11. Treatment of Specific Products and Issues

A. Introduction

11.1 This chapter provides examples of how different national statistical agencies handle different commodities and explains some pricing issues important in international trade. The emphasis is on those areas in which price measurement generally is regarded as difficult; however, examples of routine commodity areas 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 the discussion of each issue includes mention of outstanding issues—issues that point to problems in the described procedures.

11.2 A general problem in constructing export and import price indices (XMPIs) is formulating a precise characterization of the good or service to be priced. To some extent, that characterization hinges on the definition of the commodity area to which the commodity is assigned. For the purposes of this chapter, the Standard International Trade Classification (SITC) Rev. 3 will be used as a reference. The linkage between the selection of the products to be priced and their SITC assignment is independent of whether there is probability or judgmental sampling.

11.3 In addition to the SITC Rev. 3 used in this chapter, other classification systems used for the calculation and publication of XMPIs are presented in Chapter 4. These include the Harmonized Commodity Description and Coding System, Broad Economic Categories, the Central Product Classification, the Statistical Classification of Products by Activity in the European Union, and, for services trade, the Extended Balance of Payments Services Classification.

11.4 After the selection of a commodity 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 this *Manual* have provided discussion of the conceptual framework underlying many aspects of constructing XMPIs. This chapter will provide some examples of different statistical agency practices.

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

11.6 Generally, the commodity areas that allow for a straightforward application of the methods and concepts are ones for which the trade is countable. That is to say, a respondent's trade is physically measurable. In this case, the definition of the commodity's price is clear. Examples of commodity areas falling into this category and discussed below are agriculture (SITC 0), crude petroleum and gasoline (SITC 33), and metals (SITC 68).

11.7 Commodity areas that experience frequent technological change present some special problems. Though the trade in the computer industry (SITC 75) may be measurable, constructing price indices for computers is difficult when trying to capture quality change that arises from the technological change. Computers and motor vehicles (SITC 78) are examples provided in this chapter.

11.8 Clothing (SITC 84) presents a similar problem. The trade is measurable, but the measurement of price change is complicated by the change in the quality of the clothing and the influence of seasons. The case of the clothing industry is specifically considered.

11.9 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 covers some of the difficulties involved with calculating XMPIs for services and considers XMPIs for services such as airfreight, air passenger fares, crude oil tanker freight, ocean liner freight, and travel and tourism.

11.10 The discussion below does not fully address issues concerning sample design or sampling methodology. These features are discussed only to the extent that they affect the establishment of a pricing strategy for the commodity or service area.

11.11 The chapter concludes with a discussion of various pricing issues that are particularly important for calculating XMPIs. These issues include the country of origin/destination, duties, currency conversion, intracompany transfers, and price bases.

B. Agriculture, SITC 0

11.12 Many countries employ secondary sources for prices of agricultural commodities that are already being collected in order to decrease the sampling and repricing burden to respondents.[1] For example, the Australian Bureau of Statistics (1995) uses the wool market indicator price from the auction market for exported greasy wool because a large percentage of greasy wool exports are sold through this market. Other examples of the use of secondary source data are the U.S. Bureau of Labor Statistics' use of export price data from the U.S. Department of Agriculture for exported grains (U.S. Bureau of Labor Statistics, various issues) and the U.K. Government Statistical Service's use of meat prices from the Meat and Livestock Commission (Richardson, 2000). 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 the trade of commodities' make prices unobservable during part of the year. Second, volatility in price and production from year to year, and sometimes within a year, are caused by external forces such as the weather or economic influences.

11.13 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.

[1]Note that sources of secondary price data might also be available for other homogeneous commodities, such as crude petroleum and raw metals.

B.1 Seasonal commodities in the Canadian FPPI

11.14 The following description is drawn from the recently redesigned Canadian Farm Producer Price Index (FPPI) (Baldwin, 2002) and the procedures introduced to meet these problems, which are representative of the techniques used by other countries for producer price indices (PPIs) and which may be applicable to XMPIs.

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

B.2 Seasonal baskets

11.15 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. consumer price index (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.

11.16 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.

11.17 The Rothwell formula is

$$P^{(c)}_{y,m/0} = \sum_j p^j_{y,m} q^j_{c,m} \Big/ \sum_j p^j_0 q^j_{c,m}, \tag{11.1}$$

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

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

$$P^{(0)}_{y,m/0} = \sum_j p^j_{y,m} q^j_{0,m} \Big/ \sum_j p^j_0 q^j_{0,m}, \tag{11.2}$$

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

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

11.18 The Rothwell formula for the annual index would be

$$P^{(c)}_{y/0} = \sum_j p^j_y q^j_c \Big/ \sum_j p^j_0 q^j_c, \tag{11.3}$$

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

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

$$P^{(0)}_{y/0} = \sum_j p^j_y q^j_c \Big/ \sum_j p^J_0 q^j_c,$$

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

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

11.19 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 to 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 obviates 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.

11.20 A major strength of this approach is that it accounts for highly seasonal products available for only a few months in the year. In 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. In 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.

11.21 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 to include sales in November, where before no sales have 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.

11.22 Imputations cannot always be avoided. If there typically is 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 example of the lengthened season discussed above. In such a situation, 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.

11.23 The problems of imputation, as well as the formation of the seasonal basket, are ones faced by seasonal commodities, such as clothing, discussed in Section C.

B.3 Annual price index

11.24 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 trade 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.

11.25 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.4 Annual chaining

11.26 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.

11.27 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. With this basket, indices are recalculated for each month from January 1998 onward; the recalculated 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 of using quantities sold for the period 1994 to 1998.

B.5 Linking at the annual index

11.28 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.

