APPLICATION OF INDEX NUMBER ON SOME SELECTED COMMODITIES IN KANO STATE METROPOLITAN MARKETS

Mustapha Usman Baba[1], Abdulrahman Abdulhameed[3], Muslimu Khamis[2], Kabir Dalha Kabir[3] and ZainabSuraj Murtala[4]

1. Department of Statistics, School of Technology, Kano State Polytechnic, Nigeria. mubstatistics@kanopoly.edu.ng, mustyubaba2@gmail.com
2. Jammaje Academy. mulimukhamis@gmail.com
3. Department of Art and Humanities, Kano State Polytechnic, Nigeria.
4. National Diploma in Statistics Student, Department of Statistics, School of Technology, Kano State Polytechnic, Nigeria. Zainab789@gmail.com

Abstract

Index number theory has been developed mainly in the context of price statistics. For that reason, a brief comparison between price statistics and MIR may help the analysis. The starting point in price statistics is the need to monitor the evolution of prices, isolating the price developments from changes in quantities. For this paper, an attempt has been made to apply the index number on some selected commodities, by adopting a questionnaire for obtaining information on prices of those commodities directly from the retailers in some markets within Kano Metropolis; the data collected include the prices of those commodities within the period under study. The result obtained shows that there is a significant increase in the prices of those commodities while the quantity is fixed and remain constant. The commodities were mostly grains, they are; Beans, Corn, Wheat, Guinea corn, Soya beans, Groundnut, & Millet, with an increase of 115.6,100,107, for Lespeyers, Paasches and Fishers ideal methods respectively.

Keywords: Index Number, Kano, Price, Quantities.

Introduction

An *index number* is a percentage ratio of *prices*, *quantities* or *values* comparing two time periods or two points in time. The time period that serves as a basis for the comparison is called the *base period* and the period that is compared to the base period is called the *given or current period*. A price index measures the change in the money value of an item (or group of items) over time whereas a quantity index measures the non-monetary value of an item (or a group of items) over time. An index number that represents a percentage comparison of the number of cars sold in a given month as compared with that of a base month is a quantity index. A price index represents a comparison of prices between two time periods and, finally, a value index is one that represents a comparison of the total value of production or sales in two time periods without regard to whether the observed difference is a result of differences in quantity, price or both. Index numbers are also differentiated according to the number of commodities or products included in the comparison. A *simple index*, also known as a *relative*, is a comparison involving only one item but an index whose calculation is based on several items is known as an *aggregate* or *composite* index. A very famous example of a composite index is the **Retail Prices Index** (RPI), which measures the changes in costs in the items of expenditure of the average household. **According to Tuttle**, "Index number is a single ratio (or a percentage) which measures the combined change of several variables between two different times, places or situations". We can thus say that index numbers are economic barometers to judge the inflation (increase in prices) or deflationary (decrease in prices) tendencies of the economy. They help the government in adjusting its policies in case of inflationary situations.

Prasada (2015) presented a paper titled “Construction of Cost-of-Living Index Numbers- A Unified Approach”, and stated that, average price of each commodity is defined using the total value of i^{th} commodity, expressed in a common currency unit, and the total quantity of i^{th} commodity, total obtained over all M situations. This definition makes use of the implicit price component in a pair of value and quantity observations. Then the exchange rate for J^{th} currency unit R is defined by comparing the price vector pj and the average prices P., i = I,...,N. This is done by comparing the expenditure sufficient to buy the quantity vector q_j at these two price vectors. Thus, the equation seems to be a system derived from intuitive understanding of the concepts of exchange rates and average prices.

Mulligen (2012): Quality aspects in price indices and international comparisons: Applications of the hedonic method, and found that, the issue of quality differences that is apparent in price index numbers is at least as relevant for international comparisons. Because the composition of production of some goods is strongly heterogeneous across countries, a quality adjustment is necessary in those cases. The hedonic method, which is applied more frequently in the field of price indices, may also provide a solution in the case of international price comparisons. In calculating quality-adjusted price indices for automobiles, the hedonic method is not undisputed. Cars may be too complex for this method, since there is a vast array of price determining characteristics, many of which appear only in certain models or types, and most of which are correlated with each other. In price indices, there may be sufficient overlap in the year-to-year availability of cars to use alternative methods, but this is not the case for international comparisons.

