Integration of CPI and PPP: Methodological Issues, Feasibility and Recommendations

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1.   Introduction

1.   Consumer price index (CPI) and purchasing power parity (PPP) conversion factors share conceptual similarities. The CPI measures changes in levels of prices of goods and services over time within a country whereas PPPs measure differences in levels of prices across countries or regions within a country. Therefore the CPI and PPPs refer, respectively, to the time and spatial dimension of price movements.

2.   The consumer price index is one of the most widely used economic indicators, compiled and disseminated by national statistical offices on a regular basis. The CPI measures play a prominent role in monitoring the effects of government policies, particularly monetary policy, and provides the general public with a measure of changes in the prices of goods and services consumed. Purchasing power parities are defined as "the number of currency units required to buy goods equivalent to what can be bought with one unit of the currency of the base country; or with one unit of the common currency of a group of

countries" (United Nations, 1992). Purchasing power parities are of relatively recent origin, for use in making comparisons of real income and national price levels at different levels of aggregation.

3.   Despite conceptual similarities and closely related data collection requirements, historically there has been very little harmonization of the activities of national statistical offices involved in both CPI and PPP work. A few general guidelines to national statisticians on how some CPI related price data could be used in ICP work are provided in the Handbook on ICP prepared by the United Nations (1992).

4.   The present paper discusses similarities and differences in the conceptual and methodological foundations of these two activities in an attempt to identify a basis for integrating the price and expenditure share data for the CPI and PPP computations. The main objective is to identify the steps involved in achieving a close integration of CPI and PPP activities. Given the timeframe and nature of the annex, no attempt is made to provide specific guidelines or operational procedures for such an integration.

5.   The outline of the paper is as follows. Section 2 provides a brief overview of the compilation of the CPI and PPPs based on various draft chapters of the CPI Manual under preparation and a number of publications on PPPs from various international organisations, including the United Nations, OECD and the Eurostat. Section 3 examines similarities and differences in the concepts and proposes a number of steps involved in their integration. A few conclusions are provided in Section 4.

2.   CPI and PPP : An Overview

6.   To assess the feasibility of integrating the activities of CPI and PPP computation, it is necessary to examine, briefly, the framework underlying these two concepts. There is an extensive literature on the consumer price index, as evidenced by the wealth of references on the subject contained in several chapters of this Manual. This reflects not only the great importance attached to the CPI in national economies, but also the long history behind the measurement of CPI. In contrast, literature on PPP measurement is relatively recent, and much of the work in this area is in the form of books, monographs and papers prepared for use within the international organizations actively involved in PPP work. An important source on the methods for data compilation and subsequent aggregation can be found in Kravis et al. (1982), the Handbook of the ICP (UN, 1992) and the more recent publication on PPPs from OECD (1987, 1996 and 1999).

2.1   The Consumer Price Index

7.   The consumer price index is a statistical measure of changes in prices of consumer goods and services over a given period of time. There has been considerable debate in the literature concerning the meaning and scope of a price index number and what exactly a CPI is supposed to measure. The current manual adequately deals with this aspect.

Time Span

8.   The time span covered by the CPI is usually a quarter or a year, but the time span could be quite brief, maybe a day, a week or a month, depending upon the type of index computed. There are several steps involved in the derivation of the indexes. Problems associated with seasonality of price changes and their treatment have been well researched (Quah and Vahey, 1995 and Gavasto et al , 1996).

Target Population

9.   The first step in constructing a CPI is to identify the target population and determine the purpose for which it is to be used. In many countries, indexes are constructed for several major cities and are designed to provide information specific to these cities. Such indexes are useful in wage determination and cost of living adjustments for public servants. Price indexes may also be constructed for different regions or states of a country, specially in larger countries consisting of several administrative regions. It is common, for example, to compute price indexes for rural and urban populations of a given country. In countries like India, such indexes are widely used in poverty and income distribution studies.

Item Specification and Expenditure Classification

10.   The next step is to determine the goods and services to be included in the study, defining the boundary of the CPI. Issues here concern whether the CPI should be based on household consumption expenditure or include consumption of public services like health and education. Several controversial issues arise in the treatment of expenditure on assets, including housing, and financial assets. Chapter 5 of the Manual deals with these issues.

11.   Items used in measuring price changes are usually classified by different expenditure groups, generally following Classification of Individual Consumption by Purpose (COICOP). The detail and the nature of the expenditure groups are determined by the classifications contained in the household expenditure surveys. These provide the required weights for the index number construction. Generally, product specifications are laid down centrally for product types but for many products, and field staff select a heterogeneous set of sampled products with differing descriptions. The product list is thus likely to vary across countries depending upon the details contained in country-specific household expenditure surveys.

Price Collection and Survey Methods

12.   Typically, collection of price data is based on sample surveys. Sampling is used in the selection of outlets as well as items for which price data are collected by trained field staff. It is necessary to determine which types of outlets, their number and their geographical location prior to the data collection. Price data collection also has a time dimension: what time of day and which day of the week or the month should be considered for collecting price data.

13.   The main concern of the survey methods is in the sample design and the construction of an estimator with as small a bias and variance (or mean squared error) as possible. The designs used are based on concepts *of simple random sampling*, *stratified sampling* and *probability proportional to size sampling* schemes. The chapter on sampling issues in the CPI manual by Dalen provides an excellent exposition and very useful insights into the issues involved in the selection of sample design and subsequent estimation.

Aggregation of Price Data

14.   The price data collected are aggregated to yield the final estimate of the CPI. All the item (commodity/service) prices are assigned to commodity or expenditure groups. These strata are usually identified at different levels of aggregation. Aggregation proceeds by levels or strata. The primary or elementary level occurs where the price change for items within the group is estimated without using any weights. This arises due mainly to the non-availability of any quantity weights. This situation may change with increased availability of scanner data. This has the potential to provide information on price as well as quantities associated with each transaction through shop or supermarket outlets. Some of the popularly

used elementary indexes are described below. These formulae are useful when a comparison of methodologies for CPI and PPP's is made.

Elementary Indexes

15.   The following formulae are commonly used in constructing unweighted price index numbers at the elementary level.

Arithmetic mean of price relatives:

$$I_{01} = \frac{1}{n} \sum_{i=1}^{n} \frac{p_{i1}}{p_{i0}}$$

where p_{it} (t = 0 or 1) refers to the price of the i-th commodity in period t and n refers to the number of commodities in the sample that belong to the particular elementary commodity group.

16.   Ratio of arithmetic mean prices:

$$I_{01} = \frac{(1/n)\sum_{i=1}^{n} p_{i1}}{(1/n)\sum_{i=1}^{n} p_{i0}}$$

17.   Geometric mean of price relatives:

$$I_{01} = \prod_{i=1}^{n} \left[\frac{p_{i1}}{p_{i0}} \right]^{\frac{1}{n}}$$

18.   Ratio of harmonic mean of prices:

$$I_{01} = \frac{(1/n)\sum_{i=1}^{n} (1/p_{i0})}{(1/n)\sum_{i=1}^{n} (1/p_{i1})}$$

19.   Dalen (1998) has a list of several more index number formulae that can be used in computing elementary price index numbers.

