Luigi Biggeri · Guido Ferrari
Editors

Price Indexes in Time and Space

Methods and Practice

Physica-Verlag
A Springer Company

Editors
Professor Luigi Biggeri
University of Florence
Viale Morgagni 59
50134 Firenze
Italy
biggeri@ds.unifi.it

Professor Guido Ferrari
University of Florence
Viale Morgagni 59
50134 Firenze
Italy
ferrari@ds.unifi.it
and
Renmin University of China
59 Zhongguancun Street
Beijing 100872
China

ISBN 978-3-7908-2139-0 e-ISBN 978-3-7908-2140-6
DOI 10.1007/978-3-7908-2140-6
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2009940050

Cover design: Integra Software Services Pvt. Ltd., Pondicherry

Printed on acid-free paper

Physica-Verlag is a brand of Springer
Springer is part of Springer Science+Business Media (www.springer.com)

Foreword

In his "Prime ricerche sulla rivoluzione dei prezzi in Firenze"* (1939), Giuseppe Parenti, by Fernand Braudel regarded as an author who "se classait, d'entrée de jeu et sans discussion possible, à la hauteur même d'Earl Jefferson Hamilton. . .." begins his opening lines with a description/definition of the price revolution which took place in the XVI in Europe as "that extraordinary enhancement of all things that occurred in European countries around the second half of the XVI; revolution in the true meaning of the word, as not only, like any strong price increase, it modified the wealth distribution process and changed the relative position of the various social categories and of the different functions of the economic activity, but affected too, in a way that was not enough studied yet, the relative evolution of the various national economies, and finally, ..., certainly contributed to the birth, or at least to the dissemination, of the new naturalistic economic ideas, from which the economic science would have sprung". Definition that can be taken as the founding metaphor of this volume.

The ideal stimulus represented by Parenti's work may have opened the way to the now long standing tradition which links the research activity of the Department of Statistics of the University of Florence to price index numbers problems, concretized in the many works produced by its researchers and in the organization of the International Seminar on "Improving the Quality of Price Indices" held in Florence in 1995 under the joint auspices of the Department of Statistics itself and of Eurostat. This seminar can be viewed as a milestone for the research project on "Price Indexes in Time and Space" granted by the Italian Ministry of University (MIUR), which disembogued into the International Workshop on price indexes held in September 2008 at the Department of Statistics, and of which this volume constitutes the printed voice.

The work carried out by scholars, researchers, national and international organisms and institutions committed to the analysis of price index numbers theory and practice and price indexes production is too vast to be accounted for and discussed in this book. And, after all, such an exercise would go beyond its objectives.

---

*In "Studi di storia dei prezzi", cared of the Dipartimento di Statistica dell'Universitá di Firenze and of the "Fondation de la maison des sciences de l'homme, Paris", Ann Arbor, 1981.

We will therefore restrain ourselves to stress some points.

To begin with, a general remark is in order: both the interest of researchers and scholars and the attention and work of the statistical offices and organizations in the twentieth century was basically focussed on time indexes, more specifically on time price indexes and even more specifically, on Consumer Price Indexes (CPIs), particularly in the early stages of the journey.

Even Irving Fisher, in his classic volume "The Making of Index Numbers" (1922) discussed index numbers as synonymous of time (price) indexes, with no mention to possible space extension of the concept.

Furthermore, and to quote another prominent scholar and Nobel Prize winner, Ragnar Frisch in his fundamental article "Annual Survey of General Economic Theory: The Problem of Index Numbers" (Econometrica, 1936) claims "...will be confined to those (index numbers) whose object is to measure some sort of purchasing power". Here the expression "purchasing power" refers to time only.

Parallel to this main trend of thought, although shifted in time, and under the boost of very concrete motivations dictated by the needs for making international comparisons of income and Gross Domestic Product (GDP), Irving B. Kravis, Alan Heston and Robert Summers enlivened the United Nations International Comparison Project (ICP) in 1968 by publishing the first volume of the series on "International Comparisons of Real Product and Purchasing Power", reporting the research work the objective of which was to develop a comprehensive and reliable system of estimates of real GDP and the purchasing power of currencies based upon detailed price comparisons among countries.

