



Methodological Improvements of Spatial Price Differences for Large Emerging Economies

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Abstract

Most current studies on per capita income do not consider differences in regional price level, leading to underestimation or overestimation of the real income per capita gap between regions. With the development of ICP, more and more excellent methods have been developed, which provides new methods to calculate spatial price differences and reflect the real price level among different regions. The paper (i) discusses different methods about calculation of SPI in urban, rural and joint rural-urban regions, and introduces CPD method at basic heading level and EKS method on aggregation of basic heading level; (ii) constructs comparable basket products at 29 cities from 1990 to 2015; (iii) calculates SPI and real income per capita at each city.

Keywords: subnational Purchasing Power Parity; Spatial Price Index; Regional disparity.

1. Introduction

Large emerging economies' rapid developments such as China have been accompanied by wide gaps in the level of economic development and huge differences in income per capita among different regions. This implies that there may be large differences in price levels across regions. However, current studies on per capita income do not consider differences in regional price level. The average price in the International Comparison Program (ICP) is not only concerned with countries but has subnational implications, especially in the developing countries with large regional disparity. However, the current simple weight average method of national average prices cannot effectively reflect the spatial price differences and cannot reflect the real price level in significantly unbalanced regions and induce important impacts on the reliability of Purchasing Power Parities (PPPs).

Following the development of ICP, measurement methods of PPPs become diversified, for example, Country-Product-Dummy (CPD) method, EKS, GK, which are all the aggregation methods. Zhao & Wang (2015) had compared above mentioned methods with each other, and they thought that the best method is the EKS for the reason that this method is of stability, transitivity and simplicity. Yu (2014) used CPD aggregation method for the basic heading commodities, and EKS aggregation method for the basic heading commodities. The advantage of CPD method lies in missing data could be interpolated by random method; EKS method is transitive and unbiased. Therefore, the paper will follow those methods used by Yu (2014) to measure SPI of regional price level in China.

Difficulties of constructing Spatial Price Index lie in the collection of data, including price, quantities and expenditures of each product (goods and service) at every region. Problems are concluded as follows: first, the "basket" defined should be comparable and representative. The more the representative products are, the closer it will be to the real economic condition; there are more comparable products, and it is meaningful in constructing SPI. However, comparability and representativeness sometimes cannot co-exist; second, quantities of representative commodities is less, resulting in poor connection with CPI. For example, Yan & Fan (2016) only collected 20 basic heading commodities, which is less than 262 basic heading commodities used in CPI calculation; third, most studies only use urban related data to calculate SPI, and rural price difference is excluded, such as Yu (2014).



In our study, we are going to construct a set of (rural, urban, total) city-level Spatial Price Index (subnational PPP) for the year 1990-2015. We will illustrate the significant effect of ignoring spatial price differences in a large emerging economy using China as a case.

2 Methodology

2.1 Methodology on Calculation of Urban SPI

To compare the aggregate price levels on rural regions across 29 cities, we proceed in three steps. First, define a living expenditure basket as a list of products (goods and services) and their prices in the base year 2015. Second, calculate price index on the basic heading in using CPD method. Third, calculate SPI above basic heading in using EKS method.

2.1.1 Computing PPPs for Individual Products

The PPP for region k with respect to region j is given by

$$PPP_{jk} = \frac{P_{ik}}{P_{ij}}$$

Where P_{ik} and P_{ij} are, respectively, the prices of product i in region k and j

2.1.2 Computing PPPs at the Basic Heading Level (World bank, 2013)

Country Product Dummy (CPD) method represents a simple regression approach to measure price level differences in different countries. The CPD method was first proposed by Summers (1973) as a method for filling missing price data in the context of international comparisons.

$$p_{ij} = PPP_j \cdot P_i \cdot u_{ij}; j = 1, 2, \dots, C; i = 1, 2, \dots, N$$

where P_{ij} is the price of item i in region j ; PPP_j is the purchasing power parity of the currency of the j -th region; P_i is the regional average price of the i -th commodity; and u_{ij} are independently and identically distributed random variables.

In logarithmic form the model is linear and

$$\ln p_{ij} = \ln PPP_j + \ln P_i + \ln u_{ij}$$

$$= \alpha_j + \gamma_i + v_{ij}$$

α_j represents the purchasing power parity of region j , showing the number of region j currency units that have the same purchasing power as one unit of currency of country 1 or the reference region. Then the model can be written as

$$y_{ij} = \ln p_{ij} = \alpha_1 D_1 + \alpha_2 D_2 + \dots + \alpha_C D_C + \gamma_1 D_1^* + \gamma_2 D_2^* + \dots + \gamma_N D_N^* + v_{ij}$$

where $D_j (j = 1, 2, \dots, C)$ and $D_i^* (i = 1, 2, \dots, N)$ are, respectively, region and commodity dummy variables. Then the model can be written as

$$y_{ij} = x_{ij} \beta + v_{ij}$$

where $x_{ij} = [D_1 D_2 D_C D_1^* D_2^* D_N^*]$ and $\beta = [\alpha_1 \alpha_2 \alpha_C \gamma_1 \gamma_2 \gamma_N]$ and where the values of the dummy variables are determined at the ij -th observation.



The main advantage of the CPD model is that it is possible to use very sophisticated econometric tools to derive interesting results; CPD method is useful in handling a number of data related problems including missing price data and also in computing standard errors associated with PPPs obtained (Rao, 2004).

