Price and volume index numbers

A short course

Chapter 1: Introduction to index numbers

Learning objectives

At the end of this chapter the students will be able to

- Explain what an index number is
- Compile a simple index number
- Identify different types of index numbers
- Explain how index numbers can be used in practice

Introduction

Index numbers play a major part in economic statistics and national accounting.

This short course was originally developed for the countries of the Southern African Development Community (SADC). It is available and may be adapted for use anywhere

What is an index number?

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

Examples of elementary indices

The population of Zambia each year may be converted into index numbers with the year 2000 as a base year like this.

Year	Population	Index 2000=100
2000	9,885,591	100.0
2001	10,089,492	102.1
2002	10,409,441	105.3
2003	10,744,380	108.7
2004	11,089,691	112.2
2005	11,441,461	115.7
2006	11,798,678	119.4
2007	12,160,516	

The average exchange rate of Tanzanian shillings to US dollars each year, convert this series into index numbers with the year 2000 as a base year.

Year	TShs per US$	Index 2000=100
2000	800.7	100.0
2001	876.4	109.5
2002	966.6	120.7
2003	1038.6	129.7
2004	1089.3	136.0
2005	1128.8	

Exercise 1

Fill in the missing index numbers in the red boxes above. (See the next page if you do not know how to do the calculations.)
By what percentage has the 2007 population of Zambia increased since the year 2000?

Rule of three

The "rule of three" is a very useful procedure when deriving index numbers from a series of statistics.

The boxes in the table below form the corners of a rectangle. To calculate the missing number, you multiply the numbers in the two boxes adjacent to the empty box and divide by the number in the box in the diagonally opposite corner.

Year		TShs per US$		Index 2000=100
2000	A	800.7	B	100.0
2001		876.4		109.5
2002		966.6		120.7
2003		1038.6		129.7
2004		1089.3		136.0
2005	C	1128.8	D	

D = B*C/A = 100*1128.8/800.7 = 141.0

Notice that the results can be seen in different but mathematically equivalent ways. One way is this: the result D (141.0) is obtained by multiplying B (100) by the ratio of C to A (1128.8/800.7 = 1.410). Another way is this: the result D (141.0) is obtained by multiplying C (1128.8) by a fixed ratio (B/A, 100/800.7 = 0.1249).

Types of elementary indices

The examples above are very simple (elementary) forms of index numbers. They refer to a single variable, such as the population, the exchange rate or the value of something in money terms. These relatives do not involve "weights". There are three main types

- Value indices (indicating relative values of anything measured it terms of money)
- Volume or quantity indices (indicating relative quantities of something)
- Price indices (indicating the relative prices of a specific item)

Discussion

What types of index is each of the two examples given above: value, quantity or price?

Why index numbers?

Indices of the elementary kind have little value in themselves. But they can be used to compile more complex "composite" indices, involving many different goods and services. In economic statistics, the term "index numbers" is usually reserved for these more complex "composite" indices. Index numbers become essential when measuring the change in price of a whole variety of products, the prices of which may be varying in different ways.

One can always measure the relative value of a variety of things, as in the turnover of the manufacturing industry (for example) in different periods. But a problem arises when you want to separate out the change in value between changes in price and changes in quantity. Here is a definition of the problem:

The "index number problem"

The problem is how to combine the relative changes in the prices and quantities of various products into (i) a single measure of the relative change of the overall price level and (ii) a single measure of the relative change of the overall quantity level.

Or, conversely, how a value ratio pertaining to two periods of time can be decomposed in a component that measures the overall change in prices between the two periods—that is, the price index— and a component that measures the overall change in quantities between the two periods—that is, the quantity index.

There is no unique way to achieve this.

Source: *Producer price index manual: Theory and practice* IMF, Washington DC, 2004

Types of composite indices

There are only two types of composite indices, (because "value" indices are always simple relatives or ratios of value). They are

- Price indices
- Quantity (or volume) indices

Quantity and volume are synonyms here. In economic statistics, changes in quality are to be considered as changes in quantity and included with them.