20.   In practice, one of the above formulae is selected for combining the observed price changes in the elementary group to form an index. The choice of the formula may result in a bias in the estimation of an average price change for the group. If the changes in the prices of all the commodities in the group move uniformly, then all these indexes provide the same answer. However, in practice, movements are not likely to be uniform. When the price changes are not uniform, theoretical and empirical research has shown that the use of the arithmetic mean of price relatives is likely to have an upward bias (Obst, 2000; Diewert, 1995 and Dalen, 1992). The geometric mean of price relatives corresponds to a Cobb-Douglas preference system, whereas the ratio of the arithmetic means of prices tends to give more importance to higher priced goods. The use of harmonic means was advocated in Szulc (1989), if the products in the elementary aggregates are reasonably homogeneous in terms of quality, but are subject to frequent discounts. Turvey (1996) also examines the elementary price indexes in some detail.

Index Numbers for macro level

21.   Once the price changes at the elementary level are compiled, the next step is to aggregate them to derive indexes at levels that correspond to major headings in the list of goods and services, or to derive a single measure of price change in the form of a CPI. Besides the selection of an appropriate formula for the purpose of aggregation, an important remaining choice concerns the use of fixed-base versus chain index numbers. While use of fixed base index numbers is still very common, there has been a shift towards the use of chain index numbers. Some of the technical advantages and problems associated with the use of chain index numbers are well described in Forsyth and Fowler (1981) and Szulc (1983). Use of chain index numbers is also dictated by practical considerations in dealing with new and disappearing goods and the treatment of quality change.

22.   Index number formulae beyond the elementary level are derived using systems of weights. Use of these weights is necessary from sampling and economic-theoretic perspectives. Most commonly used formulae are:

Laspeyres index:

$$I_{01} = \sum_{j=1}^{M} I_{01}(j) w_{j0}$$

where $I_{01}(j)$ refers to the price index computed for a commodity group, j-th, through the use of an elementary index number formula with period $_0$ as the base, and where w_{j0} refers to the weight associated with the commodity group j in the base period.

Paasche Index:

$$I_{01} = \frac{1}{\sum_{j=1}^{M} I_{10}(j) w_{j1}}$$

where I_{10} refers to the price index when period $_1$ is compared with period $_0$ as the base. Weights used are for the period $_1$. The Paasche index may be considered as a weighted harmonic mean of the elementary indexes using the current period weights.

Fisher Index:

$$I_{01} = \sqrt{\text{Laspeyres x Paasche}}$$

Tornqvist Index:

$$I_{01} = \prod_{j=1}^{M} \left[I_{01}(j) \right]^{\frac{w_{j0} + w_{j1}}{2}}$$

where w_{jt} (t = 0,1) are the observed expenditure shares associated with each commodity group j in periods 0 and 1.

23.   The choice of an index number formula has been a predominant research focus for a onsiderable time. From a purely statistical point of view, on the basis of the axiomatic approach to index numbers (see Balk, 1995 for an excellent review), and on the basis of an economic theoretic approach to price index numbers in the form of a cost of living index (COLI), both the Fisher and Tornqvist indexes are considered to be appropriate.

24.	However, in many national statistical offices, a Laspeyres index or a Laspeyres-type index is still the preferred method of computing the price index number. The choice is based on practical considerations, and on the fact that expenditure share weights from the household expenditure surveys are not available on an annual basis. A fixed set of weights are thus used. Sometimes these weights are modified using additional information, but only until a new set of weights become available.

## 2.2	*Purchasing Power Parities (PPPs)*

25.	The research literature on PPPs is relatively modest in comparison to that on the CPI. This section is devoted to a brief description of the salient features and the principal steps involved in the computation of PPPs. This description is necessary for the analysis of the steps involved in the harmonization and possible integration of the ICP activity in computing PPPs and the activities of national statistical offices involved in CPI compilation.

General Background

26.	Conceptually, the PPPs are very similar to consumer price indexes. The PPPs are measures of price level differences across space or, in their most popular form, across countries. Because the prices of goods and services in different countries are expressed in national currencies, the purchasing power parity between currencies of two countries, say A and B, is the number of units of currency of country B (or A) that has the same purchasing power as one unit of currency of country A (or B). Though the PPPs are similar to price index numbers in spatial comparisons, they assume special significance because the PPPs can be used as a conversion factor, in place of exchange rates, in converting various economic aggregates from different countries into a common currency unit. The converted aggregates are expressed in a common currency unit, and the aggregates are considered to be real value aggregates devoid of price variations among countries. These real aggregates make it feasible to undertake cross-country comparisons and to undertake economic and statistical analyses on global and regional levels.

27.	Basic work on the need for purchasing power parities as currency conversion factors began with the seminal work of Gilbert and Kravis for the OEEC in 1954 and the subsequent work of Gilbert and Associates (1958). These two studies demonstrate the fact that there can be a considerable gap between the official exchange rates and purchasing power parities, and therefore the need for research on the computation of PPPs for different currencies. This has led to the eventual establishment of the International Comparison Project (ICP) at the University of Pennsylvania by Kravis, Heston, Summers and Kenessey. The work by Kravis *et al.* (1975 and 1978) was instrumental in establishing the procedures and guidelines for undertaking international comparisons. The report of Kravis, Heston and Summers (1982) on Phase III of the ICP, may be considered as a definitive account of the standard procedures of the ICP. The ICP had been upgraded subsequently from the status of a project to a program due to the increased coverage of more than 65 countries in Phase IV. The publication of the *Handbook of the International Comparison Programme* (UN, 1992), is another major source for the procedures recommended for use in international comparisons. There are several OECD publications, all with the title "Purchasing Power Parities and Real Expenditures" (OECD 1987, 1996 and 1999), that deal with procedures underlying PPP computation. Similar publications are regularly published by Eurostat. The following description of some of the steps and procedures is drawn from various sources on the ICP.

Scope and Coverage of ICP

28.	Compared to the consumer price index described in Section 2.1, the PPPs under the ICP have a much wider coverage of goods and services. In fact, the PPPs are designed to convert nominal value aggregates in national accounts into real value aggregates that are comparable across countries, and

therefore cover all entities that make up the gross domestic product (GDP) of a country. There are three different accounts from which the GDP statistics can be derived: the expenditure, production and income accounts. The ICP focuses on the measurement of differences in price levels across different countries based on the data and entries for the expenditure side of the national accounts. The principal reasons for advocating this approach are the advantage of defining the unit price more meaningfully for the expenditure items, the similarity with the consumer price index number construction, and the availability of price and expenditure data from different countries. International comparisons based on the production side of national accounts have been conducted outside the auspices of the ICP by a group of researchers at the University of Groningen, the Netherlands. This group, under the leadership of Angus Maddison, has undertaken international comparisons of the manufacturing and agriculture sector comparisons under the auspices of the International Comparisons of Output and Productivity (ICOP) project. The ICOP, despite its role in sectoral productivity comparisons, has been limited due to a lack of appropriate data in many countries.

29.   The PPPs computed under the ICP relate to all the components of GDP on the expenditure side. The breakdown of GDP used in ICP work, consists of the following major components: Household Consumption, Government Consumption, Capital Formation, and Net Exports. These major components are further subdivided into several sub-groups, which are again subdivided until the "basic heading" level is reached. All the classifications used in ICP are consistent with the SNA, though some of the recommendations of the 1993 Revised SNA on capital formation still need to be incorporated into the ICP work. But the development of the ICP has always been coordinated and made consistent with the essential features of the SNA.

30.   The scope of ICP, and the resulting PPPs, is thus much wider than that of the CPI. PPPs for the major expenditure aggregate, household consumption or private consumption expenditure, are the closest in product coverage to the consumer price index. Thus PPPs for the household expenditure category may be considered as spatial measures of price differences similar to the CPI, which measures temporal changes in prices.