2.1.3 Methods of Aggregation above the Basic Heading Level within Regions

The EKS method was independently discovered by Éltető and Köves (1964) and Szulc (1964). The model can be written as

$$EKS_{jk} = \left(F_{jk}^2 \cdot \prod_{l=1}^n F_{jl} / F_{kl} \right)^{1/n} \quad l \neq j, k$$

where EKS_{jk} is the subnational PPPs between region j and region k ; F_{jk} is Fisher (1922) ideal bilateral price index between region j relative to k ; F_{jl} is Fisher ideal bilateral price index between region j relative to l ; F_{kl} is Fisher ideal bilateral price index between region k relative to l . EKS method is stable, transitive and simple.

2.2 Methodology on Calculation of Rural SPI

Keep quantities of products purchased by each province in the base year same, then difference in values at region level only reflect price difference. This method can be written as

$$P_{jk} = \frac{\sum_{i=1}^n p_{ij} q_{ij}}{\sum_{i=1}^n p_{ik} q_{ij}}$$

This method follows the nature of price index, and can calculate space price index directly. However, the method needs a large number of data, including price and quantity of detailed products at each region.

2.3 Methodology on Calculation of Joint Rural-Urban SPI

The joint basket involves (i) nationwide average per capita product quantities, (ii) nationwide average product prices. (i) The nationwide average per capita quantity of a product (joint quantity) is obtained by the rural per capita quantity multiplying the rural share of the population, plus the urban per capita quantity multiplying the urban share of the population. (ii) To obtain the nationwide average price of a product requires two steps. In a first step, the nationwide average per capita expenditure on the product (joint expenditure) is obtained by rural average per capita expenditure (rural quantity times rural price) multiplying the rural share of the population, plus the urban average per capita expenditure multiplying the urban share of the population. In a second step, dividing the nationwide average per capita expenditure on the product by the nationwide average per capita quantity of the product yields the nationwide average product price (joint price) (Brandt & Holz, 2006).

3 Data

To compare the aggregate price levels across 29 cities between 1990-2015, it requires three types of data, including price and expenditures of each product (goods and service), and CPI, and we proceed in three steps. First, define a living expenditure basket as a list of products (goods and services). Second, this basket is priced in each city for the base year. Third, for time series comparisons, the provincial prices of this basket in other years are obtained using the provincial Consumer Price Index (CPI).



A “basket” is a list of products with product quantities and category-specific adjustment factors (Brandt & Holz, 2006). Two factors at least should be thought about to choose basket, which is application of SPI and availability of data. SPI will be applied to estimate real income per capita in this paper, so product category should not only include food, also contains articles and services for daily use. Second, we need to have prices, expenditures and CPI on every kind of products.

This paper collects and organizes data sets including prices, quantities, expenditures and CPI on each product (see table 1). However, the products category and basic heading level are different among these data, and the same indicator can change over time and region. Therefore, it is necessary and important to adjust them into a unified category.

Combining some products into the same basic heading level is the main method. For example, melons and fruits belong to a basic heading level, and their prices depend on calculating average price of apple, pear, orange, red dates, melon seed. Finally, this paper gets a basket including 7 categories and 35 products.

Table 1 Data Prepared

		Details	Time series	Source
Consumption Expenditure Per Capita	Per Capita Consumption Expenditure of Urban/Rural Households by 31 provinces	8 categories and 40 basic heading level products	1990-2015	China Statistical Yearbook
	Per Capita Consumption Expenditure of Rural Households by 31 provinces	8 categories	1990-2015	China Rural Statistical Yearbook
		7 categories and 35 basic heading level products	1980-2005	China Rural Household Survey Yearbook
Price	National average price and price at 29 cities	8 categories and 40 basic heading level products	1988-1994	China Price of commodities Statistical Yearbook
	average price at urban region of 31 province	68 products	1981-1985	China Urban Household Survey Yearbook at 6th five-year Plan
	Cement price		1992-2013	China Cement Almanac
	National average price and price at 31 provinces	Above 80 products	1990-	Statistical Yearbook on each Province



Consumption Quantities per capita	Consumption Per Capita of Major Foods of Urban/Rural Households	Above 18 products	1990-2015	China Statistical Yearbook ; China Rural Statistical Yearbook ; China Rural Household Survey Yearbook
	Main Durable Goods Owned Per 100 Urban/Rural Households	Above 20 products		
CPI	Rural/ Urban/Total Consumer Price Indices by Category and Region	8 categories and 22 basic heading level products	2001-2014	China Statistical Yearbook(2015)

4. Conclusions

The paper (i) discusses different methods about calculation of SPI in urban, rural and joint rural-urban regions, and introduces CPD method at basic heading level and EKS method on aggregation of basic heading level; (ii) constructs comparable basket products at 29 cities from 1990 to 2015; (iii) calculates SPI and real income per capita at each city.

There are some shortcomings of methods on calculation of rural SPI. (i) Problems on using CPI. Because we cannot get rural commodities price data in recent years, this paper calculates the real expenditure per capita in recent years by using price data in 1990 and CPI data. However, those products included in CPI are quite different with products included in price data, resulting in a deviation. (ii) Ignoring changes in quality of products. The quality of products vary greatly from 1990 to 2015, so it may be inappropriate to get expenditure per capita in recent years by using CPI. (iii) The theory on calculation of rural SPI is simple, but the data processing is cumbersome.

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