Although price indices and quantity indices are very similar in theoretical construction, it is very important to understand the difference between them. There is also a fundamental difference when it comes to measuring them. Changes in the price of an item are far easier to measure than changes in quantity (or value).

The quantities (or values) of items sold in different outlets may vary enormously, depending on many factors including the size and location of the outlets. Prices, by comparison, will not vary so much from outlet to outlet. It is also much easier to find out the price of an item, than the quantity that may have been sold during a month. Knowing price movements in a few outlets will be a good guide to the average movement overall. There will be a tendency for the price of similar items to change in a similar way. On the other hand, with some exceptions, quantities may vary widely and may be difficult to define. Knowing quantities (or values) from a few outlets or producers may not be a very good guide to the total.

Definitions

Price (quantity) index

A price (quantity) index is a measure reflecting the average of the proportionate changes in the prices (quantities) of the specified set of goods and services between two periods of time. Usually the index is assigned a value of 100 in some selected base period, and the values of the index for other periods are intended to indicate the average percentage change in prices compared with the base period.

Source: IMF PPI manual

Base period of a price index

The base period generally is understood to be the period with which other periods are compared and whose values provide the weights for a price index. However, the concept of the "base period" is not a precise one and may be used to mean rather different things. Three types of base periods may be distinguished:

(i) the *price reference period*, that is, the period whose prices appear in the denominators of the price relatives used to calculate the index, *or*

(ii) the *weight reference period*, that is, the period, usually a year, whose values serve as weights for the index. However, when hybrid expenditure weights are used in which the quantities of one period are valued at the prices of some other period, there is no unique weight reference period, *or*

(iii) the *index reference period*, that is, the period for which the index is set equal to 100.

The three reference periods may coincide but frequently do not.

Source: IMF PPI manual

Examples of index numbers

From your own knowledge, list at least three common price indices

Ana at least one quantity index

Using index numbers

Levels and changes

There is often considerable confusion between the *level* of an index and *changes* in the levels. For example, the phrase "level of inflation" actually refers to the rate of change in the general level of prices. Even if inflation is decreasing, prices will still be going up. This is like saying a lorry is slowing down, but it is still moving forward.

The index numbers can tell you the percentage change that has occurred between any two periods.

Exercise 2

Calculate the annual rates of change of the population of Zambia and those of the Tanzanian exchange rate. What can you say about the rates of change in each case?

How is the consumer price index used?

This is an extract from the ILO's consumer price index manual

The origins and uses of consumer price indices

CPIs must serve a purpose. The precise way in which they are defined and constructed depends on what they are meant to be used for, and by whom. CPIs have a long history dating back to the eighteenth century. Laspeyres and Paasche indices, which are still widely used today, were first proposed in the 1870s. The concept of the cost of living index was introduced early in the twentieth century.

Traditionally, one of the main reasons for compiling a CPI was to compensate wage-earners for inflation by adjusting their wage rates in proportion to the percentage change in the CPI, a procedure known as indexation. For this reason, official CPIs tended to become the responsibility of ministries of labour, but most are now compiled by national statistical offices. A CPI that is specifically intended to be used to index wages is known as a compensation index.

CPIs have three important characteristics. They are published frequently, usually every month but sometimes every quarter. They are available quickly, usually about two weeks after the end of the month or quarter. They are also usually not revised. CPIs tend to be closely monitored and attract a lot of publicity.

As CPIs provide timely information about the rate of inflation, they have also come to be used for a wide variety of purposes in addition to indexing wages. For example:

- CPIs are widely used to index pensions and social security benefits.
- CPIs are also used to index other payments, such as interest payments or rents, or the prices of bonds.
- CPIs are also commonly used as a proxy for the general rate of inflation, even though they measure only consumer inflation. They are used by some governments or central banks to set inflation targets for purposes of monetary policy.
- The price relatives derived for CPI purposes can also be used to deflate household consumption expenditures or other items in national accounts.

These varied uses can create conflicts of interest. For example, using a CPI as an indicator of general inflation may create pressure to extend its coverage to include elements that are not goods and services consumed by households, thereby changing the nature and concept of the CPI. It should also be noted that because of the widespread use of CPIs to index a wide variety of payments – not just wages, but social security benefits, interest payments, private contracts, etc. – extremely large sums of money may turn on their movements, enough to have a significant impact on the state of government finances. Thus, small differences in the movements of CPIs resulting from the use of slightly different formulae or methods can have considerable financial implications. CPI methodology is important in practice and not just in theory.