Item Specification and Expenditure Classification

31.   The ICP uses a pyramid structure similar to that used in the standard CPI compilation. Starting with a list of products, the prices of goods and services are aggregated into basic headings. These basic headings are identified on the basis of standard sample survey principles underlying the identification of strata in a stratified sampling framework. The basic headings consist of all the items which have a low dispersion of price ratios. They therefore provide reliable estimates of PPPs for the basic heading level.

32.   The basic heading level is the lowest level aggregate for which expenditure data are available. Since PPPs at the basic heading level are computed without weights for individual products, the basic heading level may be considered to be similar to the elementary level used in CPI construction. The basic heading level PPPs, measuring price level differences for all the products included in the listing, are then aggregated to provide PPPs for various sub-aggregates, which are further aggregated to result in PPPs at the GDP level. The mechanism of deriving PPPs can differ depending upon the aggregation procedure used.

Product Listing and Price Data

33.   Since the ICP involves comparisons across countries, the main principle used in developing a product listing requires identical products to be selected for all countries. The selection of the product list is probably the most difficult and most contentious issue in constructing PPPs. To keep the quality of the

products constant to the maximum extent possible, a very detailed set of product specifications is employed. The choice of identical products then guarantees that the PPPs do in fact measure price level differences rather than differences in product qualities. Heston (1996), along with UN (1992), provides an excellent discussion of the issues involved.

34.   The principle of identity is implemented through a number of operational requirements. A common practice, where feasible, is to specify products with definite characteristics and brand name, in order that these items can be priced to the full specifications. The second requirement is to ensure that the size (unit for pricing) of the goods or service to be the same across all countries where it is priced. The other recommended practices include the use of physical and functional properties, such as the voltage of motors; maintaining a similarity in the types of outlets where the products are purchased, and maintaining consistency in the terms and conditions associated with the purchase, especially for transport services and producer durables that can be purchased with differential warranties.

35.   The development of the product list is a difficult exercise, with the degree of difficulty depending on the size and the degree of homogeneity of the group of countries involved in the comparison. The product listing for a comparison across countries in the European Union could differ significantly when the OECD countries or countries within Asia or Africa are being compared. A corollary of this is that if a global comparison were to be undertaken, with all countries included, the product list would be quite difficult to specify.

Identical Products versus Representativeness

36.   Because ICP requirements dictate that identical products are used for price comparisons, and subsequent computation of the PPPs, it is quite possible that the products priced in different countries from the ICP product list may not be representative of the items that are consumed in these countries. In fact, representativeness is in direct conflict with the identical product list philosophy underlying the ICP. An extreme example of the adherence of this principle can be seen from the following quote from the UN Handbook (1992) on ICP, which states "Thus, items that are important in a given country that do not exist in any of the partner countries are not useful for ICP purposes".

37.   The problem of representativeness of items has been widely recognized by the ICP practitioners. A solution that is commonly recommended is to place an asterisk (*) against all the items priced that are considered to be representative in a given country. These asterisks are then taken into account in the computation of basic heading (or elementary level) purchasing power parities.

38.   Given the problems encountered in the specification of a product list for world comparisons, work on the ICP has been regionalised in order to achieve maximum comparability. Another possible solution discussed in Heston (1996) suggests that a direct comparison of every country with every other country need not be made, but, instead, a comparison through a system of links should be undertaken so that a more complete list of products could be used in deriving PPPs between countries. This is a suggestion that could be considered in future projects of the ICP.

Price Data and Quality Adjustments

39.   Due to the potential problems involved in data collection, and the flow-on effects on the quality of the results, the ICP is quite prescriptive of the data collected. Currently, the ICP requires all price data to be gathered on an annual basis, and averaged over the year. Actual implementation of this procedure may vary from country to country. The prices to be used are those actually paid by the households, which

already include all the taxes (sales, excise and value added), delivery costs and discounts and subsidies from the government in the form of reduced prices.

40.   Considerable resources are devoted to making quality adjustments where price comparisons involve goods and services that vary in quality across countries. Adjustments for quality are made using hedonic regressions or other indicators of quality. Quality indicators are used especially in the comparison of health and education services.

41.   The ICP manual (UN, 1992) as well as the Phase III report (Kravis et al, 1982) describe these procedures in detail. Despite the detailed specifications and descriptions, major problems remain in this area. The practical implementation of these procedures requires subjective expert decisions dictated primarily by the circumstances arising in different cases.

Expenditure Data

42.   Expenditure data provides information that is necessary for the formulation of the weights to be used in the aggregation of price data. Gross domestic product and its expenditure side components form the basis for ICP work. Thus all the expenditure data used for the purpose of weighting prices is based on the national accounts of the countries. The boundaries for various categories used in the ICP are consistent with the standard national accounting practices advocated in the SNA (both the 1968 and the revised 1993 SNA). The expenditure aggregates are sometimes derived through the use of output measures and commodity flows as well as more standard types of expenditure surveys. Most countries construct national accounts on an annual basis, thus providing information on expenditures in different categories.

Aggregation Procedures

43.   The procedures for aggregating price data differ significantly from the index numbers used in the computation of the CPI. Because a number of countries are involved in the PPP computations, the comparisons are multilateral in nature. This implies that all comparisons between all pairs of countries are considered important and are simultaneously used. The most important requirement imposed on the computation of PPPs is the property of transitivity. Transitivity is an internal consistency requirement which guarantees that the PPP for two currencies, say A and B, is the same whether it is derived through a direct comparison of A and B or through an indirect comparison which compares A with C and C with B, which are in turn combined to provide an indirect PPP for A and B. This requirement is mostly due to the spatial nature of the comparison where no natural ordering of the countries involved could be imposed without a value judgement.

44.   Several other requirements, such as base invariance and additivity, are also considered. Kravis et al. (1982) provide an excellent summary of these properties. Diewert (1986, 1995, 1996) and Balk (1996) describe a number of properties, stated in the form of axioms similar to those used in the context of the consumer price index numbers, that can be used in the assessment of various aggregation procedures.

45.   Similar to the computation of consumer price indexes, PPPs are computed in two stages. At the first stage, PPPs are derived at the basic heading level, measuring relative differences in prices that make up the particular basic heading. A distinguishing feature of this stage is that no quantity or expenditure data are available for the identical products. There are three methods that are commonly used for computing PPPs at the basic heading level.

The EKS Method

46.   This EKS method, due to Elteto and Koves (1964) and Szulc (1964), which is also more recently being attributed to an earlier of contribution of Gini (1931), provides a transitive comparison between countries A and B that is derived by computing the geometric average of all direct and indirect comparisons between A and B. If there are M countries in the comparison, then a comparison between j and k is derived as:

$$I_{jk}(EKS) = \prod_{s=1}^{M} \left[I_{js} \, I_{sk} \right]^{\frac{1}{M}} \text{ where } I_{js} = \prod_{i=1}^{n} \left[\frac{p_{is}}{p_{ij}} \right]^{\frac{1}{n}} \text{ and, } I_{sk} = \prod_{i=1}^{n} \left[\frac{p_{ik}}{p_{is}} \right]^{\frac{1}{n}}$$

and I_{jk} is the EKS index, which is the geometric average ratios of prices of commodities for which prices are collected in both countries j and k.

