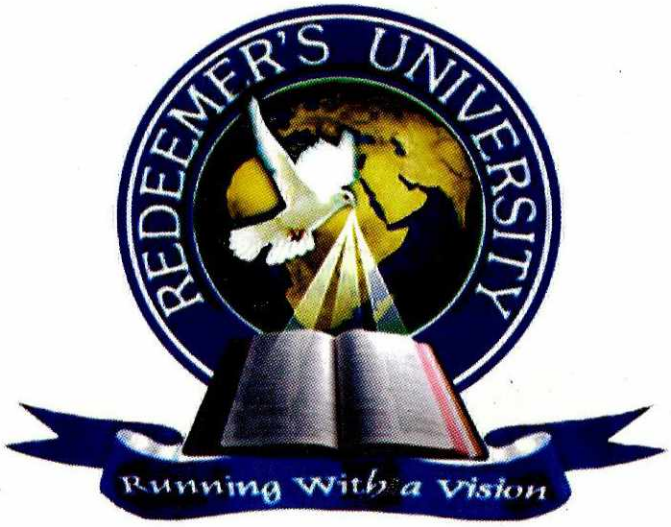

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AN APPLICATION OF CONSUMER PRICE INDEX IN MARKETING AND SALES MANAGEMENT

Nnamdi J. Mojekwu
Department of Actuarial Science and Insurance
University of Lagos, Lagos, Nigeria
jnmoje@yahoo.com

Salome O. Ighomereho
Department of Economics and Business Studies
Redeemer's University, Ede, Osun State, Nigeria
ighomerehosalome@gmail.com

And
Rahim A. Ganiyu
Department of Business Administration
University of Lagos, Lagos, Nigeria
abdulrahimajao@yahoo.com

Abstract
Index number is a special type of average which helps to measure economic fluctuations on price level and it is an indispensable tool of economics and business analysis. It is very useful in measuring relative changes in the value of money and for deflating nominal data to real data. This paper examined the various methods of constructing index number and the index number theories that generated the methods. In addition, the paper demonstrated the usefulness of index number in marketing especially in sales management using secondary sources of data which include the annual turnover of 7-UP Bottling Company Plc from 2001 to 2012 and Consumer Price Index (CPI) for the same period. The analysis indicated that real sales give a more realistic trend than nominal sales. By adjusting for inflation, managers can uncover the real growth in sales because it stabilizes the variance of random or seasonal fluctuations and highlight cyclical patterns in the sales data. Therefore, it was recommended that business managers in general and marketing managers in particular should index sales values whenever there is need to analyze sales trend.

Keywords: *index number, turnover, Consumer Price Index, real sales, nominal sales*

INTRODUCTION

An index number is a statistical measure designed to indicate changes in a variable or a group of related variables with respect to time, geographical location or other characteristics such as income and profession (Spiegel, 1992; Idele, 1999). In the view of Weisstein (2013) index number is a statistic which assigns a single number to several individual statistics in order to quantify trends. Generally, index numbers measure the relative change in price, quantity, value or some other variable of interest from one time period to another (Agbadudu, 1994; Gupta, 2010). It is usually a single ratio or a percentage which measures the combined change of several variables between two different times, places or situations.

From the inception of business as a discipline, index numbers were constructed to gauge the effect of changes in prices. The earliest reported research in index problem can be traced to

Henry Vaughan who examined price level changes in his book "*A Discourse of Coin and Coinage*" in 1675 (Wikipedia, 2010). Vaughan tried to separate the inflationary impact of the influx of precious metals brought from the New World by Spain from the effect of currency debasement. Although Vaughan can be considered as the pioneer of price index research, his analysis did not actually involve calculating an index. In 1707, William Fleetwood did the first true analysis on price index. This was necessitated by an Oxford student who asked Fleetwood to help show how prices had changed. The student stood to lose his fellowship since a fifteenth century stipulation barred students with annual incomes over five pounds from receiving a fellowship. Fleetwood, who already had an interest in price changes, had collected a large amount of price data dating back hundreds of years. He proposed an index consisting of average price relatives and used the method to show that the value of five pounds had changed greatly over the course of 260 years. He argued on behalf of the Oxford student and published his findings in a book titled "*Chronicon Preciosum*" (Wikipedia, 2010).