Source: *Consumer price index manual: Theory and practice (Chapter 1)* ILO, Geneva, 2004,

Exercise 3

Two uses of price indices are given below, indexation and deflation.

Indexation

Consider a building contract in which it is agreed that monthly payments will be indexed according to a given price index. Suppose the value of the work done in December (according to the original prices) was 80,000 Pula. Suppose the price index for December was 172 while the price index was originally 160 at the time the contract price was agreed. What would the indexed payment be?

Write down your calculations in detail

Deflation

The following data come from South Africa. First, construct a value index of bank deposits based on the year 2000. Then use the CPI to obtain an index of the "real" value of bank deposits. (Divide the value index by the price index, and multiply by 100.)

Year	Bank deposits Rand millions	Value index 2000=100	CPI (Muni-cipalities) 2000=100	Index of real bank deposits 2000=100
1999	550,158		94.9	
2000	602,617		100.0	
2001	719,887		105.7	
2002	812,290		115.4	
2003	911,284		122.1	
2004	1,033,134		123.8	
2005	1,232,628		128.0	
2006	1,539,452		134.0	

What kind of an index is the last column – value, quantity or price?

What was the average annual rate of growth in the real value of bank deposits between 2000 and 2005?

Chapter 2: The basic theory of index numbers

Learning objectives

At the end of this chapter the students will be able to

- Explain what a Laspeyres (and Lowe) index number formula is
- Describe other types of index numbers
- Write down three different formulae for Laspeyres indices

Value, price and quantity

This session involves some simple algebra.

- $v_{i,t}$ denotes the value of a single item i at time t
- $p_{i,t}$ denotes the price of the item i at time t
- $q_{i,t}$ denotes the quantity of the item i at time t

So $v_{i,t} = p_{i,t} * q_{i,t}$ (As in Excel, $*$ means "multiplied by".)

Exercise 1:

Express q in terms of v and p.

$q_{i,t} =$

For example, if the price of a kilogram of rice is 200 shillings, what quantity can I buy for 1,000 shillings?

- V_t is the sum of the values $\sum_i v_{i,t}$. (We shall omit the i in future.)
- PI and QI will be used to denote price and quantity indices

Note: While the values of different items can be summed, it makes no sense to add quantities, and certainly no sense to add prices of different items.

The Laspeyres (and Lowe) indices

It is often assumed that the formula used for constructing price indices is a Laspeyres index. In reality, the formula is more likely to be a Lowe index, which is more general.

The Lowe price index
A Lowe price index measures the proportionate change between periods 0 and t in the total value of a specified basket of goods and services; that is,

$$PI_{0,t} = 100 * (\sum p_t * q) / (\sum p_0 * q)$$

where the q are the specified quantities (that need not refer to any particular period). This type of index is described as a Lowe index after the index number pioneer who first proposed this general type of index.

Lowe indices are widely used for CPI purposes, the quantities in the basket typically being those of some weight reference period b, which may precede the price reference period 0.

The Laspeyres index is a special case of the Lowe index:

The Laspeyres price index
A Laspeyres price index is a Lowe index in which the basket is composed of the actual quantities of goods and services in the earlier of the two periods compared:

$$PI^{L}_{0,t} = 100 * (\sum p_t * q_0) / (\sum p_0 * q_0)$$

The q_0 are the quantities in the first of the two periods. The earlier period serves as both the weight reference period and the price reference period.

When we say that a price index is Laspeyres, we are assuming that the quantities measured in time period b are the same as those in the price index reference period 0.

Could you make any sense of the above formulae? The example (on the next page) of the way the Laspeyres Formula works may help.