11.29 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.6 Analysis of monthly price changes

11.30 Monthly baskets have the disadvantage of having 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.

11.31 The decomposition is as follows:

$$\left(P^{(c)}_{y,m/y-1} - P^{(c)}_{y,m-1/y-1}\right) = \frac{\sum (p_{y,m} - p_{y,m-1}) q_{c,m-1}}{\sum p_{y-1} q_{c,m-1}} + \frac{\sum p_{y,m}(q_{c,m} - q_{c,m-1})}{\sum p_{y-1} q_{c,m}}, \qquad (11.4)$$

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

$$\left(\sum (p_{y,m} - p_{y,m-1})\, q_{c,m-1} \Big/ \sum p_{y,m-1}\, q_{c,m-1}\right) \times 100, \qquad (11.5)$$

and a residual component,

$$\left(\sum p_{y,m}\,(q_{c,m} - q_{c,m-1}) \sum p_{y,m-1}\, q_{c,m-1}\right) \times 100. \qquad (11.6)$$

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

11.32 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:

$$\left(\frac{\sum(p_{y,m} - p_{y,m-1})\overline{q}_{c,m-1\&m}}{\sum p_{y,m-1}\,\overline{q}_{c,m-1\&m}}\right) \times 100, \qquad (11.7)$$

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

11.33 Equation (11.5) 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 (11.7) 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 (11.5) thus is more closely connected to the published FPPI than is equation (11.7). Yet the latter may be a better measure of month-to-month price change because it uses quantity weights from two time periods.

11.34 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.)

11.35 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 sales in month $m - 1$.

11.36 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,

$$\left(\frac{\sum(p_{y,m} - p_{y,m-1})\overline{\overline{q}}_{c,m-1\&m}}{\sum p_{y,m-1}\,\overline{\overline{q}}_{c,m-1\&m}}\right) \times 100, \qquad (11.8)$$

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.

11.37 In calculating an Edgeworth-Marshall cross using equation (11.7), one must impute prices for commodities unavailable in either month $m - 1$ or m (but not both) and not, as with equation (11.5), only for those unavailable in month m.

11.38 The December to 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. Because 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. Because they use the same basket, comparisons of the May 1998 (1998 = 100) and May 1999 indices give a pure price change measure.

B.7 Other issues

11.39 *Use of receipts in the absence of quantities sold.* For some commodities, 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.

11.40 *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.*

B.8 Seasonal commodities in the U.S. XMPI

11.41 The discussion presented in the sections above relates to the methodology employed by the Canadian

FPPI; the following section describes treatment of seasonality in the U.S. XMPI.

11.42 An analysis of seasonal commodities in U.S. XMPIs was performed by Alterman, Diewart, and Feenstra (1999). Four different approaches to the treatment of seasonal commodities were described by the authors as follows.

- An *annual price index* addresses the seasonality problem by treating each commodity in each month as a different commodity to be compared. The commodity-month observations are compared as a set with the same set of observations for the previous year to obtain the annual index.
- In a *year-over-year price index,* the index is calculated by comparing the sets of commodities in one month with the same set in the same month of the previous year. For example, the price of the commodities traded in April 2005 would be compared with the price of the same commodities traded in April 2004.
- Another option is to simply exclude the seasonal commodities from the index calculation and to calculate a *month-to month index over nonseasonal commodities.*
- Finally, a *month-to-month index with maximum overlap* can be calculated by comparing the prices for all commodities available in two consecutive months. This last option is the one that the U.S. Bureau of Labor Statistics (BLS) uses in practice.

11.43 Alterman, Diewart, and Feenstra (1999) tested these four approaches using simulated and real data and recommend that XMPIs use a *month-to-month index with maximum overlap* estimated with a geometric index using monthly trade weights lagged two years. The introduction of monthly weights would ensure that seasonal commodities would drop out of the index during the months when there is no trade.

11.44 The Canadian and U.S. approaches raise issues that some countries may want to avoid by coming up with alternative methods. As described earlier, the seasonal basket combines information from annual and monthly data, creating issues about (1) how to select the market basket and (2) how to interpret the switch between annual and monthly quantity data. In addition, one must choose the appropriate base year. A fuller discussion of seasonal adjustment is provided in Chapter 23.

C. Clothing, SITC 84

11.45 The procedures used by the Australian Bureau of Statistics PPI for the clothing industry can also be applicable to the calculation of XMPIs for apparel. The broad category of apparel covers trade in a wide range of garments, from basics to high-fashion items. The commodities can be categorized in a number of ways, but commodity classifications generally adopt the traditional split of

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

11.46 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.

11.47 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.

11.48 After the items to be covered by the index (e.g., women's dresses) are selected, the respondents to be included in the index and the specific items to be priced need to be selected. As is the case with all XMPIs, the selection of respondents will normally be based on data from export and import trade statistics.

11.49 Selection of the actual specifications to be priced will require contact with the respondents and may be complex. Key principles in selecting the actual specifications from any particular respondent are as follows:

- Specifications should provide adequate coverage of the types of garments traded within that commodity category. In particular, they should represent the pricing practices adopted by the respondents. That is, the factors that cause prices to move differently across specifications, such as the type of material used (e.g., cotton fabric shirts may move differently in price with polyester fabric shirts), should be taken into account.
- 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).

11.50 As was the case for agricultural goods, a general problem in pricing clothing is the distinct seasonal variations in the clothing traded because manufacturers switch from summer to winter clothing, Some garments are traded for only part of the year; therefore, some technique is required to handle the period when these seasonal items are not traded. The most common technique is to simply repeat prices for the out-of-season items.

11.51 As was mentioned regarding agricultural products, the problem of missing items is common when dealing with seasonal commodities. Imputations are therefore necessary. Section B.6 of Chapter 8 discusses imputations.