Currently, the relevance of index numbers to practical applications in diverse areas of the economy and business has increased considerable (Vartia, 2010). Index numbers are now used to measure the level of business and economic activities and for gauging the economic status of a country. They also reveal trends and tendencies in business cycles and the inflationary (increase in prices) or deflationary (decrease in prices) tendencies in an economy (Paul, 2007). They reflect the purchasing power of money as it describes the pattern of movement of prices. As a result, index numbers are useful in formulating suitable policies both at the micro level and at the macro level and they can assist managers of business organizations in making decisions especially with respect to pricing, product and market development decisions. Due to the prominent role of index numbers in the economy and in business, the paper examined the nature of index numbers and the various theories and methods of constructing index numbers. This review is important because it provides a historical excursion on how index numbers are constructed especially the Consumer Price Index which is the most common index. In order to appreciate the usefulness of index numbers in business, the paper considered its application by using Consumer Price Index (CPI) as published by World Bank (2013) to deflate the annual turnover of 7-UP Bottling Company Plc from 2001 to 2012. The purpose is to demonstrate the role of index numbers in business especially in marketing and sales management.

LITERATURE REVIEW

Construction of Index Numbers

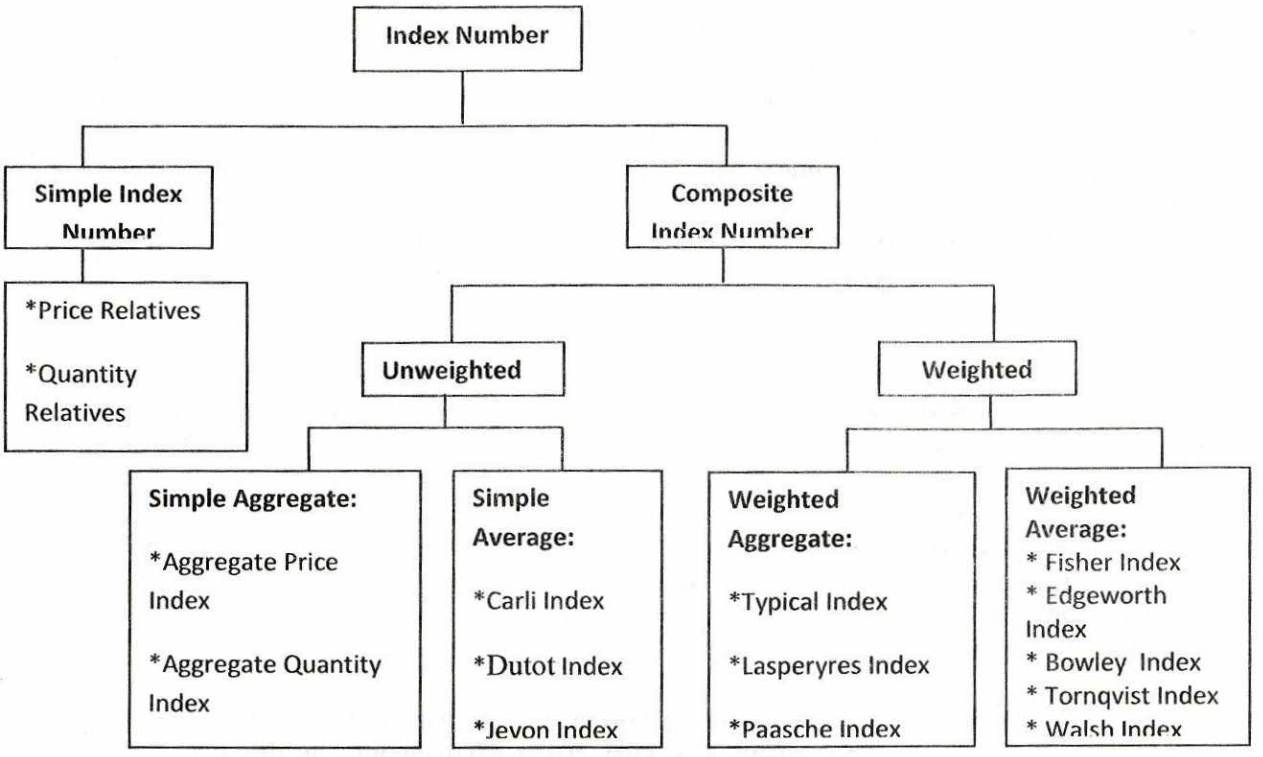
One of the key issues in the literature is the debate over the relative merits of chained base index (index numbers constructed on shifting base period under which the prices of the subsequent years are each compared with the prices of the immediately preceding years) and fixed base index (index numbers constructed on a fixed base period, usually a year with which the prices of given commodities for subsequent years are each compared) (ILO, 2004; Diewert, 2013). Hill (1988 and 2003) provided some useful advice on when to use chained versus fixed base index. He advocated the use of chain base index if prices and quantities have smooth trends and fixed base index if there is price bouncing behaviour. This implies that if there are smooth trends, then chained index will provide better results than their fixed base counterparts whereas if there are erratic moves in prices without clear trends, then fixed base index will provide better results. However, an examination of price indices (NBS, 2012 and World Bank, 2013) indicates that fixed base index is the most commonly used base period.