This was probably the first time that the space purchasing power terminology and meaning, and therefore, the space CPI concept and the related purchasing power parity (PPP) definition appeared.

Official international statistical agencies, such as the United Nations Statistical Division (UNSD), the OECD, and Eurostat started working on the subject, in the framework of the ICP while continuing to be interested in, and producing time price indexes.

The National Statistical Offices (NSOs) did not follow that trend and continued to elaborate essentially time price indexes, namely time CPIs.

As a consequence, the two aspects of the same question continued to be treated and approached in parallel and their duality was somewhat, if not totally, ignored.

This volume intends to somehow bridge this gap, as is obvious from its title "Price Indexes in Time and Space".

If the measurement of time inflation and, subsequently as above said, of space price comparison has been a first and fundamental concern, other problems appeared downstage as well, claiming for their own adequate place.

Such is, firstly, the question of the space comparability of time CPIs, which has opened the way to the studies on harmonized price CPIs and their elaboration.

Secondly, great importance has increasingly been taken by price indexes other than the CPIs: wholesale, production, international trade price indexes and so on.

Again, noteworthy significance has been gained by price indexes utilized as National Accounts (NA) deflators, as well as those in the financial field.

This volume, and the underlying research project, reflect the above points. Indeed, the logic that has driven us has been that of stressing the close duality of time and space frames, the most advanced methodologies of statistical approach, also with extensive reference to the axiomatic approach and with emphasis on CPIs, both in time, basically as inflation measures and as time deflators of NA aggregates, and in space, again as (spatial) inflation measures or PPPs and as space GDP deflators, keeping in mind the problems of basket choice, weighting and integration-harmonization. All this, with a perspective as general as possible, which accounts for the highly relevant questions of the elaboration, use and validity of the sub-indexes, for the implications in the financial field and, last but not least, for the practical problems of construction and dissemination of the indexes. That is to say:

- the CPIs theory, the time-space background and the analysis of the time-space integration-harmonization;
- the space CPIs, the PPPs and the international comparisons of GDP;
- the time CPIs used as sub-indexes;
- the time indexes used as NA deflators;
- the price indexes in the financial field.

All the above confirms, we believe, that the subject of price index numbers retains its fascination and utility, despite the elapsing of time. If anything, it seems to strengthen all its virtues, due to the needs that the new theoretical and practical economic challenges entail.

As a matter of fact, a price index is a tool as simple as it is powerful and useful which does not cease to unfold its attractiveness and the many uses one can make of it.

It is the will to stress and emphasize once more the meaning and the effectiveness of price index numbers and to recover their whole potential in a comprehensive framework that has supported our endeavour and the related work.

The papers in this book deal with all the above topics in an effort to discuss them and afford some contribution to the theoretical debate as well as to the methodology and practice of elaboration.

An old Chinese saying warns: "you can dig a seventy-two-feet-deep well with hard work, but if you do not find water it is as if you had not worked at all".

We hope we found some water.

Firenze, December 2009

Luigi Biggeri
Guido Ferrari

Contributors

Bert M. Balk Rotterdam School of Management, Erasmus University, Rotterdam, and Statistics, Netherlands, bbalk@rsm.nl

Luigi Biggeri Istat, Rome, Italy; University of Firenze, Firenze, Italy, biggeri@ds.unifi.it

Carsten Boldsen Hansen United Nations Economic Commission for Europe, Geneva, Switzerland, carsten.hansen@unece.org

Isabella Carbonaro DET, University of Rome Tor Vergata, Italy, isabella.carbonaro@uniroma2.it

Margherita Carlucci Department of Economics, Sapienza University of Rome, Italy, margherita.carlucci@uniroma1.it

Giuseppe Cavaliere Dipartimento di Scienze Statistiche, Universita' di Bologna, Italy, giuseppe.cavaliere@unibo.it

Michele Costa Dipartimento di Scienze Statistiche, Universita' di Bologna, Italy, michele.costa@unibo.it