Vartia(2010): Principles of Defining Index Numbers and Constructing Index Series, stated that, systematic gradual progress has been going on in the *theoretical basis* of index number problem during the last 30years. Knowledge of its importance for practical applications has increased considerably. Here the efforts of Euro Stat, the Ottawa Group, IMF and other economic organizations have been very important. The production of the PPI Manual organized by IMF is an important undertaking from this point of view (see IMF, 2004). Good atmosphere in the co-work of academic experts and official appliers is an important explanatory variable in success of the projects (or of lack of it). The PPI Manual can be considered humorously as an updated version of the "Fisher's Index Number Bible" from 1922s.

Krishnan (2010): Constructing an Area-based Socioeconomic Index: A Principal Components Analysis Approach, the results of our analysis showed a significant level of 0.00, a value that is small enough to reject the hypothesis (the probability should be less than 0.05 to reject the null). It can be concluded that the strength of the relationship among variables is strong or the correlation matrix is not an identity matrix as is required by factor analysis to be valid. These diagnostic procedures indicate that factor analysis is appropriate for the data. The correlations were checked for multicollinearity problems. Some researchers use factor analysis if the variables show multicollinearity. However, multicollinearity could increase the standard error of factor loadings, making them less reliable and also difficult to label. Some researchers either combine collinear variables or eliminate them prior to factor analysis. Some others forgo factor analysis altogether. In the present study, the Kaiser-Meyer-Olkin (KMO), a Measure of Sampling Adequacy (MSA) was used to detect multicollinearity in the data so that the appropriateness of carrying out a factor analysis can be detected. More specifically, sampling adequacy predicts if data are likely to factor well, based on correlations and partial correlations. The KMO measure compares the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. If the variables, in fact, have common factors, the partial correlation coefficients should be small relative to the total correlation coefficient. The maximum value of KMO can be 1.0, a value of 0.9 is considered as 'marvelous', 0.80, 'meritorious', 0.70, 'middling', 0.60, 'mediocre', 0.50, 'miserable' (Antony & Rao, 2007; see also, Planning Commission, 1993).

Clements (2008): Stochastic index number; the sampling variance of the inflation estimator is proportional to the variance of relative prices. When there is more dispersion of relative prices, i.e., when prices are changing more disproportionately, the sampling variance increases. This is also an attractive result which agrees with the intuitive idea that the underlying rate of inflation is in some sense less well defined when there are large changes in relative prices. The results can be extended to allow for more general specifications for the distribution of the disturbance terms. Crompton (2000) analyzes White (1980)-type heteroscedasticity and derives analytical scalar expressions for the standard error of inflation under this formulation. Selvanathan and Prasada Rao (1999) consider a more general error covariance structure. Even with these extensions, the basic insight remains unchanged, viz., the standard error of the estimate of the rate of inflation increases with the degree of variability of relative prices. Price of a single commodity from one time to another is, of course, found by dividing its price at the second time by its price at the first time. The ratio between these two prices is called the price relative of that one particular commodity in relation to those two particular times.

AKINTOYE (2013): Construction Tender Price Index; Modeling and Forecasting Trends: Between 1980 and 1987, the UK Building Cost Index produced by the Building Cost Information Service increased at an annual rate of 6.3% compared with Tender Price Index 3.3% and Retail Price Index at 6.7% per annum. This significant disparity between Tender Price and Building Cost Index is unexpected in view of the attributed importance of input prices in the tender price formation. This suggests that other factors apart from input prices may be responsible for the trends in building prices generally. The thesis reviews the pricing strategies of construction contractors leading to the conclusion that macroeconomic factors are equally important.

Methodology

Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of non-probability or non-random sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study corresponds to price developments and what part corresponds to movements in volumes. The impact of price developments is calculated by fixing a certain business volume for the two periods (Laspeyres price index). From that we can obtain an index defined as:

$$P_{01}^{la} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$$

In other words, applying these price indices, an increase in transactions from one period to another can be, in principle, decomposed into an increase in price and an increase in volume.

In simple terms, an index [or index number] is a number showing the level of a variable to its level [set equal 100] in a given base period. We begin by considering the simplest form of index numbers, elementary indices, also known as relatives.

Result

Table I- this table contains base and current year prices (2015 to 2017) and quantity, with commodities (rice and flour).