The literature on index numbers (Silver, 2008; Carlo, 2009; Diewert, 2010) also revealed that several formulae have been proposed for constructing index numbers, each giving different results. Index numbers can be constructed for single commodities (simple index numbers) or for a group of commodities (composite index numbers). When dealing with single commodities; price, quantity or value relatives are used. However, in many situations, there is need to combine several items and develop an index to compare the cost of aggregation of the items in two different time periods. For instance, if the interest is to develop cost of building index, the items in the index might include cement, gravel, sharp sand, iron, planks and roofing sheets.

When dealing with a group of commodities, the available methods of constructing index numbers can be grouped into unweighted indices and weighted indices. In the unweighted indices, weights are not expressly assigned whereas in the weighted indices weights are assigned to the various items. The unweighted indices can be further divided into two, the simple aggregate method and the simple average aggregate method. Also, the weighted indices can be classified into two, the weighted aggregate methods and the weighted average methods. The simple aggregate methods include aggregate price index, aggregate quantity index and aggregate value index while the simple average aggregate methods include Carli, Dutot and Jevons indices.

The simple aggregate methods assign equal importance to all items but in most cases, some items are more important than the others (Mojekwu, 2012). To overcome this disadvantage of the simple aggregate method, the weighted approach is advocated. The weighted approach weighs the price of each item by a suitable factor. This factor is often taken to be the quantity of the item sold during the base year or the given year (Spiegel, 1992). There are several index that apply this approach but there is still widespread disagreement as to which formula is the best (Hill, 2003). The weighted aggregate methods consist of typical, Laspeyres and Paasche indices. In weighted Average approach, the price relatives for the current year are calculated on the basis of the base year price. These price relatives are multiplied by the respective weight of the items. The products are added up and divided by the sum of weights (Gupta, 2010). The weighted average methods are Fisher, Edgeworth, Bowley, Tornqvist, Walsh, Kelly and Young indices.

Figure 1. Summary of the Methods for Constructing Index Numbers



Source: Authors

Figure 1 shows the various methods that have been developed for constructing index numbers. All the methods are useful and important but they all have advantages and disadvantages. The methods of price, quantity and value relatives are very easy to calculate, understand and interpret but they take every commodity on its own and so, it is not a summing index. As such, when there is need to combine several items and develop an index, they cannot be used. The simple aggregate methods on the other hand can be described as summing index and they are easy to calculate, understand and interpret. However, they fail to take into consideration the relative importance of the items as there are no weights assigned to the prices. Also, the value of the index is affected by the particular units in which the items are measured.

The weighted aggregate methods assign weights to all items because some items are usually more important than the others but there is the problem of the weight to be used. For instance, typical index use fixed weights, Laspeyres index use base year quantities while Paasche index use current year quantities. The weighted average methods also have the challenge of the type of average to use. For example, in 1922, Fisher argued that using the arithmetic mean of the base and current year weights would not cater for the variations of increases and decreases present in Laspeyres and Paasche method. He then suggested the use of geometric mean of the two indices. This shows that all the methods for constructing index numbers have one or more limitations.