11.52 Another problem is finding the same items to price in the new season (e.g., this winter) as were priced in that season of the previous year (i.e., last winter). Items often change because of fashion, and style changes the relative costs of different fabrics (e.g., 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.

11.53 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 (e.g., pure cotton, cotton blend, polyester),
- Quality of fabric (e.g., weight, thread count, type of dyeing used), and
- Quality of make (e.g., example, type of seams, buttonholes, collar, pleats).

11.54 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 may be necessary though quite difficult. 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 in Section G.) 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.

11.55 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."

11.56 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 and asked for an estimate of the cash value of the difference.

11.57 If such an estimate is not available from the respondent, it may be feasible for the commodity expert in the statistical office to estimate the value of the quality change. Hedonic regression methods may be employed if resources permit. Descriptions of hedonic techniques used for clothing in consumer price indices can be found in Liegey (1993).

11.58 Seasonal dimensions can be handled by creating checklists that are seasonally based. Thus, a list for an item could include women's summer dresses, fall dresses, and so on.

11.59 Two prominent issues arise with measuring price change for clothing. First, as mentioned above, is how to impute missing prices and quantities. Second, there is a question of whether changes in fashion should be considered as quality change. Earlier it was argued that such changes should not be considered quality change.

D. Crude Petroleum and Gasoline, SITC 33

11.60 In many countries, detailed data on crude petroleum imports are already collected by the Ministry or Department of Energy. If trade volumes and quantities are available at a detailed enough level to ensure that the crude stream is homogenous over time, then a unit value methodology can be employed to obtain prices per barrel of oil. The following methodology is used by the U.S. BLS to measure price changes for imported crude petroleum.[2]

11.61 The U.S. BLS uses two different methodologies to calculate its import crude oil index: one methodology for the initial estimate and another for the three subsequent revisions. The U.S. BLS primarily uses transaction data from the Department of Energy (DOE). The DOE collects data on the costs and quantities of virtually all foreign crude oil acquired for importation into the United States. When the crude oil index for a given month is published for the second, third, and fourth times, the U.S. BLS simply aggregates the transaction data from the DOE. However, most of these data are available only on a lagged basis. About half the data are available with a one-month lag and almost all the data are available with a two-month lag. The initial data are also subject to revision. Thus most transaction data are unavailable when the first estimate of the crude oil index is published. As a result, the U.S. BLS uses a different methodology for the first estimate of the crude oil index. The DOE transaction data are aggregated for the current month, but this short-term relative is not published; rather, it is used as an input in a regression model.

11.62 The second input in the regression model is based on prices from the U.S. Energy Information Administration (EIA). The EIA publishes weekly U.S. average prices for crude oil that are weighted by estimated import volume. The U.S. BLS computes another measure of monthly crude oil price change by calculating the monthly average of these weekly average prices. The final revision of the monthly percent change in the crude oil index (using DOE data) is regressed on the initial percent change of the DOE transaction data and the EIA monthly percent change. This regression model is used to calculate the estimate of the current month's crude oil index. In the six years that the regression model has been used, the root mean squared error of the model's estimate has been 64 percent lower than the value derived from the limited DOE transaction data and 41 percent lower than the EIA monthly percent change.

11.63 Unlike other commodities, the reference period for the crude oil index is the entire month rather than the first week of the month.

[2]The following description is found in the U.S. BLS (undated), "How the International Price Program Measures Price Change for Crude Oil and Gasoline in the U.S. Import/Export Price Indexes," Division of International Prices.

11.64 Secondary source data are also used by the U.S. BLS for the XMPIs for gasoline. The U.S. BLS uses spot prices from the first week of the month to calculate the import and export gasoline price indices. Reuters News Service is the source for the spot prices for conventional regular gasoline for New York Harbor, the U.S. Gulf Coast, and Los Angeles. The prices are published in the EIA's Weekly Petroleum Status Report.

11.65 The import and export gasoline price indices use the same price data but differ solely because of the different weights associated with the prices for New York Harbor, the U.S. Gulf Coast, and Los Angeles. Most imports come into New York and most exports leave from Los Angeles. The weights are derived from the EIA's Petroleum Supply Annual. The reference period for gasoline is the first week of the month.

E. Metals, SITC 68

11.66 Pricing of metals can rely on secondary source data from the London Metal Exchange. World prices are available for metals such as aluminum, copper, lead, nickel, tin, and zinc.

11.67 The secondary source prices may differ from transactions prices owing to differences in transportation costs. In addition, these prices are quoted in U.S. dollars so they would have to be converted into the national currency (see Section H.2). Finally, the cost of insurance included may vary (see Section H.4 for a description of different price bases used).

F. Electronic Computers, SITC 75

11.68 Some countries use data from major trading partners as a proxy for import price indices. For example, the United States is a major exporter of electronic computers, so U.S. export price indices for computers could serve as a proxy for other countries' import price index for computers.

11.69 A process for estimating price changes for electronic computers that has served as a model for many countries was developed by the U.S. PPI program, outlined in Holdway (2001). This methodology, which has also been adopted by the U.S. XMPI program, is described below.

11.70 The primary commodity traded in 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 incorporates computers for the purpose of performing functions such as measuring, displaying, or controlling process variables are classified based on the manufactured end product.

11.71 Trade in computers can be disaggregated into several categories. These categories should be broadly defined because the rapid pace of industry technological change can render narrowly defined categories obsolete. The U.S. BLS structure for computers is based on product detail collected by the U.S. Census Bureau in its Current Industrial Report survey; the categories are as follows:

- Host computers, multiusers (mainframes, super computers, medium-scale systems, UNIX servers, PC servers);
- Single-user computers, microprocessor-based, capable of supporting attached peripherals (personal computers, workstations, and portable computers); and
- Other computers (array, analog, hybrid, and special-use computers).