Worked example

These are the data for **period 0**, for the cost of some basic foods

Item	***Quantity q_0***	***Unit price p_0***	***Value p_0*q_0***
Rice	1 kg	150 per kg	150
Beef	300 gms	500 per kg	150
Cabbage	500 gms	200 per kg	100
Papaya	250 gms	400 per kg	100
Total	$\sum(p_0 * q_0)$		**500**

These are the data for **period t**, for the cost of the same quantities of basic foods

Item	***Quantity q_0***	***Unit price p_t***	***Value p_0*q_0***
Rice	1 kg	135 per kg	135
Beef	300 gms	550 per kg	165
Cabbage	500 gms	200 per kg	100
Papaya	250 gms	480 per kg	120
Total	$\sum(p_t * q_0)$		**520**

This table shows that the price of rice went down by 10 per cent, but the price of beef increased. Cabbage stayed the same and papaya was up by 20 per cent.

Exercise 2

From the results above, calculate the Laspeyres index for period t.
(In period 0 the index is 100.)

Now write down the formula for a Laspeyres quantity index. It is similar to the Laspeyres price index formula, but now the prices are fixed and the quantities vary.

$$QI_{0,t} =$$

A useful feature of the Lowe index formula is that it can be decomposed (or factored) into the product of two or more indices of the same type, covering segments of the same period. For example: (omitting the 100)

$$PI_{0,t} = (\sum p_t * q_b) / (\sum p_{t-1} * q_b) * (\sum p_{t-1} * q_b) / (\sum p_0 * q_b)$$

$$= PI_{t-1,t} * PI_{0,t-1}$$

This means that if a Lowe index goes up by 20 per cent and then down by 10 per cent, the overall change is an increase of 8 per cent.

Discussion

How is this 8 per cent calculated? Why is the answer not 10 per cent?

Other types of index number formulae

The Paasche index formula is perhaps the best known after the Laspeyres.

Paasche price index

A Paasche price index is a Lowe price index in which the basket is composed of the actual quantities of goods and services in the later of the two periods compared.

$$PI^P_{0,t} = (\sum p_t * q_t) / (\sum p_0 * q_t)$$

The later period is the weight reference period and the earlier period is the price reference period.

It is very rare for a Paasche index to be constructed directly. But they appear particularly in the context of GDP. The "implied" GDP deflator is a Paasche price index. It is obtained by dividing estimates of GDP at current prices by estimates of GDP at constant prices (and multiplying by 100). Estimates of GDP at current and at constant prices are of the form $\sum p_t * q_t$ and $\sum p_0 * q_t$ respectively.

One theoretically desirable property of an index number is that it should be symmetric. Neither the Laspeyres nor the Paasche index is symmetric. Examples of symmetric indices are given below.

Symmetric indices
Symmetric indices treat the two periods symmetrically by attaching equal importance to the price and expenditure data in both periods. The price and expenditure data for both periods enter into the index formula in a symmetric way.

Fisher index
A Fisher index is the geometric average of a Laspeyres price index and Paasche price index.

Edgeworth price index
An Edgeworth price index is a Lowe price index in which the quantities in the basket are simple arithmetic averages of the quantities consumed in the two periods.

Törnqvist price index
A Törnqvist price index is defined as the weighted geometric average of the price relatives in which the weights are simple arithmetic averages of the expenditure shares in the two periods. Also known as the Tornqvist–Theil price index.

Walsh price index
A Walsh price index is a Lowe price index in which the quantities are geometric averages of the quantities in the two periods.

Source: *Consumer price index manual: Theory and practice (Glossary)* ILO, Geneva, 2004

Learning points

- The theory tends to concentrate on *pairs* of time periods. In practice, economic statistics consists of *series* of annual, quarterly or monthly periods. Moreover, the series are dynamic: new periods have to be added on a regular basis.
- Timely information is rarely available on values and quantities in the latest period.
- In most cases, quantities are not actually reliably measurable. So index number formulae in practice are expressed in terms of values and prices only (more below).

Question

Can you think of a comprehensive set of statistics in which both values and quantities are available for the latest period?

Why are symmetric formulae rarely used in practice for monthly statistics?

Two stages in index number calculations

There are two main stages in the calculation of an index such as the CPI. The first is the collection of the price data and the calculation of the "elementary" price indices for each basic product (such as rice). The second is the aggregation of the elementary price indices to arrive at price indices for groups of products (such as food), up to the overall CPI itself. Expenditure data are needed for each elementary item in order to calculate weights for the second stage.