Approaches to index number Theory

The reason for several methods of constructing index numbers is because there are many alternative index number theories and so statistical agencies have been unable to agree on a single target index formula to guide them in the preparation of index numbers especially Consumer Price Index and index of real output. There are five fundamental approaches to index number theory (Diewert, 2005). They include the fixed basket, axiomatic, economic, stochastic and Divisia approach.

Fixed Basket Approach

Early theorists assumed that index numbers are statistical aggregates or measures of central tendency of a distribution. According to this approach to index number theory, one index number should be chosen over another if it is a better descriptive statistic for the underlying distribution according to some criteria relevant to the choice of such a statistic (Reddy and Plener, 2006). The fixed basket approach involves specifying the commodity 'list' q and calculating the price index as the ratio of the costs of buying this same list of goods in periods i and o. With time, economists and price statisticians demanded more precision with respect to the specification of the basket vector q. There are two natural choices for the reference basket: the period o (base year) commodity vector qo or the period i (current year) commodity vector qi. These two choices lead to the Laspeyres price index (1871) and the Paasche price Index (1874) (Anghelache *et al.*, 2011).

The problem with the Paasche and Laspeyres index number formulae is that they are equally plausible but they give different results. This suggests that, if we require a single estimate for the price change between the two periods, then we need to take some sort of evenly weighted average of the two indexes as the final estimate of price change between periods o and i (Pursiainen, 2005). However, there is more than one way of taking an average, so the question of the "best" average to take of the Paasche and Laspeyres indexes became a crucial issue. At this point, the fixed basket approach to index number theory gave way to the axiomatic approach to index number theory.

The Axiomatic Approach

The axiomatic approach to index number is one in which the theoretical foundations of index numbers are built on certain postulates or axioms, which are meant to be so general that any index is expected to satisfy them in practice. It also considers the actual prices and quantities observed in the two periods or situations being compared as independent variables (ILO, 2004). This approach originated from the work of Fisher (1922) who required indices to satisfy certain conditions or tests, if they were to be useful for economic analysis and policy making (Hill, 1988; Reddy and Plener, 2006). These axioms are described as basic properties which are desirable for every price index to satisfy (Hill, 1988). In this case, index number formulae are evaluated based on the properties and those which satisfy the properties, automatically satisfy various tests of the type which Fisher proposed in 1922 and other tests which were proposed later (Diewert, 2005). The tests are unit test, time reversal test, factor reversal test, circular test, mean value test, monotonicity test, proportionality test and product test.

On the axiomatic approach, no index number has been able to satisfy all the tests but it appears to favour the Fisher ideal index (Silver, 2008). Although the tests are important in choosing the right index to use, in most cases, they are satisfied approximately (Spiegel, 1992). This inability to satisfy all the axioms of this approach led to the consideration of an alternative approach based on utility or production functions (Hill, 1988).

Economic Approach

The third approach is the economic theoretic approach, which seeks to define price or volume indices with reference to underlying utility or production functions (Hill, 1988; Clement *et al.*, 2006). It is based on the standard assumption of a utility-maximizing consumer. This assumption introduces a functional dependency between prices and quantities in the data. The approach enables the definition of economic price and quantity indices, which are theoretical constructs based on the preferences of the consumer (Pursiainen, 2005).

In this approach, the quantities are treated as functions of the prices and so the information on which an economic theoretic index is based does not consist of two price vectors and quantity vectors, but rather two vectors of prices and a functional relationship connecting the quantities to the prices in both situations being compared (Fisher and Shell, 1972). As the parameters of this underlying function are generally unknown and incapable of being estimated in most real world situations, it follows that economic theoretic index, although precisely defined, cannot be calculated in practice except in special circumstances. This approach to index number gave rise to superlative index number formulae such as Törnqvist and Walsh indexes but it also supports the Fisher index because they give similar results (Silver, 2008).