S/N	**Commodities**	**Base year prices** $\boldsymbol{in\ Naira\ (P_0)}$	**Base year quantity** $\boldsymbol{in\ kg(Q_0)}$	**Current year prizes** $\boldsymbol{in\ Naira(P_1)}$	**Current year quantity** $\boldsymbol{in\ kg(Q_1)}$
1	Rice	138300	50	14200	50
2	Flour	8590	50	11700	50

Table II- this is computation of our data collected

S/N	**Commodities**	P_0	Q_0	P_1	Q_1	p_1q_0	p_0q_0	p_1q_1	p_0q_1
1	Rice	138300	50	14200	50	710000	690000	710000	690000
2	Flour	8590	50	11700	50	585000	429500	585000	585000
Total						1295000	1119500	1295000	1119500

Price index

1-Using Lespeyers method

$$P_{01} = \frac{\sum P_1\, Q_0}{\sum P_0\, Q_0} \times 100$$

P_{01} =1295000/1119500× 100

P_{01} = 1.156 ×100

P_{01} =115.67

2-Using paasches method

$$P_{01} = \frac{\sum P_1\, Q_1}{\sum P_0\, Q_1} \times 100$$

P_{01} =1295000/1119500×100

P_{01} = 1.156 ×100

P_{01}=115.67

3-Using fisher's ideal method

$$P_{01}=\sqrt{\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \frac{\sum P_1 Q_1}{\sum P_0 Q_1}} \times 100$$

$P_{01}=\sqrt{115.6 \times 115.6}$

$P_{01}=\sqrt{13363.36}$

=115.6

This shows that there is no significant difference in prices index using difference method, and we will have an increase in 115.6 %.

Quantity index

1-lespeyers method

$Q_{01}=\frac{\sum q_1 p_0}{\sum q_0 p_0} \times 100$

$Q_{01}=\frac{1295000}{1119500} \times 100$

$Q_{01}=1.156 \times 100$

=115.6

2-paashes method

$Q_{01}=\frac{\sum q_1 p_1}{\sum q_0 p_1} \times 100$

$Q_{01}=\frac{1295000}{1295000} \times 100$

$Q_{01}=100$

3-fishers ideal method

$Q_{01}=\sqrt{\frac{\sum Q_1 P_0 \sum Q_1 P_1}{\sum Q_0 P_0 \sum Q_0 P_1}} \times 100$

$Q_{01}=\sqrt{la^{Q01} pa^{Q01}}$

$Q_{01}=\sqrt{115.6 \times 100}$

$Q_{01}=\sqrt{11560}$

=107

This shows that there is a difference in quantity index by comparing different methods; lespeyers, paasches and fishers ideal method with different significant value increasing 115.6, 100, and 107.

Table 1- this table contains base and current year prices and quantity indices, and some selected commodities like beans, corn, wheat, guinea corn, soya beans, groundnut and millet.

S/N	**Commodities**	**Base year prices** $in\ Naira\ (P_0)$	**Base year quantity** $in\ kg(Q_0)$	**Current year prices** $in\ Naira(P_1)$	**Current year quantity** $in\ kg(Q_1)$
1	Beans	18000	110	28800	110
2	Corn	8900	110	10500	110
3	Wheat	16400	110	14500	110
4	Geneacorn	11350	110	12850	110
5	Soya beans	14000	110	15300	110
6	Grand nut	35700	110	18500	110
7	Millet	10000	110	13100	110

Table 2

S/N	**commodities**	P_0	Q_0	p_1	Q_1	p_1q_0	p_0q_0	p_1q_1	p_0q_1
1	Beans	18000	110	28800	110	3168000	1980000	3168000	1980000
2	Corn	8900	110	10500	110	1155000	979000	1155000	979000
3	Wheat	16400	110	14500	110	1595000	1804000	1595000	1804000
4	Geneacorn	11350	110	12850	110	1413500	1248000s	1413500	1248000s

Price index

1-Using lespeyers method

$$P_{01} = \frac{\sum P_1\, Q_0}{\sum P_0\, Q_0} \times 100$$

$$P_{01} = \frac{12490500}{12578000} \times 100$$

$=0.99\times 100$

$=99$

2-paashes method

$$P_{01} = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100$$

$P_{01} = \frac{12490500}{12578000} \times 100$

$= 0.99 \times 100$

=99

3-fishers ideal method

$$P_{01} = \sqrt{\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \frac{\sum P_1 Q_1}{\sum P_0 Q_1}} \times 100$$

$= \sqrt{\mathbf{99 \times 99}}$

$= \sqrt{\mathbf{9801}}$

=99

This shows that there is no difference in prices index using different methods, and there is an increase of 99%.

Quantity index

1-lespeyers method

$$Q_{01} = \frac{\sum q_1 \, p_0}{\sum q_0 \, p_0} \times 100$$

$= \frac{12578000}{12578000} \times 100$

=100

2-paashes method

$= Q_{01} = \frac{\sum q_1 p_1}{\sum q_0 p_1} \times 100$

$= \frac{12490500}{12490500} \times 100$

=100

3-fishers ideal method

$=\sqrt{100 \times 100}$

$=\sqrt{10000}$

=100

This also shows that there is no significant difference in quantity with an increase of 1.