11.72 Rapid changes in computer technology can create the classification problem of new product classes that do not fit neatly into an existing product classification structure. For example, handheld devices would be classified under "portable computers" in the above classification structure. However, index users, including producers, have come to view the portable computer designation as including only laptops or notebooks. Therefore, the introduction of handheld devices into the index should result in revision to the commodity title such as changing "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)."

11.73 The product classification issue described above is related to rapid postsample changes in output. Similar adjustments at the disaggregate level may be required for the trade in other high-tech industry products such as semiconductors.

11.74 In the U.S. XMPI program, computer exporters and importers were selected with a probability proportionate to size as measured by trade value, and then individual commodities representing current trade patterns were selected based on their relative importance to a respondent's value of shipments. Respondents provided detailed product specifications for each of the computers that were sampled for which the respondents provide monthly price updates. Because of rapid technological change, respondents 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 XMPI 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.

11.75 Hedonic methods are used to estimate quality change valuations for computers in the PPI and the XMPI. 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.

11.76 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 is provided in Chapter 8, Section E.4.

11.77 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 XMPI.

11.78 The mechanics of quality-adjusting price relatives when computer characteristics change is 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

$$PR = \frac{P_c - ICP}{P_0}.$$

11.79 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.

11.80 The independent variables specified in the hedonic models include inputs such as microprocessors, memory, and disk drives, all of which exhibit extraordinarily rapid price declines. Many other inputs are also used in the regressions. Because the costs of these components change rapidly, the U.S. BLS has opted for frequently updated cross-sectional models rather than less-frequent updates of pooled data.

11.81 Ideally, the U.S. BLS would update its cross-sectional computer models on a monthly basis, but resource constraints result in quarterly updates. Nevertheless, the U.S. BLS 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 U.S. BLS 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.

11.82 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 U.S. BLS's real-time monthly production environment.

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

G. Motor Vehicles, SITC 78

11.84 The primary commodity of the broad motor vehicle building industry is motor vehicles and engines and parts for motor vehicles. The discussion below describes the PPI for the Australian automobile industry and the methods of the Australian Bureau of Statistics, which are also useful for XMPIs.

11.85 The commodity areas can be defined by the main activities of the industry, such as

- Motor vehicles,
- Motor vehicle engines and parts,
- Motor vehicle bodies,
- Automotive electrical and instruments, and
- Other automotive components.

11.86 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.

11.87 The following discussion focuses on complete motor vehicles. The concepts discussed also will be of assistance in considering issues involved with pricing other motor vehicle–related production.

11.88 The next stage is to select potential respondents that are representative of these activities. As is the case with all XMPIs, the selection of potential respondents will normally be based on data from export and import trade volumes.

11.89 The prices should reflect market values in cases where the trading partners are related. In such cases, cross-subsidization may make it difficult to obtain the proper price. More details on intra-company transfer pricing are provided in Section H.3.

11.90 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 those for some commodities.

11.91 A major issue for producing an index for any technologically advanced commodity, such as motor vehicles, is quality change. Although 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.

11.92 Examples of motor vehicle features, which may be relevant for item selection and assessment of quality change, include

- Make and model,
- General type of vehicle (e.g., sport, four-wheel drive, limousine, sedan, wagon),
- Engine size,
- Exterior dimensions,
- Interior dimensions,
- Torque,
- Anti-lock braking system,
- All-wheel drive,
- Fuel consumption (high consumption is regarded as a negative attribute; the type of fuel used has differing assessments depending on relative fuel costs and efficiencies),
- Airbags,
- Traction-control systems,
- Safety rating,
- Acceleration,
- Brake horsepower,
- Curbside weight,
- Air-conditioning,
- Cruise control,
- Compact disc player and stacker,
- Global positioning system,
- Keyless entry,
- Security system,
- Power windows,
- Electric sunroof,
- Electric mirrors, and
- Metallic paint.

11.93 One method commonly employed for change of specification is the overlap method of pricing, discussed in Chapter 8. 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.

11.94 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 XMPIs, because assessments of quality change are best made on estimates of production cost 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.

11.95 Another approach is to use hedonic methods for quality adjustment purposes (see Chapters 8 and 22 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 (i.e., 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. The hedonic function on which these implicit characteristic prices are based should be updated at least annually. See Bodé and van Dalen (2001) on the use of hedonic methods for constructing constant quality price indices for motor vehicles.

11.96 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.

11.97 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.

11.98 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, one must take care 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. Services

11.99 Most countries that produce XMPIs publish indices only for trade in commodities; however, services make up an increasing amount of international trade. In order to obtain accurate balance of payments data in inflation-adjusted terms and to fully analyze international trade, services XMPIs are needed. The Voorburg Group, established in 1986, recognized the need for better measurement of the service sector and has been coordinating research into services measurement issues including research on measuring prices for internationally traded services.

11.100 Measurement of services is complicated by the intangible nature of the commodities traded. Often it is difficult to even define the service being traded. In many cases the transactions are unique and a stable commodity cannot be tracked over time.

11.101 Often, internationally traded services are not classified according to the classification systems used by national statistical agencies. For example, in the United States the BLS instead publishes indices according to two different definitions (U.S. BLS, 1997). First, a balance of payments definition (import and export) is used, so that the indices measure price trends for payments between domestic and foreign residents on internationally traded services. These indices are used to deflate the foreign sector of the national accounts. Second, an international services definition (inbound and outbound) is used to measure price trends regardless of the residencies. These indices are useful for the analysis of international trade and inflation.