Stochastic Approach

The stochastic approach is a new way of viewing index numbers where uncertainty and statistical ideas play a central role. Rather than just providing a single number for the rate of inflation, the stochastic approach provides the whole probability distribution of inflation (Clement *et al.*, 2006). It originated with Edgeworth, Bowley as well as Young and it was driven by the quantity theory of money which states that as the quantity of gold or money increases, all prices should increase approximately proportionally (Diewert, 2010).

The advantages of this approach over other approaches to index number theory is that it provides not only a point estimate of the rate of inflation, but also its variance, the source of which is the divergence of the individual prices from a common trend. That is, the extent to which the structure of relative prices change. Therefore, it provides the intuitively plausible result that it is more difficult to obtain precise estimates of inflation when there are large changes in relative prices (Selvanathan and Prasada Rao, 1994; Clement *et al.*, 2006). Selvanathan and Prasada Rao (1994) noting this advantage, stated that the stochastic approach can be utilized to derive standard errors for many well known index number formulae. The attraction of this approach is that it provides an alternative interpretation to some of the well known index numbers as the estimator of parameters of specific regression models. Unfortunately, it neglects one key variable, the economic importance of each price relative. The stochastic approach, although less influential than the previous approaches is mostly applied to output indices (Selvanathan and Prasada-Rao, 1994).

The Divisia Approach

The fifth approach to index number theory is the continuous time Divisia approach. It is attributable to the French economist named Divisia. It is based on the assumption that price (p) and quantity (q) data are available as continuous functions of time. The theory of differentiation is used in order to decompose the rate of change of a continuous time value aggregate into two components that reflect aggregate price and quantity changes (Anghelache *et al.*, 2011). This approach does not lead to a single discrete time bilateral index number

formula. So, it provides little practical advice for statistical agencies, although it is conceptually useful (Diewert, 2005).

There are quite a number of index numbers that are computed to examine the level of change in different aspects of the economy such as Consumer Price Index, Wholesale Price Index, Productivity Price Index, Wage Index, Human Development Index, Unemployment Index, Personal Consumption Expenditure Index (PCE) etc. However, the most popular index is the Consumer Price Index (Weisstein, 2013). The Lasperyres index which is based on the fixed basket approach is usually used to construct Consumer Price Index (CPI) (NBS, 2012; World Bank, 2013) because in comparison to other methods, the weights are the same always and so, the computation is less stressful. This is because it requires quantity data from the base period only; therefore, the changes in the index can be attributed to changes in the price. This allows more meaningful comparison overtime. Finally, it is easy to apply when there are many items.

CONSUMER PRICE INDEX (CPI)

A Consumer Price Index (CPI) measures changes in the price level of a market basket of consumer goods and services purchased by households (World Bank, 2013). It measures either the rate of price inflation as perceived by households or changes in their cost of living (that is, changes in the amounts that the households need to spend in order to maintain their standard of living). Such changes affect the real purchasing power of consumers' incomes and their welfare.

It is also a measure of the rate at which the prices of consumer goods and services are changing over time (UNSD, 2010). It is a key statistic for making economic and social policies especially for government, businesses, households and individuals (ILO, 2004). It provides an estimate of average prices of basic needs as well as the determination of future changes in prices of commodities. It tracks the variation in prices for different consumer goods and services over time in a constant geographical location and it is integral to calculations used to adjust salaries, bond interest rates and taxes. It is widely used in official statistics to convey information about the relative changes in price and for comparing values of different amount of money at different points in time (Spiegel, 1992).

It is constructed using the prices of a sample of representative items whose prices are collected periodically. Sub-indices and sub-sub-indices are computed for different categories and sub-categories of goods and services are combined to produce the overall index with weights reflecting their shares in the total of the consumer expenditures covered by the index (NBS, 2012). The two basic types of data needed to construct the CPI are price data and weighting data. The price data are collected for a sample of goods and services from a sample of sales outlets in a sample of locations for a sample of times. The weighting data are estimates of the shares of the different types of expenditure in the total expenditure covered by the index. These weights are usually based on expenditure data obtained from expenditure surveys for a sample of households or on estimates of the composition of consumption expenditure in the national income and product accounts (NBS, 2012).