Stage 1: Elementary aggregates

Elementary aggregate
An elementary aggregate is the smallest aggregate for which expenditure data are available and used for CPI purposes. The values of the elementary aggregates are used to weight the price indices for elementary aggregates to obtain higher-level indices. The range of goods and services covered by an elementary aggregate should be relatively narrow, and may be further narrowed by confining the goods and services to those sold in particular types of outlet or in particular locations.

Elementary price index
An elementary index is a price index for an elementary aggregate. Expenditure weights cannot usually be assigned to the price relatives for the sampled products within an elementary aggregate, although other kinds of weighting may be explicitly or implicitly introduced into the calculation of elementary indices. Three examples of elementary index number formulae are the Carli, the Dutot and the Jevons.

Carli price index
An elementary price index defined as a simple, or unweighted, arithmetic average of the sample price relatives.

Dutot price index
An elementary price index defined as the ratio of the unweighted arithmetic averages of the prices in the two periods compared.

Jevons price index
An elementary price index defined as the unweighted geometric average of the sample price relatives.

Source: *Consumer price index manual: Theory and practice (Glossary)* ILO, Geneva, 2004,

The method recommended internationally is the Jevons method. Reasons for this include:

- Unlike the Carli, the Jevons index is independent of the chosen price base period
- Unlike the Dutot, the Jevons index is independent of the levels of price quotations
- Prices are always positive and tend to follow a log-normal distribution

Three Laspeyres index formulae

There are three ways in which to formulate the Laspeyres (Lowe) index calculations.

Method 0

The first, method 0, is the basic Laspeyres formula already given above.

$$PI^{L}_{0,t} = 100 * (\sum p_t * q_0) / (\sum p_0 * q_0) \quad \ldots\ldots\ldots(0)$$

Method 1

However, a Laspeyres price index can also be expressed as a weighted arithmetic average of price relatives, that uses the expenditure shares in the earlier period as weights. In this method, data on quantities are not required, only price relatives are base period values. In practice this is the method that is most often used.

Method 1 formula

The price relatives and weights are defined as follows

- $r_{0,t} = p_t / p_0$ is the price relative for one item, relative to the base period
- $w_0 = v_0 / V_0$ are the expenditure share of the item in the total expenditure

Then $PI^L_{0,t} = 100 * (\sum w_0 * r_{0,t})$ ....(1)

Exercise 3

Write down the steps needed to derive the formula for Method 1

Starting with Method 0:

$$PI_{0,t} = 100 * (\sum p_t * q_0) / (\sum p_0 * q_0)$$

Replace q_0 with v_0 and p_0

$=$

Simplify, and replace p_t/p_0 with $r_{0,t}$

$=$

Replace $\sum v_0$ with V_0 and bring the division by V_0 inside the summation

$=$

Finally introduce w_0

$=$

Using the data from our earlier example on page 3, we can construct the index without knowing the quantities involved:

The weights are obtained from the last column of the table on page 3, period 0. The relatives are obtained by expressing each

Item	*Weights* w_0	*Relatives* r_t	$w_0*r_t/100$
Rice	30	90	27
Beef	30	110	33
Cabbage	20	100	20
Papaya	20	120	24
Total	**100**		**104**

The index result for period t is 104.

Method 2

The third method of calculation (sometimes called "modified" Laspeyres) involves calculating price relatives for successive periods. In other words, there is no fixed price reference period in this method. The price reference period is the one but last in the series. The advantage of this method is that it makes the substitution of items easier.

$$PI^L_{0,t} = PI^L_{0,t-1} * (\sum w_{t-1} * r_{t-1,t}) \qquad \ldots\ldots\ldots(2)$$

The weights w_{t-1} in this formula have to be re-calculated in every time period, or replaced by more up-to-date information.