Luca De Angelis Dipartimento di Scienze Statistiche, Universita' di Bologna, Italy, l.deangelis@unibo.it

Rita De Carli ISTAT, Rome, Italy, decarli@istat.it

Marco Fattore Dipartimento di Metodi Quantitativi per le Scienze Economiche ed Aziendali, Università degli Studi di Milano - Bicocca, Via Bicocca degli Arcimboldi 1, 20126 – Milano, Italy, marco.fattore@unimib.it

Guido Ferrari Dipartimento di Statistica, Università di Firenze, Firenze, Italy, ferrari@ds.unifi.it, and Renmin University of China, PRC

K. Renuka Ganegodage School of Economics, The University of Queensland, St Lucia 4072, Australia, r.ganegodage@uq.edu.au

Giorgio Garau DEIR, University of Sassari, Sassari, Italy, giorgio@uniss.it

Javier Huerga European Central Bank, Frankfurt am Main, Germany, javier.huerga@ecb.int

José Mondéjar Jiménez Facultad de Ciencias Sociales de Cuenca, UCLM, Spain, Jose.Mondejar@uclm.es

Tiziana Laureti Department of Statistics and Mathematics for Economic Research, University of Naples "Parthenope", Naples, Italy, tiziana.laureti@uniparthenope.it

Patrizio Lecca Department of Economics, University of Strathclyde, Glasgow, UK, patrizio.lecca@gmail.com

Matteo M. Pelagatti Dipartimento di Statistica, Università degli Studi di Milano-Bicocca, Via Bicocca degli Arcimboldi, 8, I-20126, Milano, matteo.pelagatti@unimib.it

Alicia N. Rambaldi School of Economics, The University of Queensland, St Lucia 4072, Australia, a.rambaldi@uq.edu.au

D.S. Prasada Rao School of Economics, The University of Queensland, St Lucia 4072, Australia, d.rao@uq.edu.au

Raffaele Santioni Bank of Italy, Economic Research Unit, Rome, Italy, raffaele.santioni@bancaditalia.it

Lucia Schirru DEIR, University of Sassari, Sassari, Italy, luciaschirru@gmail.com

Paul Schreyer OECD Statistics Directorate, Paris Cedex 16, France, Paul.Schreyer@OECD.org

Jan de Haan Statistics Netherlands, Division of Macro-Economic Statistics and Dissemination, JM Voorburg, The Netherlands, j.dehaan@cbs.nl

Contents

Part I
Consumer Price Indexes
Time-Space Integration

Are Integration and Comparison Between CPIs and PPPs Feasible?

Luigi Biggeri and Tiziana Laureti

1 Introduction

The importance of integration and comparison between the Consumer Price Indices (CPIs) and the Purchasing Power Parities (PPPs) has been widely discussed in literature (Heston, 1996; Rao, 2001a; ILO/IMF/OECD/UNECE/Eurostat & The World Bank, 2004; Ferrari, Laureti, & Mostacci, 2005), and recognised in two critical reviews of ICP (International Comparison Program) and PPP computation by international organisations (Castles, 1997; Ryten, 1998) as well.

A more integrated approach to CPI and PPP for household consumption is required in order to: (i) explore the feasibility of integrating the PPP activities with the streamlined activities of the National Statistical Offices (NSOs) for the compilation of CPIs; (ii) examine the relationship between the PPPs for international comparisons with the evolution of CPIs in the countries in question. Integration and comparison are very advantageous both among different countries and different areas or cities within a country (ILO/IMF/OECD/UNECE/Eurostat & The World Bank, 2004).

Over the last decades there has been very little harmonization of the activities and surveys of NSOs involved in both CPI and PPP work while the need for comparisons of CPIs and PPPs depends on the possibility of providing complete matrices of temporal-spatial price differences (ILO/IMF/OECD/UNECE/Eurostat & The World Bank, 2004) which can be used for a better comprehension of the factors which influence price levels and their changes in different countries.

Therefore the feasibility of integration and comparison between CPIs and PPPs is an important issue which we will deal with in this paper considering only household consumption aggregates and binary comparisons between two areas or countries.