The Modified EKS Method

47.   The modified EKS method is the procedure that is currently in use at the OECD (1999). This procedure tries to account for the fact that not all commodities for which prices are collected are really characteristic or representative in one or both of the countries. The procedure takes explicit account of those commodities which are starred, (*), if the item is important in a given country. The modified EKS method uses the same formula as above, but the binary index on the right hand side is replaced by:

$$I_{js} = \left\{ \prod_{i \in M(s)} \left[\frac{p_{is}}{p_{ik}} \right]^{\frac{1}{n(s)}} \prod_{i \in M(j)} \left[\frac{p_{is}}{p_{ik}} \right]^{\frac{1}{n(j)}} \right\}^{\frac{1}{2}}$$

where n(s) and n(j) are the number of starred items in countries s and j; M(s) and M(j) are the sets of commodities that are starred in countries s and j.

The Country-Product-Dummy (CPD) Method

48.   The CPD method was originally proposed by Summers (1973) as a tool to deal with missing price observations. The method is a simple statistical devise that can be used in deriving the PPPs for a particular basic heading by simply regressing the logarithm of observed price against a set of dummy variables, defined with respect to the commodities and countries. Thus the procedure involves the model:

$$\ln p_{ij} = \eta_1 D_1 + \eta_2 D_2 + \ldots + \eta_n D_n + \pi_1 D_1^* + \pi_2 D_2^* + \ldots + \pi_M D_M + u_{ij}$$

where D_i (I= 1,2,…,n) and D_j^* (j=1,2,…M) are, respectively, dummy variables for the n commodities in the basic heading and M countries involved in the comparisons.

49.   Once this regression equation is estimated, the purchasing power parity for currency of country k with country j as base can be obtained by the exponential of the difference in the estimates of π_j and π_k obtained from the regression equation.

50.   The CPD method has not been the preferred method for aggregation below the basic heading level. The EKS procedure and its variants have been the preferred procedures. There has been some recent work by Rao (1996), Kokoski, Moulton and Zieschang (1996) where generalizations of the CPD method have shown the versatility of the method for application in a variety of situations.

Aggregation Methods above the Basic Heading Level

51.   A number of methods for aggregation above the basic heading level have been developed over the last three decades. In the interest of brevity, only two of the principal methods are discussed below. These are the Geary-Khamis and EKS Methods for international comparisons, the principal aggregation methods used in various international comparison exercises in the ICP, OECD, EUROSTAT and the FAO of the United Nations.

Geary-Khamis Method

52.   The Geary-Khamis method was originally proposed by Geary (1958) and subsequently developed by Khamis (1970,1972 and 1984). The Geary-Khamis (GK) method provides a way of calculating PPPs from observed price and quantity data (applied at the Basic Heading Level). Let p_{ij} and q_{ij} denote the price and quantities of i-th product in j-th country. Also let P_i denote the international average price of i-th commodity. The GK method is defined through the system of inter-related equations below.

$$P_i = \frac{\sum_{j=1}^{M} p_{ij} q_{ij} / PPP_j}{\sum_{j=1}^{M} q_{ij}} \quad \text{and} \quad PPP_j = \frac{\sum_{i=1}^{N} p_{ij} q_{ij}}{\sum_{i=1}^{N} P_i q_{ij}} \,, \text{ where } PPPj \text{ is PPP for a product aggregate}$$

including basic headings i=1…n for a country j.

53.   These equations are used for all the commodities and the currencies of the countries involved in the comparison. The PPPs resulting from the GK method are transitive and the method has the property of "additivity" which is useful when national accounts at constant prices (or in a common currency) are compiled. However, the method is usually criticised for the possible bias due to the Gerchenkron effect.

EKS Method

54.   The two variants of this method described above, in the context of aggregation below basic heading level, are modifications of the original proposal of Elteto, Koves (1964) and Szulc (1964). The method starts with a matrix of binary comparisons derived using the Fisher index number formula. A set of transitive multilateral index numbers are generated from the non-transitive binary indexes using the following formula.

$$I_{jk}(EKS) = \prod_{\ell=1}^{M} \left[F_{j\ell} \, F_{\ell k} \right]^{\frac{1}{M}}$$

where F_{jk} refer to the Fisher binary index number comparing the purchasing power of currencies of countries j and k.

55.   This method has long been advocated because it preserves "characteristicity" (see Drechsler, 1975) of the binary comparisons based on Fisher index. The Fisher index is a formula with very useful statistical and economic-theoretic properties.

56.   There are several other procedures in the literature, and also some variants of these two methods. For a discussion of some recent developments and on additivity, see Rao (1997), Cuthbert (1999), Hill (1999), Rao and Timmer (2000) and Sakuma, Rao and Kurabayashi (2000).

3. Integration of CPI and PPP Work at the National Level

57.   This section examines the feasibility of integrating the work on purchasing power parities (PPPs) with the ongoing work on consumer price indexes undertaken by national statistical offices. Such an integrated approach has the potential to benefit both activities and ensure the long term viability of the PPP work.

58.   The present work on the CPI Manual by the Inter-secretariat Working Group on Price Statistics comes at a critical time for the ICP. Following the reviews of Ryten (1998) and Castles (1997), the ICP work on PPPs is undergoing a review of the structures needed to improve and sustain the work of ICP. One of the criticisms made of the ICP work is that many ofthe national statistical offices are not convinced of the benefits of their involvement, and that results from various ICP benchmarks are not consistent with growth rates observed in the countries involved in the PPP comparisons. Castles (1997) also criticizes the ICP work for the counter-intuitive results produced, especially at the basic heading level. Both reports, Ryten (1998) in particular, recommend an examination of the feasibility of integrating PPP work with the CPI work at the national level. They suggest that integration of CPI and PPP work will bring about a more enthusiastic participation of the national statistical offices in the ICP. Such integration may also lead to improvement in ICP results and the elimination or at least, minimization of anomalous results.

3.1   CPI and PPP Construction - Similarities and Dissimilarities

Purpose

59.   Both CPI and PPPs are concerned with the measurement of price changes. CPI measures price changes over time, and PPPs measure changes or differences between countries. In many countries CPIs are compiled at the national level as well as for selected cities and regions. PPPs may also be used to measure subnational or interregional price differences. While both CPI and PPP have the common purpose of identifying price differences, they are applied to different domains. Most of their differences in practice arise from the requirements for measuring price changes over time and across space.

Scope and Coverage

60.   There is a difference in scope and coverage between CPI and PPP as outlined previously, the CPI is a measure of changes in prices of goods and services that belong to the consumption basket in a given country. In contrast, PPPs are aimed at measuring differences in levels of prices of goods and services that belong to the expenditure side of the national accounts in many countries. The main expenditure components of the national accounts are private consumption, government consumption, capital formation, and net exports. The ICP merges the portion of government expenditure that provide goods and services to households with private consumption to form household consumption. The scope and coverage of goods and services in the ICP is much wider than that of the CPI. However, the household consumption concept used is almost identical to that used in the CPI construction.

61.   *Any integration of CPI and PPP work will necessarily be confined to the household consumption aggregate of the national accounts. But it may be feasible to integrate the government sector and capital formation elements with the construction of producer price index (PPI) numbers.*

Price Data and Sampling Practices

62.   In most countries the CPI price data are collected using standard survey methods to record the prices of goods and services that enter the consumption basket. The consumption basket is based on surveys of consumer spending. A schedule of goods and services to be priced is determined, then prices for

these goods and services are obtained from selected retail outlets or other sources. Special sampling issues arise in the selection of outlets from which price data are collected.

63.   In the case of PPP, the commodity listing, with specific product quality specifications, is arrived at by the ICP experts. This commodity listing is prepared in consultation with experts from different countries participating in the international comparison exercise. Such a process of commodity selection for pricing can, at best, be described *as judgmental sample*.

