Understanding the
Consumer Price Index

GOVERNMENT OF BERMUDA
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Department of Statistics

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Understanding The Consumer Price Index

Introduction

Commonly referred to as the CPI, the Consumer Price Index is one of the most widely-used statistical series produced by the Department of Statistics. It has many applications which directly or indirectly affect all residents in Bermuda.

The CPI is used extensively in collective bargaining by labour unions and employers for the adjustment of wages and salaries. Rental agreements, insurance premiums, pensions, alimony and child support payments are all forms of contractual and price-setting arrangements, very often tied to movements in the CPI.

It serves as a gauge for assessing the current performance of the economy and it is an important tool used by government in formulating and evaluating economic policy. Additionally, private researchers, students and the public use the CPI for social and economic studies of the economy, school projects and general information.

"Understanding the Consumer Price Index" is designed to give users of the CPI a general understanding of how it is calculated, and how to use it more efficiently and effectively for day-to-day practical applications.

What is the Consumer Price Index?

The Consumer Price Index measures changes in the general level of prices of consumer goods and services purchased by private households. It is the appropriate economic instrument to use when determining the effect of changes in retail prices on the average household budget. Additionally, the CPI is the most used measure of inflation in Bermuda.

The CPI was discontinued in Bermuda at the end of World War II but re-introduced in 1961. Rapid changes in the consumption and expenditure patterns by private households during the post-war period made it sufficiently impracticable to produce a CPI representative, on a continuous basis, of household spending patterns. Since 1961, however, the calculation of the index has changed to include generally accepted standards of best practice.

The Contents and Structure of the CPI

The Consumer Price Index measures price movements of a given quality and quantity of goods and services. The goods and services included within the scope of the index can be figuratively thought of as a 'shopping basket.' Since the quality and quantity of the goods and services in the 'shopping basket' do not change over the life of the basket it is also referred to as a 'fixed' basket of goods and services.

The 'shopping basket' is comprised of a broad cross-section of consumer products and services that typically are purchased by the households. No two households are exactly alike in their spending habits. Each purchases a different combination of goods and services for consumption. For example, it would be very unusual to find a single household using both a gas stove and an electric stove to prepare meals in the home. However, both types of ranges are included in the shopping basket since both are purchased by large numbers of Bermuda households. Generally speaking, the CPI 'basket' includes those goods and services which are important to households based on the amount of expenditure made on them by households. The CPI is a measurement of pure price change in the sense that every item in the 'basket,' has a price association fixed with a specific quantity and quality. If the quality and quantity to price relationship is not maintained, it is difficult to measure pure price changes.

Since the CPI is calculated using a fixed shopping basket of goods and services, it must be updated periodically to ensure its continued relevancy to the actual spending habits of the households to which it relates. For this reason the Department of Statistics undertakes Household Expenditure Surveys (HES) to collect information on how households spend their money on a periodic basis. The data collected are used to update the 'basket'. This update allows for new goods or services that have become significant in household budgets to be included in the 'basket,' and other items upon which household spending has waned to be downgraded or excluded.

In constructing this 'shopping basket,' the selected goods and services are organized first by commodity type. They are then divided into sub-components and assigned to a major expenditure group. The Bermuda CPI is divided into nine major expenditure groups (commonly referred to as 'sectors'), namely:

- Food
- Rent
- Clothing and Footwear
- Tobacco and Liquor
- Fuel and Power
- Household Goods, Services and Communications
- Transport and Vehicles
- Education, Recreation and Reading
- Health and Personal Care

The average amount spent by all households in the HES on individual items in the basket are added together to obtain a total cost. Within each of the sectors mentioned above, the average household spending on similar individual items are grouped together. For example, in the food sector the average amounts spent on

bread, rolls, cakes and biscuits are added together. The aggregate amount spent on food by households divided by the total spending in all nine sectors of the index represents the weight for the CPI food sector. The following table shows the weighting pattern for the nine sectors

Sectors	2004 HES Weekly Expenditure ($)	Weights as Percentages (%)
Food	207.51	14.6
Rent	460.35	32.5
Clothing and Footwear	50.60	3.7
Tobacco and Liquor	28.18	2.0
Fuel and Power	43.25	3.0
Household Goods, Services and Communications	199.07	14.0
Transport Vehicles and Foreign Travel	197.17	13.9
Education, Recreation and Reading	101.05	7.1
Health and Personal Care	131.14	9.2
Total Expenditure	**1,418.32**	**100.0**

Once the 'basket' has been developed, the quality and quantity of the items in the 'basket' are maintained. However, the total cost of this 'fixed basket' will vary from one period of time to another, as the prices of the items in the basket change. Price changes resulting from such a 'constant or fixed basket' are defined as 'pure' price movements, which is what the CPI, in essence, measures. Comparing the all-items index number in one month with the all-items index of a previous month gives the percentage change in the cost of purchasing the contents of the 'shopping basket,' having regards only to changes in the prices of items contained in it.