Firstly, in Section 2 we will examine the integration issues considering the content of the different consumption baskets, which can be used for computing the CPIs in two countries and the PPPs between these countries, in order to verify the

L. Biggeri (✉)
Istat, Rome, Italy University of Firenze, Firenze, Italy
e-mail: biggeri@ds.unifi.it

L. Biggeri, G. Ferrari (eds.), *Price Indexes in Time and Space*, Contributions to Statistics, DOI 10.1007/978-3-7908-2140-6_1, © Springer-Verlag Berlin Heidelberg 2010

overlapping of the baskets, to identify a basis for integrating the price and expenditure share data for the CPI and PPP computation and to compare these results in a consistent space-time comparison of consumer prices. The potential problems and benefits that may arise from developing an integrated approach to collect the necessary information are also specified.

However, the integration approach may be hampered by using the "identity products principle" which is commonly applied for the calculation of PPPs and can seriously influence the representativeness of the PPP product list of the consumption baskets in different countries or regions within a country, and negatively affect the comparisons between PPPs and CPIs. For these reasons it is also advisable to include less comparable products in the PPP baskets.

Section 3 illustrates a simple statistical approach for investigating the advantage of broadening the definition of comparability in order to include additional products in the PPP calculation, in terms of coverage and representativeness of the computed PPPs and to evaluate the importance of different factors which affect the results of the computations.

Regarding the comparison between CPIs and PPPs it is also important to examine how the changes in consumer price levels over time in the two countries (computed by the CPIs) affect the movements over time of the PPPs calculated for household consumption.

It is not possible to totally integrate and link the commonly computed CPIs and PPPs and to carry out a direct comparison for the time being, because these indices differ in the basket of products and services in question and in the formulae used.

Section 4 illustrates a methodological approach based on the decomposition of the formulae in order to approximately evaluate the economic factors which explain the divergences between the CPIs of the two countries from time $t-1$ to time t, and the movement of the PPPs concerning the two countries in the same period.

Finally, the concluding remarks in Section 5 explain how to carry out the integration of data collection and increase the comparability of CPIs and PPPs and then underline the usefulness of the methods suggested. Lastly, a huge organisational and costly effort by the NSOs is required in order to obtain the amount of data to be collected and estimated at least in a benchmark year for achieving the desired results.

2 Integration of CPIs and PPPs

CPIs and PPPs share conceptual similarities. CPIs measure changes in price levels of products and services over time within a country, whereas PPPs measure differences in price levels across countries or regions within a country. Therefore, CPIs and PPPs refer respectively to time and spatial dimension of price differences. However, the results obtained are different according to the baskets of goods and services considered and formulae used.

In order to analyse the possible integration of CPI and PPP activities, Rao (2001a) discussed the issue of optimizing the flow of data from CPI to PPP and presented a

figure of the intersection of price data sets at a national level of a generic country, in order to verify the comparisons of sets of products and services between CPI and PPP lists within the country.

Bearing in mind the aims of this paper and considering two different countries, we are interested both in the integration of the price data collection for calculating the two indices and in the comparison between CPIs and the change in the level of PPPs. Therefore, also the CPIs of the two countries should be comparable.

In the following sub-sections, we will analyse the comparison of the CPI baskets of products in the two countries in question, then the comparison of the different baskets used for calculating the CPIs and PPPs in the two countries, and finally the potential problems and benefits involved in developing an integrated approach for collecting the required information.

2.1 The Comparison of CPI Baskets in the Two Countries

With the aim of comparing the items included in the CPI baskets of two countries, it may be necessary to divide the products and services included in the baskets into two parts: non-comparable and comparable items (with at least a minimum degree of comparability). In this way it is possible to verify the degree of overlapping of the sets of elementary items (products and services) representative of the elementary household expenditure aggregate, included in the consumption baskets used for the CPI calculations. The items priced in different countries could be identical or quite different depending on the heterogeneity level of the two countries concerning the population's consumption behaviour.