Advanced mathematicians may wish to prove the following statement

In method 2, if $w_{t-1} = (w_{t-2} * r_{t-2,t-1}) / \sum (w_{t-2} * r_{t-2,t-1})$ and $PI^L_{0,0} = 100$,

then $PI^L_{0,t} = 100 * (\sum w_0 * r_{0,t})$

Chapter 3: Practical examples

Learning objectives

At the end of this chapter the students will be able to

- calculate elementary indices
- calculate Laspeyres indices in three ways

Elementary price indices

The following data refers to the price of rice in four local markets

Rice price data	*Jan*	*Feb*	*Mar*
Market A	920	1,150	1,020
Market B	920	990	1,020
Market C	1,120	1,160	1,190
Market D	1,040	1,100	1,090

Refer to Chapter 3 for the averaging methods at the elementary level.

Exercise 1

Calculate the following index numbers by completing the table on the next page:

- A1 Carli: Arithmetic means of price relatives based on January
- A2 Carli: The same but based on March (the index would then be rescaled to January=100 for comparison purposes)
- B Dutot: Index of arithmetic means of prices
- C Jevons: Index of geometric means of prices
- D1 and 2: Indices based on geometric means of price relatives

Use Excel formulae, including the functions AVERAGE() and GEOMEAN()

		Jan	Feb	Mar
A1	Relatives based on January (Divide each price by the Jan price & multiply by 100			
	Market A	100		
	Market B	100		
	Market C	100		
	Market D	100		
	Arithmetic mean index (Make averages of the four relatives)	100.0		
A2	Relatives based on March (Divide each price by the March price & multiply by 100			
	Market A			100
	Market B			100
	Market C			100
	Market D			100
	Arithmetic means			
	Index (Jan=100) (Rescale the means using the rule of three)	100.0		
B	Arithmetic mean of prices (Average the prices on page 1)			
	Index (Jan=100) (Rescale the means using the rule of three)	100.0		
C	Geometric mean of prices (Make a geometric mean of the prices on page 1)			
	Index (Jan=100) (Rescale the means using the rule of three)	100.0		
D1	Geo mean of Jan relatives			
D2	Geo mean of Mar relatives			
	(rescaled to Jan=100) (Rescale row D2 using the rule of three)	100.0		

Discussion points

1. What do you notice about these results?
2. Which method do you favour and why?
3. Which (if any) of the observations might be an outlier and why?

Laspeyres aggregation methods

Exercise 2

In this example, we shall construct a simple price index to measure the cost of building materials needed to build a small dwelling. We shall calculate the index using the three methods described in Chapter 2.

Method 0

Complete the calculations below according to Laspeyres method 0.

Data at time t = 0

Item	***Unit***	***Quantity*** q_0	***Unit price*** p_0	***Value*** $p_0 * q_0$
Cement	50kg bag	8	18,000	
Bricks	piece	1,000	96	
Iron sheets	piece	4	10,000	
Paint	4 litre tin	5	4,000	
Total V_0				
Index PI_0				**100.0**

Data at times t = 1 and 2

Item	*Unit*	*Prices p_1*	*$p_1 * q_0$*	*Prices p_2*	*$p_2 * q_0$*
Cement	50kg bag	20,000		19,000	
Bricks	piece	101		102	
Iron sheets	piece	11,000		11,500	
Paint	4 litre tin	5,000		6,000	
Total					
Index PI_t					

Method 1

1. Calculate the weights from the values for time t = 0
   (It is not essential that they add to 100 – the total could be 10,000 or any value)
2. Calculate the price relatives $r_{0,t} = p_t / p_0$ for period t = 1
3. Multiply the price relatives by the weights and make the totals
4. Repeat for time t = 2
5. If necessary, use the rule of three to rescale so that PI_0=100.

Item	*Weights w_0*	*Price relatives $r_{0,1} = p_1/p_0$*	*$w_0 * r_{0,1}$*	*Price relatives $r_{0,2} = p_2/p_0$*	*$w_0 * r_{0,2}$*
Cement					
Bricks					
Iron sheets					
Paint					
Total					
Index PI_t	**100**				

Method 2

When t = 1, method 2 is the same as method 1. For period t = 2, do the following:

1. Update the weights w_1 based on the figures $w_0 * r_{0,1}$ above
2. Calculate price relatives for period 2 compared with period 1
3. Multiply the price relatives by the weights and make the totals
4. In the first column PI_1 is taken from the previous table
5. Use the rule of three to obtain the index for t=2.