Relative Importance of Items in the CPI Basket

The amount spent on each item in the CPI 'basket' is compared to total household spending to obtain the relative importance or 'weight' of the items in the 'basket'. The nine major sectors of the CPI each have representative 'group weights'. These weights establish the impact that a particular price change within each sector will have on the overall index. For example, a 5% rise in the price of gasoline would have a much greater impact on the household budget than a 5% increase in the price of newspapers. This is due to the fact that most households spend more on

petrol than they do on newspapers. The following table shows the average weekly spending of households classified according to the nine major CPI sectors. The weights associated with each of these sectors are shown as percentages and represent the current weighting pattern for the CPI.

Sectors	2004 HES Weekly Expenditure[1] ($)	CPI Group Weights[1] (%)
Food	207.51	14.6
Rent	460.35	32.5
Clothing and Footwear	50.60	3.7
Tobacco and Liquor	28.18	2.0
Fuel and Power	43.25	3.0
Household Goods, Services and Communications	199.07	14.0
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Total Expenditure	**1,418.32**	**100.0**

[1] Weekly expenditure and CPI group weights reflect values for the CPI target group of households and therefore differ from those reported in table A.5 of the 2004 Household Expenditure Survey Report.

The weight associated with each sector is calculated by taking the ratio of expenditure in each sector to total spending of all sectors and multiplying by 100. For example, the weight for the Rent sector is calculated as follows:

$$\frac{\text{Weekly expenditure on Rent}}{\text{Total expenditure (all sectors)}} \times 100$$

$$= \frac{\$460.35}{\$1,418.32} \times 100 = 32.5\%$$

Price Collection

The CPI is designed to measure price changes for a fixed basket of goods and services. Price movements are monitored in many retail stores from which households do their shopping and also at various types of businesses which

provide services to households. Monthly, quarterly and bi-annual pricing surveys are carried out at outlets such as: grocery stores, clothing and footwear stores, furniture and appliance shops, garages, doctors, dentists, law offices, and beauty and barber salons. Additionally, price data for bus, ferry and taxi fares, telephone and electricity charges, education and hospital fees are all collected from establishments and government agencies that provide these services. In total, over 4,065 individual price quotations are either collected and or reviewed each month to compile the Consumer Price Index.

Computation of the CPI

The computation of the monthly CPI begins with the collection of price data from retail stores and household service providers. Once the prices of goods and services have been collected, they are scrutinized to ensure validity of the data being used in the CPI calculations. Prices are compared with the previous month's price data in an effort to monitor price fluctuations and maintain consistency from month to month. A step-by-step procedure is given below, explaining how price index numbers are calculated for each sub-group of the CPI.

Example: The Food sector of the CPI is divided into two sub-components: food purchased from grocery stores and ready-to-eat food bought out, from restaurants and grocery store delicatessens. The grocery store component consists of various sub-groups such as bakery products, meat products, dairy products, vegetables and fruits. To derive a price index number for the sub-group bakery products the following steps are taken.

Step 1

The Department of Statistics collects prices of different types of baked goods such as bread, cakes, rolls and biscuits each month from various grocery stores to obtain an average price that consumers paid for bakery products. The prices are also reviewed to ensure that they refer to the same quality and quantity of baked goods observed in the previous month.

Step 2

A price relative is computed by taking the ratio of the current month's average price and the previous month's average price for all bakery products. For example, if the average price paid for bakery products during January and February was $4.75 and $4.80 respectively, then the price relative for February is calculated as:

$$\frac{\text{Average price paid in February}}{\text{Average price paid in January}} = \frac{\$4.80}{\$4.75} = 1.01005$$

This price relative tells us that the average price of bakery products increased by just over 1.0% from January to February.

Step 3

(a) The price relative is multiplied by the previous month's weight for baked goods to derive the weight for the current period.

Current month's weight = 0.77100 X 1.01005
= 0.77875

(b) Since the CPI is calculated using a base-weighted formula, the cost of bakery products in the base period is needed.

Base period weight = 0.70200

(c) The price index number for bakery products is computed as follows:

$$\frac{\text{Current month's weight}}{\text{Base period weight}} \times 100$$

$$= \frac{0.77875}{0.70200} \times 100$$

$$= 1.10933 \times 100$$

$$= 110.9$$

If the base period were April 2006 and the index number were being calculated for the current period March 2008, then the index is saying that it costs $110.90 in March 2008 to purchase the same quantity of bakery products that cost $100 in April 2006.