Considering Fig. 1, where the CPI baskets of the two countries l and J are represented, composed by N_j and N_l items respectively, it is clear that there are fewer problems in finding an overlapping area when fairly similar or homogeneous countries are being compared in terms of consumption markets and behaviour. In this case, it is possible that $N_j = N_l$ i.e. the total number of products included in the two CPI baskets of each country in question could be identical. Moreover the characteristics of the products chosen for computing the CPIs and the elementary expenditure

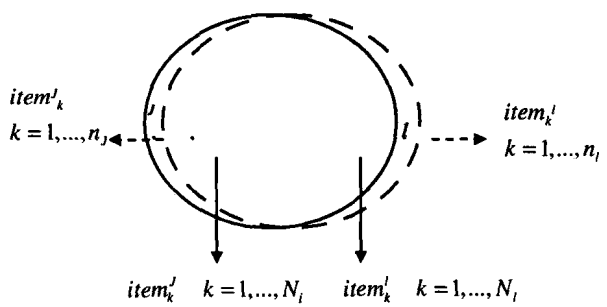

Fig. 1 Comparison of CPI baskets in the two countries, j and l

aggregates could be similar in the two countries. On the other hand, when comparisons involve countries that are fairly heterogeneous, the overlapping area will decrease.

The problem of identifying identical or similar products in the two countries can be related to the different number of items whose prices are to be collected for computing the CPIs in the two countries ($N_j \neq N_l$). Moreover, the definition and the identification of the elementary aggregates and products in the basket, and in particular the methods and practices used for price data collection, can greatly differ in the two countries according to the local situation of consumption, the differences in the consumer markets, the statistical infrastructures and the available resources.

However, even if the number of the products is the same ($N_j = N_l$), the physical and economic characteristics of the products and services which are used for calculating the CPIs can be different in the two countries due to the different patterns of consumption.

Therefore, the outer sets in Fig. 1 consist of n_j and n_l products and services (or groups of products and services) which are *typical or characteristic* regarding the consumption behaviour in country j and l respectively. These items should be considered separately in the outer sets since they have different price determining characteristics or technical parameters, and cannot be used directly for calculating comparable CPIs in the two countries.

It is worth noting that the above theoretical framework for comparing different consumption baskets is not applied from a practical point of view because the NSO of a certain country when computing national CPIs does not usually consider the comparability of the items included in that country's consumption basket with those included in the consumption basket of the other country in question.

The main components of CPIs are the data on prices of a large range of products and services *representative* of the consumption baskets of households and the information on weights associated with the various product categories reflecting the importance attached to different items.

The collection of prices and the expenditure weights are based on a classification of goods and services obtained by using a standard system such as the Classification of Individual Consumption according to Purpose (COICOP), or similar national classifications. The lowest level of product classification at which expenditure weights are available is used for identifying the *elementary aggregate indices* to be progressively aggregated to the total household expenditure level in order to obtain the general total CPI.

Within the elementary aggregate, *considered as strata sample*, the sample items to be included in the CPI computation are chosen considering the criteria of representativeness in terms both of the importance of all the products included in the elementary aggregate concerning consumption expenditure and their evolution of price changes over time. The elementary price index is computed using only price data, meaning that the index is estimated without using any weights within the elementary aggregate.

In this context, it is obvious that the items included in the CPI baskets of two countries can be quite different and it is not easy to compare these CPIs if no specification of the characteristics of products and services is given in order to harmonise the computation of the CPIs.

For this purpose the European HICPs (Harmonised Indices of Consumer Prices) are computed (ILO/IMF/OECD/UNECE/Eurostat & The World Bank, 2004, Annex 1) to measure inflation on a comparable basis taking into account differences in national definitions. They are based on the prices of goods and services available for purchase in the economic territory of each EU Member State for the purpose of directly satisfying consumer needs. The definitions of prices to be collected and of the groups of products and services to be considered are harmonised and agreed on.

The European HICPs are classified according to the four-digit categories or subcategories of the COICOP-HICP, which is the classification that has been adapted to the needs of HICPs, in order to have groups of products that are *approximately comparable* in terms of the specific items which must satisfy the same groups of consumers' need.