64.   The choice of commodities reflects the principle of "identical products". This has been the guiding principle of ICP work since its inception. Identical products ensure that quality issues do not enter into the PPP measurement and the results provide a measure only of price differences.

65.   *This difference in approaches to price data collection used in CPI and PPP can potentially limit the extent to which these two activities can be integrated. It is argued, later in this section, that these differences can be resolved, to a large extent, through a slightly different approach to international comparisons based on identifying an optimal linking of countries rather than computing PPPs simultaneously, as is currently the practice.*

Expenditure Share Weights

66.   Expenditure share weights, for the aggregation of price differences above the elementary level or basic heading level, are a common requirement for both CPI and PPP. The CPI weights are usually based on data collected through household expenditure surveys. This is one of the reasons why many countries tend to use a fixed-based approach to CPI construction, in which weights are revised periodically. Weights used in the calculation of PPPs refer to the shares in the national accounts, which are prepared annually. The shares of household expenditure recorded in the national accounts are based on data from household expenditure surveys and on data calculated through the commodity flow approach.

67.   *Common ground exists here for the integration of work on the CPI and PPPs. Depending upon the availability and accuracy of the household expenditure share data, an integrated approach can result in more reliable estimates of both CPI and PPP. An assessment has to be made on a case-by-case basis.*

Adjustments for Quality Differences

68.   The need for quality adjustments in the CPI and PPP measurement is universally recognized. Procedures based on hedonic regressions have been used in making adjustments for quality differences within some PPP categories, especially those related to health and education, and more recently for quality adjustments in measuring price changes for information technology products within the CPI.

69.   The problem of quality differences in goods and services across countries has long been considered a major problem in inter-country comparisons of prices. The concept of "identical products" was devised to address this problem. Within the ICP, adjustments for quality differences were mainly used in handling "comparison resistant" services and housing and other items in the capital formation aggregate.

70.   To minimize the need for adjustments for quality differences, the ICP approach of using "identical products" has led to the use of price data on goods and services which are not representative or of no great relevance to certain countries. Questions are often asked about the meaning and usefulness of PPP between currencies of two different countries based on goods and services that are not considered important by either country.

71.   The same problem of quality difference exists in the case of CPI comparisons. Current measures of the CPI are known to be affected by biases resulting from the rapid change in quality and the emergency

of new goods, like electronic and information technology products and financial services, and the disappearance of old goods.

72.	There are clear similarities in the types of problems that arise due to quality differences and changes encountered in the course of CPI and PPP construction. There is definite scope for further research in this area which could prove beneficial to both activities.

Aggregation Methods

73.	There is also an identifiable similarity in the general approach to aggregation. A two-stage approach is used in both cases. In the first stage, elementary unweighted indexes, or basic heading PPPs, are derived. *It may not be evident from the formulae described, but index number formulae used in both CPI and PPP computation at this level of aggregation are essentially identical when the geometric mean of price ratios is used.* The differences in formulae essentially take into account the possible lack of price data for some specific items in one or more countries.

74.	However, there are differences in the methods used at the second stage, for aggregation at levels above the basic heading level. These differences are mainly due to the transitivity requirement for PPPs, which is not an issue for the CPI. Since spatial comparisons require transitivity, it appears that there is little here in the way of a common methodology for CPI and PPPs. However, more recent literature on generalized EKS methods (Rao and Timmer, 2000) and work on the use of spanning trees (Hill, 1999), suggests that binary index formulae like the Fisher index could be used at the intermediate stage to derive transitive comparisons.

75.	*As limitations of the ICP approach to PPPs are being discovered, there is some feeling that the simultaneous multilateral approach, used in all the rounds of the ICP, may have to be replaced by a more gradual linking of PPPs through a chaining procedure. Coincidentally, there has been gradual recognition that a chain index methodology is more appropriate for temporal comparisons, as recommended by the 1993 SNA. A number of statistical offices are moving towards chain indexes based on the Fisher formula, a strategy that justifies the use of linked binary comparisons.*
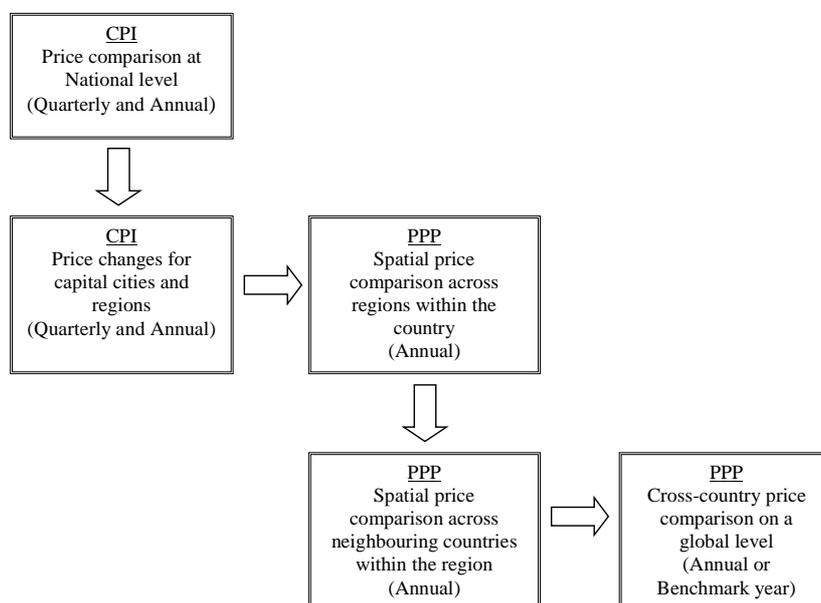
*3.2	General Approach to Integration of CPI and PPP activities*

76.	Given the common features of CPI and PPP identified in Section 2.1, is there a basis for integration work on CPIs and PPPs? To achieve such an integration, national statistical offices and organizations involved in the CPI construction must be convinced that PPP computation and any results from PPPs are a natural extension of current CPI activities. Another important step in the integration process require an increased amount of information collected and processed during the construction of CPI and which can be used in the calculation of PPPs. These two steps are examined further below.

How can ICP work be considered as an extension of CPI work?

77.	A satisfactory answer to this question has the potential to convince various national organizations to consider PPP work as an integral part of any price comparison work. Consider the following schematic diagram of a series of price comparison exercises undertaken by a national statistical office.

Figure 1: A sequence of Price Comparisons

CPI
Price comparison at
National level
(Quarterly and Annual)

CPI
Price changes for
capital cities and
regions
(Quarterly and Annual)

PPP
Spatial price
comparison across
regions within the
country
(Annual)

PPP
Spatial price
comparison across
neighbouring countries
within the region
(Annual)

PPP
Cross-country price
comparison on a
global level
(Annual or
Benchmark year)

78.　　　Figure 1 shows a natural progression of price comparisons that are currently undertaken in different countries. These are discussed in the same order.

CPI at the national level

79.　　　This is the most common feature of price comparisons in different countries. Consumer price index numbers are constructed, on a quarterly or annual basis, for the country as a whole and used for a variety of purposes.

CPI for capital cities or regions

80.　　　It is a common practice in many countries to compile CPI for major cities of the country as well as for specific regions for the country. In larger countries, this is a routine exercise that is designed to highlight the fact that price changes are not uniform across the country. City and region-specific consumer price indexes are used to adjust wages and salaries and government transfers.