Step 4

Weights and price indexes are computed for each sub-group (meat products, dairy products, etc.) in the same manner, including prepared meals in the food bought out sub-group. The current month's sub-group weights are summed to obtain the sector weight; and the index number for the Food sector is calculated using Step 3.

Step 5

Once index numbers have been derived for each of the nine major sectors of the CPI, the average price movement for all goods and services in the 'basket' is computed by taking the ratio of the current month's all-items index number and the index number for the same month in the previous year. This movement or average change in prices is identified as the 'All-items CPI' and represents the headline measure of inflation.

Using the Index Numbers

The Bermuda Consumer Price Index is published on a monthly basis. The Department of Statistics receives numerous requests for CPI information. These requests come from a diverse group of users such as researchers, students, employers and business organizations. The following calculations are presented to illustrate some of the every-day computations requested by users. The index numbers used in the examples are shown in the table below and are taken directly from the monthly CPI Release.

Bermuda Consumer Price Index
All Items Index – April 2006 = 100

Month	2003	2004	2005	2006	2007
Jan	89.7	92.4	96.2	98.6	101.4
Feb	89.8	92.6	96.2	99.0	102.1
Mar	90.0	92.8	96.5	99.2	102.7
Apr	90.8	93.7	96.6	100.0	103.1
May	90.9	94.0	96.9	99.5	104.0
Jun	91.1	94.3	97.0	100.6	104.6
Jul	91.1	94.5	97.1	100.6	104.9
Aug	91.4	94.9	97.6	100.9	104.9
Sept	92.1	95.7	98.4	101.4	105.1
Oct	92.3	95.7	98.4	101.1	105.4
Nov	92.3	95.8	98.4	101.0	105.8
Dec	92.4	95.9	98.3	101.6	105.3
Annual Average	**91.2**	**94.4**	**97.3**	**100.3**	**104.1**

1. Determining Price Changes Between Specified Periods

The CPI is an important economic indicator in that it is used primarily to measure the rate at which the average prices of consumer goods and services change over time; this is the rate of consumer inflation.

(a) Measuring a Month-to-Month Price Change

The price change between February and March, 2003 is calculated as follows:

$$\frac{\text{Mar 2003 index} - \text{Feb 2003 index}}{\text{Feb 2003 index}} \times 100$$

$$\frac{90.0 - 89.8}{89.8} \times 100 = 0.2\%$$

(b) Measuring a Year-to-Year Price Change

The price change between January, 2005 and January, 2006 is calculated as follows:

$$\frac{\text{Jan 2006 index} - \text{Jan 2005 index}}{\text{Jan 2005 index}} \times 100 = \frac{98.6 - 96.2}{96.2} \times 100 = 2.5\%$$

The 2.5% represents the rate of price increase or the rate of inflation for the period between January 2005 and January 2006.

(c) Measuring a Price Change for a Particular Period

Some users request the rate of price change for a particular day of the month, for example, 1 February, 30 April, 31 May, or even 10 August. In such cases users will have to decide which monthly index is most suitable for their requirements.

The price change between 4 October 2003 and 31 October 2007 is calculated as follows:

$$\frac{\text{Oct 2007 index} - \text{Oct 2003 index}}{\text{Oct 2003 index}} \times 100 = \frac{105.4 - 92.3}{92.3} \times 100 = 14.2\%$$

The method of calculation used in each of the above examples is the same and can be used to measure price changes over any specified period of time.

2. Using the CPI as an Economic Tool

In many practical situations, the CPI is used either as a deflation tool or an escalation tool.

(a) A Deflation Tool

Nominal figures can be very misleading when they are used to compare dollar values over different periods of time. When inflation exists, money actually loses its value. Thus to determine the effect of inflation on nominal values, it is necessary to deflate the nominal value by the rate of inflation. The resulting value is the real value or constant dollar value. This technique is shown in the following example.