HICPs must also be based on appropriate sampling procedures, taking into account the national diversity of products and prices and among other things they illustrate what national consumer price indices have in common among the various countries. Three important sampling dimensions are considered: the item dimension, the outlet dimension and the regional dimension.

Therefore, the comparability criteria used in the HICPs is quite "weak" in terms of comparability of single products since in the HICP calculation the *representativeness criteria* is the most important aspect.

2.2 The Comparison of CPI and PPI Baskets in Two Countries

Considering the above theoretical comparison of the CPI baskets in two countries (Fig. 1), the comparison between CPI and PPP baskets can only refer to the overlapping set of items, and in this case products are defined according to the need of computing adequate PPPs at elementary level. The computation of PPPs and the feasibility of the integration between CPI and PPP activities require the evaluation of the degree of comparability of the products in order to measure the price differential between the two countries in question and the corresponding definition of the representative products used for computing the elementary price indices for CPI estimation. For this purpose Fig. 1 can be modified as shown in Fig. 2.

By following the definitions of comparability and representativeness discussed in Biggeri, De Carli and Laureti (2008), we must underline that for computing PPPs the shaded overlapping area $\varpi_{j,l}$ includes only n_{jl} *identical products* with the same characteristics and are therefore strictly comparable but with different systems of weights in the two countries (j and l). The prices of these products can be and are usually used for calculating PPPs between the two countries.

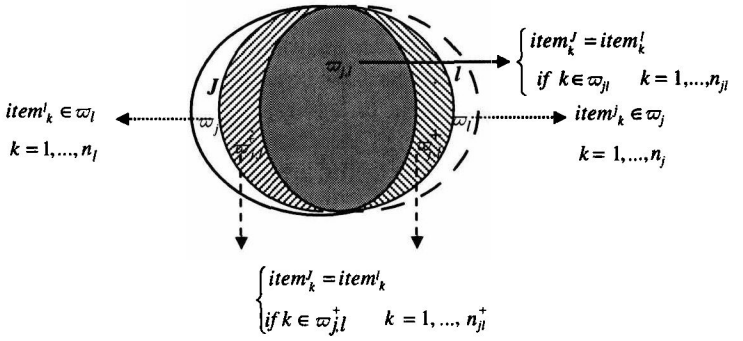

Fig. 2 Comparison of CPI and PPP baskets in two countries

The PPPs are computed at level of Basic Heading (BH) which consists of a fairly homogeneous group of items showing a low dispersion of price ratios. The basic heading level is normally the lowest level of aggregation for which expenditure data are available; therefore the PPPs at this level are computed without using weights for the individual items (Hill, 1997). The basic heading level may be considered similar to the elementary level used in CPI calculation. For the aggregation of price evolution and price differences above the elementary level or basic heading level, the expenditure share weights are common requirements for both CPIs and PPPs (Balk, 1996, 2001; Diewert, 1993).

However, the choice of the items (products and services) to be included in the BH follows different criteria (OECD-Eurostat, 2006; World Bank, 2007).

The main principle used in PPP computation in developing a product list requires a selection of "identical products" for the two countries. Identical products ensure that there are no quality issues in the measurement of the PPPs and the results only provide a measure of price differences. However, this is the most contentious issue in constructing PPPs, because the use of the identity principle can have serious implications for the representativeness of the product list of the consumption baskets in different countries.[1]

Therefore, referring to Fig. 2 and considering the BHs, the degree of the representativeness of items in the overlapping area $\varpi_{j,l}$ can be different in the two countries compared. In fact, since the patterns of consumption can greatly differ in these two countries, products that are representative and easily found in country j may not be easily found in l, due to differences in supply conditions, income levels, taste, climate, customs, etc. From a practical point of view it is evident that the strict comparability of products, obtained through a detailed specification, leads to PPPs for which it is possible to measure pure price differences. At the same time, this strict

[1] There are several operational procedures used by international organizations in order to deal with these problems (see among others, Kravis, Kenessey, & Heston, 1975, and more recently Rao, 2001b)