11.102 Transportation services are perhaps one of the more straightforward types of services to measure and one for which secondary source data might be readily available. The following sections describe the methodologies used by the U.S. BLS to produce XMPIs for airfreight, air passenger fares, crude oil tanker freight, and ocean liner freight.

H.1 Airfreight

11.103 The U.S. BLS publishes both balance of payments (import/export) and international (inbound/outbound) indices for international airfreight rates. The import airfreight index (U.S. BLS, 2008a) measures changes in rates paid for the transportation of freight from foreign countries to the United States on foreign carriers. The export airfreight index measures changes in rates paid for the transportation of freight from the United States to foreign countries on U.S. carriers and freight transportation between two foreign countries on U.S. carriers.

11.104 For the international services indices, the inbound airfreight index measures changes in rates paid for the transportation of freight from foreign countries into the United States on any carrier. The outbound airfreight index measures changes in rates paid for the transportation of freight from the United States into foreign countries on any carrier.

11.105 Airfreight consists of commodities tendered to an airline for transportation, not including mail, express, or passenger baggage. The service being priced is the transport from airport to airport, so all ground transport and port services are excluded.

11.106 The sampling frame for the U.S. airfreight indices comes from data already collected by the U.S. Department of Transportation, which includes data on airports of origin and destination, air carrier name and nationality, and service class (e.g., passenger/ cargo or cargo).

11.107 The price data are collected from responding air carriers. The price-determining characteristics for an airfreight item include the air carrier nationality, the airports of origin and destination, the shipment weight, the dimensions and packaging of the shipment, the type of commodity shipped, and the type of buyer. All of these must be captured in the item description. In addition, the price quotes must include data on commissions, discounts, and surcharges so that the net freight rate can be calculated.

11.108 The revenue weights are derived from a regression analysis based on data from entry documents filed with the U.S. Customs Bureau and are updated every five years.

H.2 Air passenger fares

11.109 The U.S. BLS publishes both balance of payments (import/export) and international (inbound/ outbound) indices for international air passenger fares (U.S. BLS, 2008b). The import air passenger fares index measures changes in fares paid to foreign carriers by U.S. residents for international travel. The export air passenger fares index measures changes in fares paid to U.S. carriers by foreign residents for international travel.

11.110 For the international services indices, the U.S. carrier air passenger index measures changes in fares paid to U.S carriers for international travel regardless of the residency of the passengers. The foreign carrier air passenger index measures changes in fares paid to foreign carriers for trips flown between the United States and foreign countries regardless of the residency of the passengers.

11.111 All of the air passenger fares indices use data from the U.S. Department of Transportation as the sampling frame. This data set includes passenger counts, revenues, airports of origin and destination, and fare classes.

11.112 Monthly price data are obtained from an electronic reservations system that is widely used in the industry. The price-determining characteristics for an air passenger fare include the airports of origin and destination, the carrier name, the fare class (coach, business, or first class), and the fare type (one-way or round-trip), fare basis code, purchase requirements and restrictions, and routing code. Transactions for frequent flyer tickets and tickets sold by consolidators are not currently available from the repricing source so these are excluded from the index.

11.113 The revenue weights are derived from the passenger count data collected by the U.S. Department of Transportation and are updated every five years.

H.3 Crude oil tanker freight services

11.114 Crude oil tanker freight services was one of the first international service indices published by the U.S. BLS. Crude oil tanker freight consists of bulk crude oil shipments measured in barrels (U.S. BLS, 2008c). Because the index measures price changes for ocean transportation from port to port, all ground transportation and port services are excluded from the price.

11.115 The international services definition is used, so the index measures changes in the rates paid for the transportation of crude oil loaded from foreign countries and shipped to the United States on tanker vessels regardless of the nationality of the shipper or the vessel operator/owner. Currently the U.S. BLS produces the index only for inbound shipments.

11.116 As is the case for the import crude petroleum index (described in Section D), data for crude oil tanker freight are collected by the U.S. Department of Energy, so the whole universe of reported transactions is available. The index uses prices calculated as the weighted average of transactions sharing trade routes for the month. Each average price uses only those transactions from the same region of origin and delivery, such as all transactions from the Middle East to the U.S. Gulf of Mexico. Individual transactions are weighted together by quantity of barrels and price per barrel.

11.117 The trade volume weights for use in aggregating the index are derived from a regression analysis of one year of tanker transactions, and are updated every five years.

H.4 Ocean liner freight

11.118 The U.S. BLS publishes an index for inbound ocean liner freight that reflects changes in rates paid for the transportation of freight from foreign countries into the United States on ocean liner vessels regardless of the nationality of the shipper or the vessel operator/owner (U.S. BLS, 2008d). It should be noted that ocean liner vessels operate on regular schedules whereas tramp and tanker ocean shipping vessels operate on irregular schedules negotiated by the shipper and the ship owner.

11.119 The sampling frame for the inbound ocean liner freight index comes from the U.S. Maritime Administration. This data set includes date of entry, U.S. port of entry, foreign port of origin, vessel name, shipping weight, operator, service type, commodity type, and customs value of the shipment. A sample of company routes is probabilistically selected.

11.120 Price quotes are collected from responding ocean liner freight operators. The price-determining characteristics include the service route, the commodity type, the container size, the type of rate (service contract or tariff), and any applicable surcharges. All commissions, discounts, and surcharges are excluded to arrive at a net freight rate. The shipping rates include only port-to-port transport, so all ground transportation and port services are excluded from the price.

11.121 The revenue weights are derived from a regression analysis of data from the U.S. Maritime Administration and are updated every five years.

