINE			
1.0000*		*BY DEFINITION	
USAGE CHARGE BASED ON TIME			
Peak minutes	32,400,000		162
Off-peak minutes	26,600,000	200,000	133
Roaming minutes	2,000,000	200,000	10
Landline minutes			
Other charges			
USAGE CHARGES OTHER THAN TIME			
Landline, per call	400,000	200,000	2
Other charges, Daily rate	200,000	200,000	1
FEATURES/OPTIONS AND FEATURE PACKAGES			
Custom calling package	130,000	200,000	0.65
Call waiting	40,000	200,000	0.20
Call forwarding	20,000	200,000	0.10
3-way conference	10,000	200,000	0.05

No answer transfer	20,000	200,000	0.10
Voice messaging	40,000	200,000	0.20

WIRELESS TELECOMMUNICATIONS (EXCEPT PAGING) WORKSHEET

PART II: AVERAGE REVENUE PER UNIT

Copy all the charges in Part I, column 1, to Part II, column 1. Obtain the net billed revenues for each type of charge and divide by the total quantity used of each charge. **OR**

The reporter may be reluctant to provide data for columns 2 and 3. If the reporter will calculate the average revenue, it is only necessary to fill columns 1 and 4.

Column 1	Column 2	Column 3	Column 4 (Column 2/ Column 3)
Type of Charge	**Total Net: Billed Revenue**	**Total Units: Billed and Free**	**Average Revenue per Unit**
ACCESS LINE	5,350,600	200,000	26.7530
USAGE CHARGE BASED ON TIME			
Peak minutes	8,388,360	32,400,000	0.2589
Off-peak minutes	2,191,840	26,600,000	0.0824
Roaming minutes	1,944,400	2,000,000	0.9722
Landline minutes			
Other charges			
USAGE CHARGES OTHER THAN TIME			
Landline, per call	60,000	400,000	0.1500
Other charges,			

Daily rate	300,000	200,000	1.5000
FEATURES/OPTIONS AND FEATURE PACKAGES			
Custom call package	449,800	130,000	3.4600
Call waiting	194,000	40,000	4.8500
Call forwarding	103,000	20,000	5.1500
3-way conference	57,500	10,000	5.7500
No answer transfer	85,000	20,000	4.2500
Voice messaging	192,000	40,000	4.8000

WIRELESS TELECOMMUNICATIONS (EXCEPT PAGING) WORKSHEET

PART III: COMPUTE AVERAGE REVENUE BILL

Copy all the types of charges in Part I, column 1 to Part III, column 1. Copy average number per access line from Part I, column 4, to column 2. Copy average revenue per unit from Part II, column 4. Multiply column 2 by column 3 and enter in column 4. Sum column 4 to base period total or "price."

Column 1	Column 2	Column 3	Column 4 (Column 2 X Column 3)
Type of Charge	**Average Number per Access Line (Part I, Col. 4)**	**Average Revenue per Unit (Part II, Col.4)**	**Weighted Revenue**
ACCESS LINE	1.000	26.7530	26.7530
USAGE CHARGE BASED ON TIME			
Peak minutes	162	0.2589	41.9418
Off-peak minutes	133	0.0824	10.9592
Roaming minutes	10	0.9722	9.7220
Landline minutes			

Other charges			
USAGE CHARGES OTHER THAN TIME			
Landline, per call	2	0.1500	0.3000
Other charges, Daily rate	1	1.5000	1.5000
FEATURES/OPTIONS AND FEATURE PACKAGES			
Custom calling package	0.65	3.4600	2.2490
Call waiting	0.20	4.8500	0.9700
Call forwarding	0.10	5.1500	0.5150
3-way conference	0.05	5.7500	0.2875
No answer transfer	0.10	4.2500	0.4250
Voice messaging	0.20	4.8000	0.9600
BASE-PERIOD TOTAL			97.0686