The index is usually computed monthly or quarterly in some countries, as a weighted average of sub-indices for different components of consumer expenditure, such as food, housing, clothing, each of which is in turn a weighted average of sub-sub-indices. The weights used are the quantities of the goods consumed and so it represents their relative importance. The principle is true for any type of index, whether price or quantity. For instance, for a quantity

index, the quantity in the numerator would be updated rather than the price and the denominator would remain the same. In Nigeria, the basket comprises 740 good and services that are regularly priced (NBS, 2012). It is only by converting the prices of these many diverse goods and services to one index number that the federal government and others concerned with inflation are kept informed of the overall movement of consumer price. It allows consumers to determine the effect of price increases on their purchasing power and it is a yardstick for revising wages and pensions and for determining real income, real sales and real GDP.

Application of Consumer Price Index (CPI) in Marketing: Deflation of Sales Data

A CPI can be used to index (adjust for the effect of inflation) the values of a variable and to deflate monetary magnitudes to show changes in real values. Deflating means adjusting, correcting or reducing a value which is inflated (Sorensen and Yosha, 2003). It is derived by dividing a monetary time series by a price index, such as the Consumer Price Index (CPI). The objective is to remove any part of the variable's change that is attributable to price movements, thereby arriving at a real or inflation adjusted indicator. The deflated series is then said to be measured in "constant prices," whereas the original series was measured in "nominal prices" or "current prices." By adjusting for inflation, an analyst can uncover the real growth because it stabilizes the variance of random or seasonal fluctuations and highlight cyclical patterns in the data.

Deflation of sales data plays an important role in marketing because it can be used to determine real sales and to compare sales values of different amount of money at different points in time. It provides a means for converting a series of values calculated at current prices into constant prices of a given year. It deflates nominal or monetary totals in order to arrive at estimates of underlying real magnitudes (Carlo, 2009). This is particularly important in an economy which has inflationary trends like Nigeria. In such an economy, the increase in the prices of commodities over a period of years means a fall in their real values. It becomes necessary to adjust or correct nominal values in accordance with the rise in the corresponding price index to arrive at the real value. In business, managers are often concerned with the way in which values such as sales change over time. To convert the value of sales in a given time period to its equivalent value in the base period, the sale values are divided by the index for the given time period and multiplied by 100. It is given as:

$$\text{Real Sales} = \frac{\text{Nominal sales}}{\text{An appropriate index}} \times 100$$

Highlighting the role of CPI in sales management, Williams (2013) in a report on economic review on real retail sales and earnings, indicated that real retail sales were corrected for understatement using CPI to deflate sales series from year 2000 to 2013. It was found that sales contracted on both a quarterly and annual basis. The analysis also indicated that nominal 0.1% contraction in retail sales was before accounting for rising prices but after deflating with CPI, seasonally-adjusted real retail sales showed a monthly contraction of 0.3%. The implication of this is that when sales are deflated, the real trend will be obvious and clear. Discussing the deceiving trend in total nominal taxable sales, Alberta (2014) argued that even though total nominal sales tax base was growing, deflating the data series to remove the effects of inflation on the series will show a very different result.

Sorensen and Yosha (2003) noted that there is no agreement on how some series should be deflated and that for GDP series some authors use the GDP deflator to transform the series from nominal to real terms, while others deflate the series with the consumer price index (CPI). The authors illustrated that the appropriate manner to deflate nominal GDP for the study of risk sharing is with the CPI and that deflating nominal GDP using the GDP deflator is conceptually flawed and may yield biased results. Using CPI deflator captures both changes in the price of consumption due to the oil-price increase and the ensuing rise in the price of services, appropriately weighted to reflect their respective shares in consumption. This yields a correct estimate of the net positive shock to the value (purchasing power) of the region. They then presented a simple model which illustrates that the appropriate deflator for the study of risk sharing is the CPI.

METHODOLOGY

The research approach for this study is the case study approach. Case study involves developing an in-depth understanding of one case which can then be used to provide a basis for explaining and understanding how other similar cases occur (Yomere and Agbonifoh, 1999). The case study used to demonstrate the role of index number in this paper is 7-UP Bottling Company Plc. Secondary source of data was used. The secondary data used include sales data of 7-UP Bottling Company Plc from 2001 to 2012 and CPI of Nigeria as published by World Bank (2013). The use of secondary data is based on the fact that CPI is usually used to deflate time series. Time series is a sequence of data points, typically consisting of successive measurements made over a time interval (Agbadudu, 1994). The times series of sales values of 7-Up bottling company and CPI are indicated in table 1.