H.5 Travel and tourism

11.122 The U.S. BLS publishes an export travel and tourism index measuring price changes for lodging, food and beverage, entertainment, local transportation, gifts and souvenirs, and other goods and services purchased in the United States by foreign visitors (U.S. BLS, 2008e). Expenditures by foreign visitors traveling to the United States for business, education, or medical treatment are excluded from this index. The indices for export travel and tourism are published according to the visitor's country of residence. The index is published with a one-month lag owing to the availability of pricing data.

11.123 Items to be priced for the index are sampled from a subset of CPI data selected on the basis of expenditures by foreign visitors to selected U.S. metropolitan travel destinations across the broad categories of lodging, food and beverage, entertainment, local transportation, gifts and souvenirs, and other expenditures. The specific transactions selected adhere to CPI's sampling methodology.

11.124 Pricing data for the export travel and tourism index are obtained monthly from the U.S. BLS CPI. The pricing data are a combination of CPI basic indices and item prices. Price data from the CPI can be used because foreigners usually pay the same prices for these goods and services as U.S. residents. The CPI basic indices are not seasonally adjusted and include taxes. The item prices also include taxes.

11.125 Prices for tour packages are excluded from this index due to data limitations. Prices for international airfare also are excluded from this index because these price changes are measured by other U.S. import/export price indices.

11.126 The trade weights used in the index reflect spending by foreign travelers as collected by the in-flight survey data collected by the Office of Travel and Tourism Industries of the Department of Commerce, Statistics Canada, and the Mexican Ministry of Tourism.

H.6 Other areas for future research

11.127 Indices for export education could be calculated from secondary source data from the College Board for tuition, fees, and room and board paid by foreign students at U.S. colleges and universities. Because the College Board publishes new data every year, both prices and weights would need to be updated on an annual basis. Normally these prices are set for the year at institutions of higher education, so annual repricing is sufficient. Although secondary source data may be readily available for higher education, it is very difficult to measure output and quality change for this service.

11.128 Other important examples of internationally traded services include the broad category of financial services and royalties and license fees.

I. Pricing Issues of Importance in International Trade

11.129 Many issues arise in the calculation of XMPIs that pose difficulties to statistical agencies. This section outlines the importance of tracking country of origin and destination as a part of the commodity description, how to handle duties associated with the transaction, which exchange rates to use, how to interpret prices for intra-company trade, and on which price basis to collect the price data.

I.1 Country of origin or destination

11.130 The country of origin for imports and the country of destination for exports might be a price-determining characteristic if the market is segmented geographically. Therefore, it is important to collect this information along with the price quote each period from the respondent. If country of origin or destination is a price-determining characteristic, only price series with a consistent country of origin or destination should be used in the calculation of the XMPI.

11.131 For imports, the country of origin is defined as the geographic location of the company that held title to the commodity when it was exported to the importing country. It should be noted that the country of origin may or may not be different from the country of manufacture. For example, if a commodity was produced in Country A, sold to a company in Country B, and then exported to the importing Country C, then the country of origin should be reported as Country B. In contrast, if the commodity was produced in Country A and merely shipped through Country B on its way to the importing Country C, then Country A is the country of origin.

11.132 When the transaction is between related parties as described below in Section H.3, it may be difficult to determine which party held title to the commodity when it was exported to the importing country. If that is the case, the country of manufacture can be used as the country of origin.

11.133 Often a commodity is imported from more than one country with no price difference. In that case a group of countries, such as “Brussels and Luxembourg,” should be recorded and tracked. Likewise if the commodity is imported from a larger number of countries, record the smallest geographic area that includes all the possible exporting countries, such as the European Union (EU) or Europe, as the country of origin.

11.134 As was the case for imports, if the commodity is exported to a number of countries, either list the countries of destination or record the smallest geographic area that includes all the possible importing countries, such as EU or non-EU. However, if an exporter sells at the same price regardless of the destination country, then the country of destination can be recorded as “world.”

11.135 If the country of origin or destination is tracked as part of the commodity description, the review of price changes described in Chapter 10, Section D, can include a check on whether a flagged price change might be due to a change in the country of origin or destination.

11.136 In addition, XMPIs calculated by country of origin or destination can be a useful series to publish when they are important determinants of overall price trends. Vachris (1992) explained how these indices can be calculated using a subset of the data already collected for XMPIs for the United States. Before producing these indices, the statistical agency must establish whether or not trade with the countries or regions is consistent with regard to both volume and composition over time so that price data can be collected. Owing to the smaller set of data, it may be necessary to implement the trade volume weights at a higher level of aggregation than the regular XMPIs. Otherwise the methodology remains the same. Examples of series published by U.S. BLS include imports from industrialized nations versus other nations, imports from regions such as the European Union and the Pacific Rim, and imports from specific major trading partners such as Canada.

I.2 Duties

11.137 Many prices used for international transactions include duties. Whether to include duties in the measurement of XMPIs depends on the purpose of the indices. If the XMPIs are intended to measure changes in the cost of living or competitiveness, then duties should be included because they are part of the cost.

11.138 Most XMPIs, however, are primarily intended for use in the deflation of the foreign sector of the national accounts, so the procedures for handling duties should follow the Commission of the European Communities and others (2008) *System of National Accounts 2008* (*2008 SNA*), as discussed in Chapters 4 and 15 of this *Manual*.

11.139 If a respondent provides a price that includes a duty, then the statistical agency must also obtain enough information to remove the duty from the price used in the index calculation. For example, if the amount of the duty is available in a fixed amount per some specified unit of the commodity, then it is easy to subtract this amount from the price each period. However, sometimes ad valorem duties (duties that are a percentage of the transaction value) are levied. In the ad valorem case, the respondent would need to provide the statistical agency with the actual or an estimate of the duty paid each period so that the duty can be removed from the price reported.