Item	*Updated weights* w_1	*Price relatives* $r_{1,2} = p_2/p_1$	$w_0 * r_{0,2}$
Cement			
Bricks			
Iron sheets			
Paint			
Total			
Index PI_t			

Did you get the same answer using all three methods?

Chapter 4: Imputation and replacement

Learning objectives

At the end of this chapter the students will be able to

- impute a price for one that is missing
- replace one item with another

Imputing for a missing price

Here is the data on the price of rice in four local markets again. This time one price is missing. Our task is to estimate what it would be.

Rice price data	***Jan***	***Feb***	***Mar***
Market A	920	1,150	1,020
Market B	920	990	1,020
Market C	1,120	1,160	
Market D	1,040	1,100	1,090

First it is important to understand why an imputation is necessary.

Exercise 1

Suppose we are using the geometric mean (Jeavons) method. The usual formula is to take the geometric mean of the four price observations If you do this for January you get 996. For February you get 1,098.

Question 1

If you take the geometric mean of all four figures in March, including zero for market C, what result do you get? Why is this result not acceptable?

NB: With a zero, the function GEOMEAN in Excel does not work – why not?

Question 2

If you take the geometric mean of the figures for three of the four markets in March, excluding zero for market C, what result do you get?

If we use the result to calculate the percentage *change* in the index from January to March, what answer do we get? Why is this result probably wrong?

Question 3

Calculate the geo-mean for markets A, B and D only, for January. If we use this result to calculate the percentage *change* in the index from January to March, what answer do we get?

Question 4

The recommended method for obtaining an imputed value is as follows. Increase the price measured in market C in January by answer to question 3. What is the result?

Question 5

Calculate the index number for March using the imputed value.

Replacing one product with another

In measuring price changes, it is crucial, as far as possible, that exactly the same product is priced on each occasion. Variations in the quality of items being priced introduces inaccuracy (if not bias) into a price index. The **quality** of an item may include the quantity being sold at one time (even if converted to a price per kg) because a small quantity may be more useful than a large quantity; it may also include the time of day or day of the week of purchase; it may include the type or location of the outlet; as well as more obvious changes in the specification of a particular item. All such variations in quality are to be avoided.

But if one product ceases to be representative, or ceases to be available altogether, then a more representative, available product must be substituted, and the measurement of price change switched from the 'old' item to the 'new' one.

Ideally the two qualities will be available in the same period *t*. It may then be argued as follows:

Suppose that the two qualities overlap, both being available on the market at time *t*. If consumers are well informed, have a free choice and are collectively willing to buy some of both at the same time, economic theory suggests that the ratio of the prices of the new to the old quality should reflect their relative utilities[1] to consumers. This implies that the difference in price between the old and the new qualities does not indicate any change in price. The price changes up to period *t* can be measured by the prices for the old quality, while the price changes from period *t* onwards can be measured by the prices for the new quality. The two series of price changes are linked in period *t*, the difference in price between the two qualities not having any impact on the linked series.

Source: *Consumer price index manual: Theory and practice (Chapter 1)* ILO, Geneva, 2004
see paragraphs 1.237-1.240 for further discussion

More often however, the old item, priced in period *t-1*, disappears in period *t* and has to be replaced. In such a case the price of the old item in period *t* should be imputed using the method described in the previous section. Then one can use the same procedure as with the overlapping case.

The following table shows how, in a price index, one specification can take over from another and a continuous index produced. February is 100*210/200=105 and April is 102*162/153=108 (two separate applications of the rule of three).