ANALYSIS AND DISCUSSION

Table 1. Sale Values of 7-Up Bottling Company Plc from 2001 to 2012

Year	Nominal Sales (N'Million)	CPI [a] (2005 = 100)	CPI [b] (2001 = 100)	Real Sales (Nominal Sales/CPI [b] *100)
2001	8 091.2	57.32	100.00	$\frac{8\,091.2}{100}$ X 100 = 8 091.2
2002	11 838.2	64.70	112.88	$\frac{11\,838.2}{112.88}$ X 100 = 10 487.4
2003	14 222.1	73.78	128.72	$\frac{14\,222.1}{128.72}$ X 100 = 11 048.9
2004	14 937.4	84.84	148.01	$\frac{14\,937.4}{148.01}$ X 100 = 10 092.2
2005	17 346.7	100.00	174.46	$\frac{17\,346.7}{174.46}$ X 100 = 9 943.1
2006	22 071.7	108.24	188.83	$\frac{22\,071.7}{188.83}$ X 100 = 11 688.7
2007	27 309.1	114.07	199.01	$\frac{27\,309.1}{199.01}$ X 100 = 13 722.5

2008	30 572.2	127.27	222.03	$\frac{30\ 572.2}{222.03}$	X 100 =	13 769.4
2009	34 864.3	141.96	247.66	$\frac{34\ 864.3}{247.66}$	X 100 =	14 077.8
2010	41 069.0	161.43	281.63	$\frac{41\ 069.0}{281.63}$	X 100 =	14 582.6
2011	51 098.0	178.93	312.16	$\frac{51\ 098.0}{312.16}$	X 100 =	16 369.2
2012	59 864.4	200.79	350.30	$\frac{59\ 864.4}{350.30}$	X 100 =	17 089.5

Sources: Financial Statements of 7-Up Bottling Company Plc (2001-2012)
World Bank Indicators (2013) CPI (2005 = 100)

The Nigeria CPI as published by World Bank was computed with a base year of 2005. However, the purpose of this analysis is to determine the increase in sales over the period without the effect of inflation. Therefore, the series of CPI with base year of 2005 was changed to a base year of 2001 as shown in table 1. To know how much sales have actually increased over the period under consideration in the company, the sale values which are in millions of naira from 2001 to 2012 were deflated using CPI with 2001 as the base year.

Index numbers are effective tools for normalizing data to a common starting point and for observing how variables change over time relative to each other. It is a common method used by economists and businesspeople to understand economic trends. As indicated in table 1, nominal sales grew faster than real sales because it contains inflation. Inflation is a sustained increase in the general price level over a period of time. When prices are increasing, there is need to deflate monetary values by a deflator in order to make meaningful comparisons. A deflator is a figure expressing the change in prices over a period of time for a product or a basket of products, which is used to 'deflate' (price adjust) a variable for the same period so as to remove price increases or decreases and leaving only volume changes. In addition, the nominal sales shows an increase in sales over the years but the real sales shows that in 2004 and 2005, there was a decline in sales which is not obvious in the nominal sales. This information which can be very useful to the manager when planning and managing sales is depicted in figure 2:

Figure 2. Trend of 7-UP Bottling Company Actual Sales and Deflated Sales from 2001 to 2012