I.3 Currency conversion

11.140 XMPIs measure price changes faced by the domestic buyers and sellers. Therefore any prices reported in foreign currencies must be converted to the national currency using an exchange rate. According to the *SNA 2008* (paragraph 3.136), the data should be converted using the exchange rate prevailing on the date of the transaction, and if that is not available then an average exchange rate for the shortest period possible may be used for the conversion. For example, the U.S. BLS price reference period is the first of the month, so it uses the average exchange rate for the previous month. Note that there are usually at least two different exchange rates for any given date, namely, the buy rate and the sell rate. To exclude the service charge represented by the difference between these rates, the midpoint between these two rates should be used. Likewise, if the rate includes a forward exchange cover, that should be removed. The exchange rates are usually not provided by the respondents, but rather are collected each period by the statistical agency from official exchange rate publications.

11.141 Some countries (currently Japan and formerly the United States) also publish XMPIs expressed in foreign currency. These indices are useful for analyzing the competitiveness of industries in a country over time because they measure price changes from the perspective of the foreign buyer (for exports) or seller (for imports). A methodology for producing indices in foreign currencies is found in Alterman, Johnson, and Goth (1987) and is summarized below.

11.142 To calculate a foreign currency price index, the statistical agency must first calculate a nominal average exchange rate index, as shown in equation (11.9) (these indices can also be published separately). Then the foreign currency price index can be calculated by multiplying the XMPI for a product category by the nominal average exchange rate index (equation (11.10)). A real average exchange rate index (equation (11.11)) may also be calculated by deflating the foreign currency price index data with CPI data from the foreign countries represented in the index.

$$\mathrm{AERI}^{n}_{y,t} = 100 \prod_{i=1}^{n}\left(ER^{t}_{i}\big/ER^{0}_{i}\right)^{W^{t}_{i}}, \qquad (11.9)$$

$$\mathrm{NFCPI}^{n}_{y,t} = \mathrm{XMPI} * \mathrm{AERI}^{n}_{y,t}, \qquad (11.10)$$

$$\mathrm{RFCPI}^{n}_{y,t} = \mathrm{NFCPI}^{n}_{y,t} \Big/ \prod_{i=1}^{n}(CPI^{t}_{i})^{W^{t}_{i}}, \qquad (11.11)$$

where:

AERI = nominal average exchange rate index;

NFCPI = nominal foreign currency price index;

RFCPI = real foreign currency price index;

ER^{t}_{i}/ER^{0}_{i} = foreign currency per domestic currency exchange rate relative for country i in period t relative to the base period 0;

XMPI = import or export price index;

CPI^{t}_{i} = consumer price index for country i in period t;

W^{t}_{i} = normalized unilateral (export or import) trade weight of country i in commodity category y;

y = commodity category for which the index is calculated;

t = index reference period;

i = a particular country; and

n = total number of countries.

11.143 These indices are useful for analyzing changes in price competitiveness because they show the price trends from the perspective of the foreign buyer (for exports) and seller (for imports).

I.4. Intra-company transfer prices

11.144 Much international trade involves transactions between related parties. For example, transactions may occur between parent companies and their wholly or partially owned subsidiaries, between a licensor and a licensee, or between two companies involved in a joint venture. Because these related parties are maximizing joint profits, the intra-company transfer price might be set in order to minimize the tax burden of profit generated in the different countries or to minimize the duty paid on the transaction. Therefore, prices for these intra-company transfers may not be based upon market values. For a more detailed presentation of the theoretical and practical implications of intra-company transfers, see

Chapter 19. A practical approach to incorporating these prices into XMPIs is summarized below.

11.145 For the purpose of calculating XMPIs it is desirable to obtain "arm's-length" prices wherever possible—that is, the prices that would be used if the parties were unrelated. The Organization for Economic Cooperation and Development (OECD) Transfer Pricing Guidelines (OECD, 2001) outlines procedures for firms to use for tax and customs declarations. In order to apply the arm's-length principle, the intra-company transaction must be compared to a transaction between unrelated parties.

11.146 Several factors affect the comparability between transactions types.[3] First, the characteristics of the commodities traded must be similar in terms of quality. In addition, the functions included in the transaction must be similar. Likewise, the contractual terms concerning the responsibilities and risks incurred by the parties in both transactions must be the same. Both transactions should have been made under similar economic circumstances to ensure that the price difference is not due to different market conditions. And, finally, a comparison of business strategies of the parties must be done because sometimes prices are set to achieve a certain market penetration or expansion.

11.147 All of the factors outlined above may result in differences between the intra-company transfer price and the price used by unrelated parties. These differences must be adjusted for when estimating the arm's-length transfer price. In practice, due to the inexact nature of estimating arm's length prices, the use of an arm's-length range is acceptable.[4]

11.148 The traditional methods of estimating an arm's-length price for tax and customs purposes include the comparable uncontrolled price (CUP) method, the resale price method, and the cost plus method. Under the CUP method, the intra-company transfer (controlled) price is compared to a similar transaction between unrelated parties (uncontrolled). The uncontrolled transaction may be between the same establishment and an unrelated one (internal comparison) or between two different establishments (external comparison). For example, establishment A's intra-company transfer price might be internally compared with a similar transaction between establishment A and unrelated establishment B. If such an internal comparison transaction cannot be found, establishment A's intra-company transfer price might be externally compared with a similar transaction between the unrelated establishments B and C in the same commodity category.

11.149 The resale price method involves collecting the price of the commodity once it is resold to an unrelated establishment and then subtracting the normally earned resale price margin to arrive at the arm's-length price. The resale price margin may be derived by comparing the transaction to similar ones between unrelated parties (either internal or external as described in the CUP method). While the resale price method uses downstream transactions to estimate an arm's-length price, the cost plus method looks upstream and begins with the expenses incurred by the seller and adding a profit markup to it.