Price Level differences across regions: Regional PPPs

81.　　　A natural extension of the CPI work within a country could provide direct measures of price level differences, not just differences in the movement of prices over time, in different regions. This is an exercise of particular relevance for countries that are large in size and are spread over a wide geographical area. It is essential in such cases that the national statistical offices provide measures of differences in price levels across regions. Currently not many national statistical offices compile regional CPIs. This is due to difficulties associated with obtaining reliable expenditure weights for different regions. Compilation of regional weights requires regional household expenditure surveys, but such surveys are not common practice.

82.　　　The next step in the extension of regional CPI work is to extend the scope to cover all the basic headings implicit in PPP computations. However such an extension is not straightforward. In addition to

weights based on expenditure surveys, compilation of PPPs at the regional level would require compilation of regional accounts similar to the national accounts. In view of the additional resources required in compiling such region-specific statistics, it is quite probable that national statistical offices would be reluctant to move in this direction. Nevertheless, the concepts of regional CPIs and PPPs, and their applications for policy purposes, are likely to be more readily appreciated by national statistical offices. Such increased understanding of the PPP concept may lead to more enthusiastic participation of countries in international comparisons of purchasing power parities of currencies.

83.   *No doubt the most important aspect of regional PPPs is that most countries, and their national statistical offices, are likely to appreciate the concept and applications of regional PPPs which may then lead to a stronger ICP.*

84.   The Eurostat, through a series of tender offerings, has initiated a systematic effort in compiling PPPs for regions within countries. It is likely that these efforts will help identify more clearly various analytical and practical issues confronted in making regional PPPs operational.

Spatial Price Comparisons with neighboring countries - PPPs for regional groups of countries

85.   A natural extension of the compilation of PPPs for regions within a country is the calculation of PPPs for countries in the neighborhood of a given country. Such comparisons are often useful in designing policies on trade and development. In many cases computing PPPs for currencies of neighboring countries would be quite similar to that involving inter-regional comparisons. In some cases it is possible that neighboring countries have more in common with a given region of a country than with other regions of their own country. For example northern Italy may have more in common with Austria than with the most southern regions of Italy. Similarly, it may be easier to make a comparison of West Bengal in India with Bangladesh (both share the same language, have common food habits, and share a long cultural heritage) than to compare West Bengal with other Indian states like Gujarat or Kerala.

86.   *In terms of motivation to undertake cross country comparisons and the minimization of problems associated with quality aspects and non-intersecting sets of products, PPP comparisons involving countries with neighboring countries would be a natural step towards increasing country participation in ICP work.*

Global comparisons and PPPs

87.   In most cases, national statistical offices may have only a limited interest in participating in an exercise of PPP compilation at a global level. The fact that such a comparison involves pricing of commodities that may not be of any significance or relevance in the context of the national economy, implies that there will be reluctance among countries to participate in such an exercise and to devote valuable financial and human resources for participation in such an ICP exercise.

88.   If, on the other hand, global comparisons can be constructed by piecing together all the comparisons obtained using clusters of neighboring countries, and it may be possible to make use of these results as inputs into a global comparison exercise.

89.   *There has been a move in this direction during the more recent phases of ICP. The methodology for global comparisons needs to be refined and implemented in order that useful results can be obtained for purposes of economic analyses and research at the global level.*

Optimizing the flow of data from CPI to PPP

90. It has been established that there is an overlap in the data requirements for the construction of PPP and the CPI. The degree of success in integrating PPP activities with those of ICP depends upon the extent to which these two activities can draw from a common pool of data and information available at the national level. The intersection of data sets is represented in Figure 2.

Figure 2: Price Data for CPI and PPP
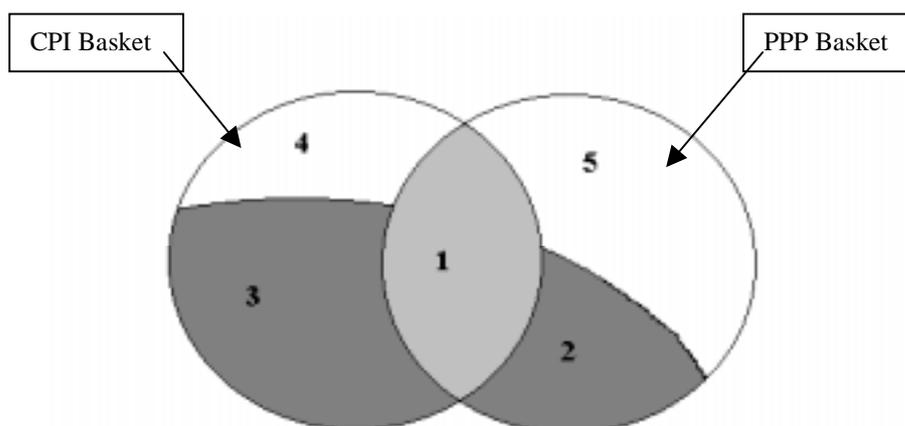
1: Common set of goods and services between CPI and PPP lists

2 and3: Subset of PPP goods and services in PPP and CPI for which prices can be derived from the CPI set using adjustment for quality difference

4: Set of goods and services in CPI baskets that cannot be used in the PPP component

5: PPP basket consisting of products under headings of expenditure in national accounts that have no direct relevance or correspondence with CPI

91. This diagrammatic representation reveals the general structure of data requirements for CPI and PPP. The CPI basket consists of all goods and services in a consumer basket. The PPP basket is made up of all the goods and services, specified in the ICP exercise through the identical product approach, to be used in PPP construction. Generally there is an overlap of these two baskets, denoted by the shaded area 1.

92. If techniques for quality adjustment are employed, it may be feasible to establish correspondence between the items specified in the PPP list that do not correspond exactly in quality with those items in the CPI basket. In that case, the shaded area 2 in the CPI basket can be used. Area 5 in the PPP basket refers to those products that are included in PPP computation from its coverage of the whole GDP. Such items are not a part of the CPI computation.

93. The area marked 4 is of importance. This consists of all goods and services that are peculiar to the country, but cannot be used in a PPP exercise involving many countries. The best chance of integration lies in reducing this area, thus making use of all the information contained in the CPI. To minimize area 4, it is necessary to compare the country in question with another country which is very similar. This ensures that the consumption baskets used in these two countries are nearly identical. The identification of countries that are "similar" is a crucial step in achieving a maximum integration of CPI and PPP work. A similar conclusion was drawn by Ahmad (1996).

94.   Recently there have been attempts made to make this concept operational. Hill (1999) has developed a distance measure based on the Laspeyres-Paasche spread and applied this spread to identify a minimum spanning tree that defines a linking procedure based on countries which are deemed to be similar. Szulc (1996) describes a linking procedure which identifies similarity using the expenditure patterns in different countries. Heston (1996) describes a linking procedure to be used at the basic heading level. Rao (1997) suggestes the use of the structure of spatial autocorrelation in the price structures to improve the reliability of estimates of PPP. Further research effort in this direction may yield significant improvements.

3.1   *Steps Towards an Integration of CPI and PPP Activities*

95.   Based on the discussion thus far, it is possible to identify a series of steps that can facilitate the integration of future CPI and PPP work. A number of activities to help the process of CPI and PPP integration and to improve the quality of PPP estimates from the International Comparison Programme are discussed below. Both Castles (1997) and Ryten (1998) identify a number of important issues to be resolved within the ICP in order to make it more attractive for national statistical offices to participate in international comparisons. Three major initiatives are discussed.