- **Time reversal and factor reversal test**

S/N	commodities	P_0	Q_0	p_1	Q_1	p_1q_0	p_0q_0	p_1q_1	p_0q_1
1	Beans	18000	110	28800	110	3168000	1980000	3168000	1980000
2	Corn	8900	110	10500	110	1155000	979000	1155000	979000
3	Wheat	16400	110	14500	110	1595000	1804000	1595000	1804000
4	Guinea corn	11350	110	12850	110	1413500	1248000	1413500	1248000
5	Soya beans	14000	110	15300	110	1683000	1540000	1683000	1540000
6	Grand nut	35700	110	18500	110	1441000	2035000	1441000	2035000
7	Millet	10000	110	13100	110	2035000	3927000	2035000	3927000
Total						12490500	1257800	12490500	1257800

Time reversal test
1-when lespyers method is used

$$p_{01} \times p_{10} = \sqrt{\frac{\sum P_1 Q_0}{\sum P_0\, Q_0} \frac{\sum P_0\, Q_1}{\sum P_1\, Q_1}} \times 100$$

$$\sqrt{\frac{12490500 \times 1257800}{12578000 \times 12490500}} \times 100 = 1 \times 100$$

$$= 100$$

2-paaches method

$$p_{01} \times p_{10} = \sqrt{\frac{\sum P_1 Q_1}{\sum P_0\, Q_1} \frac{\sum P_0\, Q_0}{\sum P_1\, Q_0}} \times 100$$

$$= \sqrt{\frac{12490500 \times 1257800}{12578000 \times 12490500}} \times 100$$

$$= 1 \times 100$$

$$= 100$$

3-fishers ideal method

$$p_{01} \times p_{10} = \sqrt{\frac{\sum p_1 q_{0.} \sum p_0 q_{1\times} \sum p_1 q_{1.} \sum p_0 q_0}{\sum p_0 q_{0.} \sum p_1 q_{1\times} \sum p_0 q_{1.} \sum p_1 q_0}}$$

$$= \sqrt{\frac{12490500}{12578000}\frac{12578000}{12490500} \times \frac{12490500}{12578000}\frac{12578000}{12490500}}$$

$$= 1$$

Factor reversal test

1-lespyers method

$$p_{01} \times Q_{01} = \sqrt{\frac{\sum p_1 q_0 \times \sum q_1 p_0}{\sum p_0 q_0 \times \sum q_0 p_0}} \times 100$$

$$= \sqrt{\frac{12490500}{12578000} \times \frac{12490500}{12578000}} \times 100$$

$$= 100$$

2-paasches method

$$p_{01} \times Q_{01} = \sqrt{\frac{\sum p_1 q_1 \times \sum q_1 p_1}{\sum p_0 q_1 \times \sum q_0 p_1}} \times 100$$

$$= \sqrt{\frac{12490500}{12578000} \times \frac{12490500}{12490500}} \times 100$$

$$= \sqrt{\frac{12490500}{12578000}} \times 100$$

$$= 9.93 \times 100$$

$$= 993.4$$

3-fishers ideal method

$$p_{01} \times p_{01} = \sqrt{\frac{\sum p_1 q_0 \sum p_1 q_{1\times} \sum p_1 q_{0.} \sum p_1 q_1}{\sum p_0 q_0 \sum p_0 q_{1\times} \sum p_0 q_0 \sum p_0 q_1}}$$

$$p_{01} \times p_{01} = \sqrt{\left(\frac{\sum p_1 q_1}{\sum p_0 q_0}\right)^2}$$

$$v = \frac{\sum p_1 q_1}{\sum p_0 q_0}$$

$$v = \frac{12490500}{1278000}$$

$$v = 9.77$$

Recommendation and Conclusion

Based on the research findings in this paper, the following recommendation is made;

- The government should give much priority to agriculture sectors, such as increasing food production of existing export crops, so that the increase in the prices of commodities will be reduced drastically over time. And this shows that it certified both time reversal and factor reversal test for the following commodities: beans, corn, wheat, guinea corn, soya beans, groundnut and millet.

Conclusion

This paper has come to conclude that, after taking an analysis on the data concerning application of index number on some selected commodities which were obtained from Sabongari, Singer, Dawanau markets, the result obtained shows that there is a significant increase in the prices of those commodities while the quantity is fixed and remain constant.

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