Gross Annual Sales of Company X

Year	Nominal Sales $ 000	Price Index (2006 = 100)	Constant Sales $ 000
2004	16,800	94.4	17,797
2005	17,500	97.3	17,986
2006	17,900	100.3	17,846
2007	19,300	104.1	18,540

The nominal dollar sales for 2004 to 2007 do not reflect sales volume for Company X, primarily because the prices of goods and services sold by Company X have also increased during these years. Company X can use the price index and derive volume sales for each year to obtain a true indication of sales growth. The price index is thus used as a deflating tool to hold prices constant over the period. When the price index is applied to the nominal dollar sales for Company X, the effect of price increases is removed and a constant dollar sales figure is obtained. The constant dollar value is a better reflection of the quantities of goods sold by the Company. The detailed calculation is as follows:

(i) For 2004: $\frac{\$16,800}{94.4} \times 100 = \$17,797$

(ii) For 2005: $\frac{\$17,500}{97.3} \times 100 = \$17,986$

The real value of economic activity for Company X for 2004 through to 2007 should be assessed using the constant dollar sales values.

(b) An Escalation Tool

One of the most common uses of the CPI as an escalation tool is through wage contracts. These contracts are generally known as collective bargaining agreements and are negotiated between employers and labour unions. The

escalation rule is called a cost of living adjustment clause which is written into the contract such that the wage to be paid in the future is adjusted automatically by changes in the CPI. An example of such a clause is as follows:

"Effective 1 October 2007, the contract will provide an increase in basic wages equal to the percentage increase in the Bermuda CPI from August 2006 to August 2007."

Example: August 2007 the rate of inflation = 4.0%
Weekly wage for Electrician = $1,045.00
Adjusted weekly wage October 2007 = $\frac{\$1,045.00 \times 104.0}{100}$
= $1,086.80

3. Determining the Purchasing Power of Money

The buying power of the Bermuda dollar changes over time as the prices of goods and services change. The CPI is used widely to determine the amount of money that would be needed in the present to have the same purchasing power as an amount that was specified in the past. This type of calculation is needed often when an amount of money has been specified in a will, a trust deed, or some other legal document. For example, if $50,000 was a stated amount in a will drawn up in 1997, the recipient may wish to know the equivalent amount of money to be received in 2007 dollars. This is calculated as follows:

2007 Annual Average CPI = 104.1
1997 Annual Average CPI = 78.2

$$\$50,000 \times \frac{104.1}{78.2} = \$50,000 \times 1.33120 = \$66,560$$

This means that $66,560 had the same buying power in 2007 that $50,000 had in 1997.

On the other hand, the question may be reversed. For instance, what sum of money in 1997 had the same purchasing power as $50,000 in 2007? The method is primarily the same with the exception that the base year is reversed to 2007.

Hence, $$\$50,000 \times \frac{78.2}{104.1} = \$50,000 \times 0.75120 = \$37,560$$

Thus a total of $37,560 in 1997 had the same purchasing power as $50,000 in 2007. The sum of money is lower because prices were lower in 1997.

Historical Series of the Bermuda CPI

The following table provides an historical series of the CPI on a monthly basis. The monthly indexes are averaged over the 12 calendar months of the year to arrive at an annual average. Changes calculated from these averages represent average annual changes for the calendar year.

Bermuda All-Items Consumer Price Index - Base: April 2006 = 100.0

Month	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Jan.	77.5	79.1	80.6	82.9	85.2	87.1	89.7	92.4	96.2	98.6	101.4
Feb.	77.5	79.0	80.6	82.9	85.2	87.3	89.8	92.6	96.2	99.0	102.1
Mar.	77.5	79.1	80.6	83.0	85.3	87.5	90.0	92.8	96.5	99.2	102.7
Apr.	77.9	79.3	81.2	83.5	85.9	88.0	90.8	93.7	96.6	100.0	103.1
May	77.8	79.5	81.3	83.7	86.1	88.0	90.9	94.0	96.9	99.5	104.0
Jun.	78.2	79.7	81.6	83.8	86.3	88.3	91.1	94.3	97.0	100.6	104.6
Jul.	78.3	79.9	82.0	83.8	86.3	88.3	91.1	94.5	97.1	100.6	104.9
Aug.	78.4	79.9	82.1	84.3	86.6	88.4	91.4	94.9	97.6	100.9	104.9
Sep.	78.7	80.2	82.4	84.6	87.0	88.7	92.1	95.7	98.4	101.4	105.1
Oct.	78.7	80.4	82.6	84.8	87.4	89.3	92.3	95.7	98.4	101.1	105.4
Nov.	78.7	80.4	82.6	84.8	87.2	89.4	92.3	95.8	98.4	101.0	105.8
Dec.	79.0	80.4	82.6	84.9	87.1	89.5	92.4	95.9	98.3	101.6	105.3
Annual Average	78.2	79.7	81.7	83.9	86.3	88.3	91.2	94.4	97.3	100.3	104.1
Annual Change	2.1	2.0	2.4	2.7	2.9	2.3	3.2	3.5	3.1	3.1	3.8

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Detailed technical information about the CPI is available upon request.

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