3.3.1   *PPs for Spatial-Temporal Comparisons*

96.   One of the major criticisms levelled against the present ICP is that PPP results, and the implied real values from different benchmarks, give results that show markedly different trends from those implicit in the national accounts of participating countries. These differences are more obvious in the case of specific expenditure categories. Castles (1997), in his report on the OECD-Eurostat program on PPPs, provides a number of examples of major changes in rankings of countries, based on real expenditure on telephone services, men's footwear, and the machinery and equipment categories. Such differences tend to cast doubts on the PPPs obtained from the International Comparison Programme.

97.   *To improve the consistency between trends observed within countries, and hence results from the ICP work, it is necessary to develop a framework which results in consistent space-time comparisons. A closer integration between CPI and PPP will help, along with further research on methods for minimizing possible inconsistencies in spatial and temporal comparisons.*

98.   PPPs are, in concept, designed for spatial price comparisons at a single point of time, but not for comparisons over time. It is well known that a country's PPP for year t+1 is not the same as the PPP for year t extrapolated on the basis of the movement in the relevant CPI in the country relative to the CPI in the reference country. There are both pratical and theoretical reasons why this is the case. In practice, as the product specifications, the expenditure classification, and the data collection and the pricing procedures evolve over time, the comparability of results from one comparison to another is affected. Also, the weights and item prices entering into the country's intertemporal price indexes are by no means identical with those used in the PPP calculations. In addition, price methodologies can vary across countries.

99.   This problem is much more important when there is a wide gap between successive benchmark comparisons. At the present time, there is no proper aggregation procedures that can generate consistent comparisons over space and time. Comparisons for one benchmark year will be altered, sometimes significantly, when data for a new benchmak is introduced with consistency/transitivity imposed on the combined data set.

100.   Even when basic data for the benchmarks and time series are consistent, two index number problems plague the extrapolation procedure. The first is that the prices for the base year are preserved as the weighting system for the time series (price conservation). The second relates to the fact that the time

series are based on national weights of each individual country, whereas PPP benchmark estimates are based on a common weighting system for both countries (weight inconsistency). There is a clear trade-off between comparability over time and across countries in one year. An optimal mix should be found. Various smoothing methods can be used to straighten out differences between intertemporal movements in PPPs and relative national CPIs. One fruitful area of research is to use a statistical technique which distributes errors in measurement of the 'true' value over the benchmark and time series. This would involve the development of measures of the reliability of benchmarks over time. This measure could be based on the variability of detailed level PPPs over time and within categories.

101.   A pragmatic approach may offer a viable solution. Such an approach is, however, necessarily rooted in successful integration of PPP and CPI activities. Once PPP construction is based on a maximum overlap of commodity listings for CPI and PPP, as shown in Figure 2, consistent time-space comparisons could be based on a gradual approach to moving from one benchmark year to another. The basic steps in this approach are outlined below.

Step 1:   Start with a set of PPPs for a benchmark year.

Step 2:   Update PPPs from the benchmark year on an annual basis. In updating PPPs for a given year, use the PPPs from the previous year along with domestic CPI and GDP deflator information. This information may be supplemented with price data collected from special surveys conducted on ICP product lists.

Step 3:   Compile annual (extrapolated) PPPs through the new benchmark year. In the benchmark year a full set of PPPs are computed using the standard ICP procedures. At this step two sets of PPPs are available, one from the new benchmark comparison and another derived using the updating procedure. A single set of PPPs are obtained through a weighted averaging of the two sets, with weights reflecting the relative reliability of these measures.

102.   The gradual approach to time-space compilation of PPPs and real national income aggregates relies heavily on the information generated by national statistical offices. The approach suggested here can lead to minimum discrepancies between PPPs from different benchmarks and national trends in different national income aggregates and components. As a result, the new procedure will have a smaller probability of producing significantly different rankings for countries between time periods.

3.3.2   Regional PPPs

103.   The intrinsic worth of the concept of PPPs for spatial price comparisons within a given country needs to be emphasized and popularized. From the current experience, this may require allocation of substantial resources necessary to meet additional data requirements.

104.   Once the countries are used to the process of constructing PPPs for different geographic regions and make use of them in regular economic analyses, there will be greater willingness to participate in a wider, international comparison exercise. The ICP exercise will then be seen as a natural progression (see Figure 1) in price comparison activities. However, it may take several years before construction of regional PPPs becomes a part of the regular activity of national statistical offices.

105.   The development of regional PPPs is still in a stage of infancy. Much of the work on PPPs so far has focused on international comparisons of purchasing powers of currencies at the level of total GDP and its major components. As a result, considerable effort has been devoted to the steps involved in the construction of these PPPs: price data, weights, and index number methods for aggregation. Results from the current PPP calculations are generally used by international organizations and economists interested in global price and income structures and issues of convergence between countries. Such international

comparison exercises always remain very remote and of limited used to national statistical organizations and researchers within countries, much to the detriment of the development of PPP work.

106.   Compilation of regional PPPs will provide valuable information for policy makers and economists interested in dynamic adjustments taking place within countries. Such PPPs will also be crucial in measuring regional inequalities and poverty and in analyzing structural differences across regions and possible convergence of different regions within a country. Despite the very useful applications of regional PPPs, not much work has been undertaken on this topic.

107.   There will be fewer problems in the process of constructing regional PPPs than for cross-country PPP comparisons. Problems of item specification and data collection are likely to be less serious since different regions within a country are likely to be more homogeneous than in the case of cross-country comparisons. Once the product listing is finalized, it would be possible to utilize the existing infrastructure to compile price data. A much more representative listing of items can be compiled for regional comparisons.

108.   Two major problems are likely to be encountered in the construction of regional PPPs. The first problem relates to the existence of regional-level "national accounts" that will make it feasible to compute regional GDP and identify various sub-aggregates at the regional level. A few accounting problems may arise in the construction of such regional accounts. The second problem is data related and concerns the existence of weights that are needed in aggregating item-level price data in successive stages of aggregation. In many countries such weights are available at the national level, normally derived from exercises such as the household expenditure survey. It is necessary to examine the feasibility of identifying weights for each region from the existing surveys.

109.   Construction of regional PPPs is likely to enhance the statistical capacity of participating countries. Application of the national accounts concepts at the national and regional level will require an organizational infrastructure for data gathering and analysis. Providing a framework to collect price statistics from different regions is likely to improve the quality of CPI estimates produced at the national level. Efforts channeled into regional comparisons are likely to have benefits to the ICP and the quality of PPPs derived within the framework of international comparisons.

3.3.3   Quality adjustment procedures in national and international comparisons

110.   A proper treatment of quality differences in the construction of the consumer price index and of purchasing power parities has long been recognized as a crucial, but difficult, element in deriving reliable measures of price changes. The effect of quality differences is likely to be more pronounced and it is more difficult to devise procedures to account for these differences. A discussion of the nature and direction of biases induced through inadequate adjustments for quality can be found in Obst (2000).

111.   Over the last decade, quality change has also been recognized as a serious problem in the measurement of CPI. The need to make quality adjustments in measuring price changes for information technology equipment, software, and services has attracted considerable attention. Triplett (2000a) provides an excellent summary of procedures for quality adjustment for information and communication products.

112.   The need for quality adjustments is well recognized in ICP work. The principle of identical products is a strategy for keeping quality-related effects to a minimum. Kravis et al (1982) discuss, in detail, methods used in deriving price comparisons for automobiles, rents and various adjustments needed for making comparisons in the case of comparison resistant services.

113.   For international comparisons, devising a satisfactory method for adjusting for quality changes has an important implication for the principle of identical products. Since the ICP product listing may not always be representative of goods and services for a given country, it would be useful if prices of representative items in two countries could be directly compared using a suitable procedure which corrects for quality differences in these items.