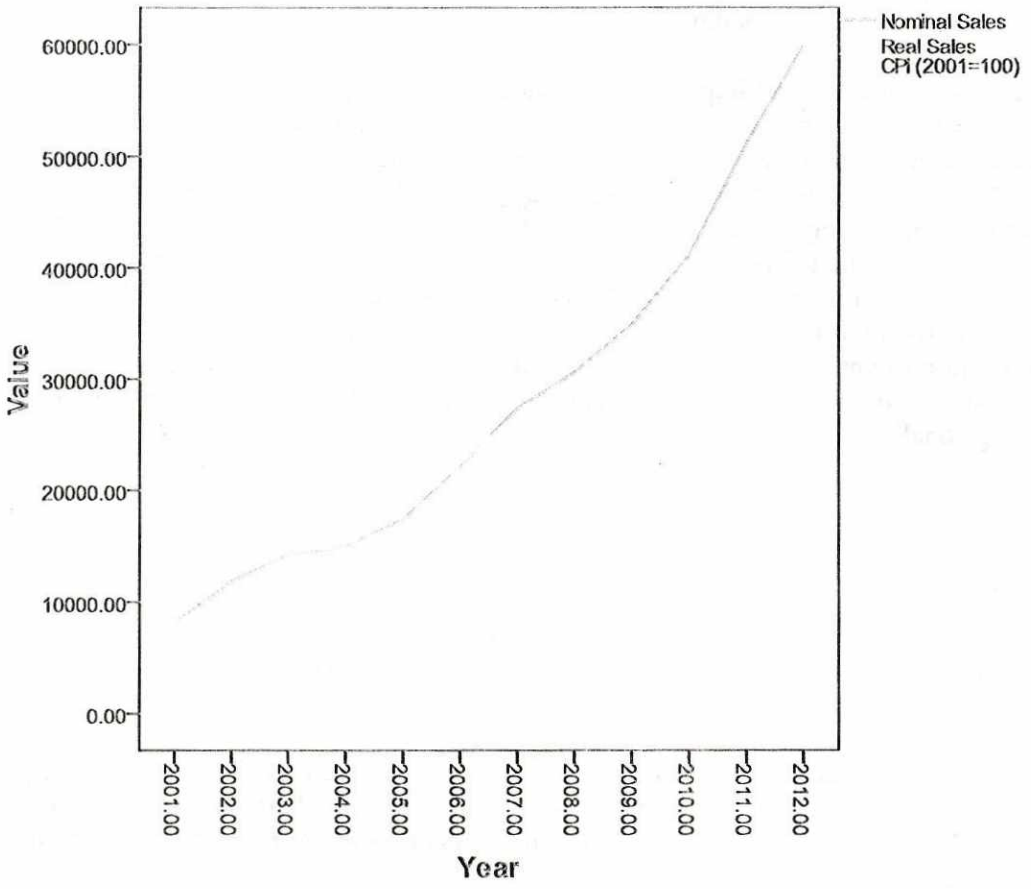


Figure 2 shows the trend of turnover for the period under consideration. It indicates that the trend of real sales is more stable than that of nominal sales because the calculation is devoid of any pricing effect. The real measure is a better overall indication of the increase in output over the time period. By removing the price effect, the data gives a clearer picture of sales level relative to any given year.

IMPLICATIONS AND CONCLUSION

Index numbers play a crucial role in the economy and in business organizations. They measure the relative change in the value of a variable or a group of related variables over a period of time or between places. To make interpretation and understanding of the relative change easier, they are expressed in terms of percentages. Moreover, they measure changes which are not directly measurable. The cost of living, the general price level or the business activity in a country are not directly measurable but it is possible to study relative changes in these activities by measuring the changes in the values of variables or factors which affect the activities

The result of the analysis is in agreement with Williams (2013) who found that sales contracted on both a quarterly and annual basis when deflated with CPI. The findings also support Alberta (2014) who noted that even though total nominal sales tax base was growing; deflating the data series produced different result. Using CPI deflator captures both changes

in periods of inflation or deflation. This is because large rises in CPI during a short period of time typically denote periods of inflation and large drops in CPI during a short period of time usually mark periods of deflation (Sorensen and Yosha (2003).

Despite the usefulness and importance of index numbers, there are some limitations to their role in the economy and in business. Index numbers are based on sample data and so if the selection is faulty, then the index numbers will give wrong figures. Also, they are constructed with different formulae and in most cases, they give different results. Usually, index numbers constructed according to Laspeyres formula give higher values than those calculated according to Paasche's formula. The choice of which formula to use tends to depend on what is being compared over time, the timeliness of the available data, how much flexibility is needed and the final use of the index, for example, if it is going to be used as an input into another piece of analysis which requires an index. In addition, they could be manipulated by those in authority and if the result of index computation is interpreted wrongly, it could lead to wrong conclusions and policies.

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