11.150 Diewert, Alterman, and Eden (2005) applied the OECD Guidelines to the specific case of obtaining prices for XMPIs and recommends the following ranking of methods for determining an arm's-length transaction. The preferred method is to obtain an internally comparable price (as described above in the CUP method). The second choice is to use an externally referenced comparable price, that is, a secondary source for the data such as a published commodity exchange market price. The third choice would be to obtain an externally comparable price (as described above in the CUP method). The fourth choice involves using downstream or upstream prices. There is an important difference between the use of downstream or upstream prices for XMPIs and the resale price and cost plus methods for estimating an arm's-length price for tax and customs purposes. Because the purpose of the XMPI is to measure price *changes* as opposed to *levels*, the downstream or upstream price can be used in the index without adjusting for profit margins if the downstream or upstream price is expected to have the same trend as the transaction price. As a last resort, the actual customs declared transfer price could be used, only if it is market-based.

11.151 Most countries exclude all non-arm's-length prices from their XMPIs. However, if the XMPIs are to be used as deflators in the national accounts, an argument can be made that because non-arm's-length transfer prices are reflected in the trade volume data, any declared transfer price should be used in the XMPI. The U.S. BLS includes both arm's-length and non-market-based intra-company transfer prices in the calculation of XMPIs owing to the large amount of intra-company trade.

[3]OECD (2001), Chapter I, paragraphs 1.19–1.35.
[4]OECD (2001), Chapter I, paragraph 1.45.

I.5 Price basis

11.152 The valuation principles used, outlined in principle to meet different user needs in Chapter 4, are often dictated by the data source. This is especially so when data are from customs sources. Export and import prices are reported using varying bases depending on which party is responsible for and pays for freight charges, loading charges, insurance, and other costs associated with shipping the goods. Establishment surveys allow for more flexibility to derive the component elements of any valuation including transportation margins. Price bases may in practice be defined according to the trade in terms developed by the International Chamber of Commerce (ICC) (Incoterm)[5] or parties may develop their own descriptions of the responsibilities of seller and buyer in international trade in non-ICC terms.

11.153 A common valuation system is to value at the market value of the goods at the point of uniform valuation (the customs frontier of the economy from which they are exported), that is, the goods are valued free on board (f.o.b.) at that frontier. In Chapters 4 and 15, the valuation principles for alternative uses of XMPIs are outlined. In practice a common f.o.b. valuation may be used. The f.o.b. value includes that of the goods and of the related distributive services up to that point, including the cost of loading onto a carrier for onward transportation, where appropriate. The ICC defines the f.o.b. price basis to mean that the goods are considered delivered when they pass the ship's rail, and the seller must bear the cost and risk of clearing the goods for export and placing them on board the ship. The risk of loss of or damage to the goods is transferred to the buyer when the goods pass the ship's rail (off the dock and placed on the ship). In some contracts this term is written as f.o.b. vessel. Another valuation is FAS (free alongside ship). Whereas a price basis of FAS requires the buyer to pay the cost of loading the goods, a price basis of f.o.b. requires this of the seller. The seller must clear the goods for export in both f.o.b. and FAS terms.

11.154 In practice, many countries (such as Australia, the United Kingdom, and Japan) designate a preferred price basis of f.o.b. domestic port for exports. For imports, side price bases of f.o.b. foreign port (e.g., in Australia) or cost, insurance, and freight (c.i.f.) (e.g., in Japan) is designated as preferred. The ICC defines a price basis of c.i.f. to mean that the seller must pay the costs, insurance, and freight necessary to bring the goods to the named port of destination and that the goods are considered delivered when they pass the ship's rail. Either the buyer or the seller may be responsible for port charges in the import country. The buyer is responsible for customs duties, import country taxes, and delivery charges from the port of importation to the final destination.

11.155 Note that the price bases described above are used only with sea and inland waterway transport. International trade also may involve ground or air transportation and there are ICC Incoterms to cover these arrangements. For example, a price basis of free carrier may be used with any mode of transport but was specifically designed to meet the requirements of multimodal transport, such as container or roll-on, roll-off traffic by trailers and ferries. It is based on the same principle as f.o.b., except the seller fulfills its obligations when the goods are delivered to the custody of the carrier (or person named by the buyer, such as a freight forwarder) at the named place. The place of delivery specified determines which party is responsible for paying to load or unload the goods. The seller is responsible for loading if the named place is the seller's premises; if the named place is not the seller's premises, then the seller is not responsible for unloading.

11.156 When countries designate a preferred price basis, prices not reported according to these preferred bases are deleted from the index calculation unless it is possible to collect enough information to convert the reported price into the preferred price basis. For example, to convert an FAS price into an f.o.b. price, the statistical agency would need to collect the cost of clearing the goods for export and the cost of loading the goods onto the ship. For imports, if the price is reported as cost and freight instead of c.i.f., then the price of the insurance would need to be added to the transactions price before it could be used.

11.157 These types of price adjustments, however, may not be necessary. Given that the purpose of the XMPI is to measure price *changes* as opposed to *levels*, it is possible to mix price bases within an elementary index calculation (as the U.S. BLS does) as long as each individual price series maintains a constant price basis over time.

11.158 One exception to the acceptance of different price bases is that any price basis that includes duties must also be accompanied by enough information to remove the duties from the price. More information about the inclusion/exclusion of duties is found in Section B.

[5]For detailed information on buyer's and seller's responsibilities and costs for any of the Incoterms 2000, see the International Chamber of Commerce website at www.iccwbo.org.