114.   There are two major strategies that could be adopted in handling the problem of quality within the ICP framework. The first compares countries that are similar and, therefore, have a fairly similar list of goods and services. This requires a suitable linking of comparisons, country by country, that will result in a set of global comparisons. The second strategy is to devise an adjustment procedure that allows comparisons to be made between products that differ in quality or in other significant characteristics.

115.   Since the seminal contribution of Griliches (1971), the hedonic method has been the main procedure for accomodating quality adjustments in price level measurement. In more recent work, Triplett (2000b) proposed the international hedonic function hypothesis which postulates that the price level differences across countries could be measured using the estimates of the constant terms in hedonic regression models, provided that the coefficients of the product characteristics in the hedonic function are identical across different countries. The hedonic method has proven useful in the measurement of consumer durables, housing and items in capital formation. Its application in the context of CPIs is generally limited to the measurement of temporal price changes for electronic items, including computers and peripherals, and other products subject to rapid technological change.

116.   The use of the hedonic method for spatial comparisons is also quite common. Kravis *et al.* (1982) used this method for comparisons of prices of automobiles and house rents. An extensive literature exists on measuring housing prices using hedonic price indexes, and part of this literature has been concerned with measuring regional differences in housing prices. One of the earliest studies is due to Gillingham (1975). Moulton (1995) extends Gillingham's methodology and applies it to CPI data to produce inter-regional housing price indexes for renters and for home owners. Kokoski, Moulton and Zieschang (1999) outline an index number methodology that combines elements of the hedonic approach with the country-product-dummy regression method to derive inter-area price comparisons for heterogeneous goods and several levels of commodity groupings. In fact the approach suggested by them combined with the generalized Country-Product-Dummy (CPD) discussed in Rao (1996) could provide the basis for a generic procedure for computing quality adjusted PPPs at basic heading levels.

117.   An important prerequisite for the use of the hedonic method is that data are readily available on the relevant characteristics of various goods and services that enter the CPI and PPP calculations. It is necessary to establish an extensive database consisting of lists of characteristics for various products available in different countries. Such a database could improve the quality of the CPI estimates produced within a given country and that of the PPPs calculated for purposes of international comparisons. Hedonic methods are quite useful in making price comparisons for investment goods in the capital formation component of the national accounts. There may also be some scope for integrating PPPs for basic headings within capital formation and the producer price indexes compiled by national statistical offices.

3.3   *Recommendations for CPI and PPP Integration*

118.   Based on the discussion thus far, it is possible to recommend a number of procedures that will facilitate the integration of CPI and PPP activities. This integration may result in a more positive and enthusiastic participation of the national organizations in the International Comparison Program and at the same time improve the quality of the estimates of the consumer price index produced for domestic use.

1. *Harmonized indexes of consumer prices (HICP):* The first step is to take a stock of the CPI practices in different countries. This may be the logical step after the preparation of the CPI manual, which could be recommended by the Inter-secretariat Working Group on Prices Statistics (IWGPS). It would be somewhat futile to attempt PPP computations if CPI activities are not undertaken on a satisfactory basis. As a part of this process, it may be feasible to examine the procedures used in data collection, including the use of survey and screening methods. Availability of household expenditure survey data is a precondition for the compilation of consumer price indexes. Once the CPI manual is completed, a concerted effort to implement the manual's recommendations could pave the way for integration of CPI and PPP work.

2. *Quality adjustment procedures*: Successful integration of CPI and PPP work depends primarily on the feasibility of abandoning the principle of "identical products" used to deal with quality issues in the ICP. Since CPI work also deals with quality adjustment and non-identical product listings (due to new and disappearing goods), development of procedures to account for quality differences would contribute to both activities.

3. *Chained comparisons and linking procedures*: Further research effort needs to be channeled into identifying the best links (which provide maximum overlap with the CPI information base) to derive chained international comparisons. Though several attempts have been made so far, none of the procedures were developed with the principal aim of integrating CPI and PPP activities. Linking at the basic heading level is probably the most appropriate approach, so that it would be feasible to use the standard ICP procedures that allow for comparisons, not only of GDP, but also the components of GDP across countries.

4. *Bottom-up approach to ICP*: Until now, the approach to ICP has been top-down. Most of the decisions regarding product selection, aggregation procedures and preparation and dissemination of results have been taken centrally, although modifications were sometimes made to meet the needs and concerns of participating countries. There is a better chance of securing country participation if the need for international comparisons was driven from the country level. In this regard the next strategy is crucial.

5. *Regional PPPs*: Regional comparisons are very important in ensuring a balanced development across all the regions. As illustrated in Section 2.2, strategies that encourage countries to compile regional PPPs will lead to a more enthusiastic participation in international comparisons.

6. *A Pilot Study*: A small scale ICP exercise, involving several countries in a region would help to demonstrate the feasibility of integrating CPI and PPI activities. The experience gained would be useful in developing a general approach to integration.

4.   Conclusions

119.   The main objective of the paper is to examine the feasibility of future integration of the CPI and PPP activities of national statistical offices. Given the current practices associated with the compilation of the CPI and PPPs, the paper identifies a number of steps that are necessary to achieve a progressive integration of these activities.

120.   The following conclusions emerge from the paper. (i) First and foremost, the process of integration requires the implementation of a number of programs, with each program requiring the devotion of considerable time and financial resources. The whole process must be based on a sequential step-by-step approach, with integration being achieved incrementally at each step. (ii) A certain degree of asymmetry in perceived benefits emanates from the integration of the CPI and PPPs. However, most of the benefits flow to the ICP and the compilation of PPPs. Since the CPI activities are far more established within the activities of national statistical offices, it is unlikely that integrating the activities of CPI and PPP will have a major influence on the methods and practices involved in the compilation of the CPI.

Integration of these activities could well result in tangible benefits accruing to many developing countries with less well-developed statistical systems. Any efforts to integrate the CPI and PPPs in these countries is likely to add an international dimension to the activities of price collection, the conduct of sample surveys and the use of index number methodologies. This additional dimension has the potential to improve administrative and organisational practices within the organisations and the quality of national statistics. Harmonising CPI activities across countries is a crucial step in attempting to bring PPP compilation within the framework of CPI activity in different countries. (iii) It is necessary to adopt a new approach where international comparisons are constructed using linked comparisons involving countries within a region. These links are likely to maximise the use of CPI price data in international comparisons. The process of linking requires the identification of ideal paths for linking based on established criteria. (iv) Adjustment for quality differences and changes, and development of standardised commodity classifications are crucial for the measurement of temporal and spatial differences in prices. Developing commodity classifications and providing guidelines to national statistical offices to monitor quality characteristics of goods and services for which price data are collected must be a priority activity for the international organisations that are involved in the use of price statistics. (v) The various measures identified in the paper that are designed to facilitate integration of CPI and PPP activities by the national statistical offices are both difficult and resource intensive. Hence the implementation process needs to be gradual, and pilot studies undertaken to identify the process and resources requirements necessary to achieve a desirable level of integration of CPI and PPP activities.

121. Finally, on a positive note, it should be mentioned that some of the steps discussed in the paper are already under consideration by Eurostat. Through a series of tenders for several research projects, Eurostat has devoted considerable resources to examination of the feasibility of compiling regional PPPs, the harmonization of the CPI activities and the institution of procedures for quality adjustments in international comparisons. Progress achieved by Eurostat over the next three years may be considered as a pilot program involving the EU member countries as a means of examining the feasibility of the recommendations made in this paper.

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