Item	*Jan*	*Feb*	*Mar*	*Apr*	*May*
Spec A	200	210	204		
Spec B			153	162	159
Price relative	**100**	**105**	**102**	**108**	**106**

[1] In economics, **utility** is a measure of the relative happiness or satisfaction (gratification) gained. Given this measure, one may speak meaningfully of increasing or decreasing utility, and thereby explain economic behaviour in terms of attempts to increase one's utility. (from wikipedia.com, accessed 10 July, 2007)

Exercise 2

Use the data below and two different applications of the rule of three to produce a price relative for this product:

Item	***Jan***	***Feb***	***Mar***	***Apr***	***May***
Spec A	500	520	540		
Spec B			675	700	750
Price relative	100				

Chapter 5: Errors in index numbers

Learning objectives

At the end of this chapter the students will be able to

- calculate standard errors of month-to-month price movements
- interpret their meaning
- use them to identify possible errors

Calculating standard errors

Here are the data on the price of maize meal in four local markets again. The task is to measure the standard error of the price *movements* not the prices.

Maize meal price data	***Jan***	***Feb***	***Mar***
Market A	920	1,150	1,020
Market B	920	990	1,020
Market C	1,120	1,160	1,190
Market D	1,040	1,100	1,090

We shall use a multiplicative model in doing this, working in logarithms. We do this because prices are always positive. They cannot be zero or negative. They tend to follow a 'log-normal' distribution. The 'opposite' of a doubling (a 100% increase) in price is a halving in price (a 50% decrease), because if the halving follows a doubling, it brings us back to the starting point. Also, if a doubling of price follows a halving, again we return to the starting point.

Discussion questions

1. What is the opposite of an increase of 25%? A decrease of ______%
2. What is the opposite of a decrease of (not 'to') 80%? An increase of _______%

Exercise 1

Complete these tables. First we take logs:

Logs of the prices ***(base 10)***	***Log(Jan)***	***Log(Feb)***	***Log(Mar)***
Market A	2.964	3.061	
Market B	2.964	2.996	
Market C	3.049	3.064	
Market D	3.017	3.041	

Next we take the differences between the logs, finding the mean and a confidence interval:

Differences of the logs	***Feb-Jan***	***Mar-Feb***	***Mar-Jan***
Market A	0.097		
Market B	0.032		
Market C	0.015		
Market D	0.024		
Mean	**0.042**		
Standard error of the mean	0.019		
2 standard errors more	0.079		
2 standard errors less	0.005		

The percentage change is obtained by subtracting 1 from the mean and expressing the result as a percentage. The spread is the width of the confidence interval

Antilog results	***Feb-Jan***	***Mar-Feb***	***Mar-Jan***
Mean	1.102		
Percentage change	**10.2%**		
2 standard errors more (a)	20%		
2 standard errors less (b)	1%		
Spread (a)-(b)	**19%**		

Interpreting the results

What do you notice about these results and what do they mean? Write down your answer

They mean that we can be reasonably confident[2] that the 'true' increase (or decrease) in price lies between the upper and lower percentages shown; between January and February the increase was somewhere between 1% and 20%.

This is a very wide range (19%). In the case of January to March, the spread is much smaller (6%). The results suggest that the variation in the price increases recorded in February was high. In particular, the price obtained from market A appears to be out of line with the others, because there was a 25% increase in February, while in March the price returned to a more reasonable level.

Any spread that exceeds a certain limit, for example 10% (ie 5% above or below the mean), ought to be investigated. Very often this will have occurred as the result of some kind of error in recording (did the specification change?) or in data entry. Maybe the 1,150 should have been 1,050.

Exercise 2

Recalculate the standard errors etc on the assumption that the price for market A in February should have been 1,050.

[2] In this case, with three degrees of freedom, the probability of the true mean falling within an interval of plus or minus two standard errors is about 86%. More observations would give better precision.

Antilog results	***Feb-Jan***	***Mar-Feb***	***Mar-Jan***
Percentage change			
2 standard errors more (a)			
2 standard errors less (b)			
Spread (a)-(b)			

Exercise 3

Compute the average monthly price changes and confidence intervals for the cooking oil price in the following markets.

Cooking oil price data

	Jan	Feb	Mar	Apr	May	Jun	Jul
Market A	453	428	468	432	435	458	489
Market B	400	430	483	436	444	445	477
Market C	420	423	481	440	445	470	454
Market D	421	450	472	411	434	471	495
Market E	406	427	450	423	441	432	486
Market F	404	441	481	434	454	451	494

Antilog results	***Feb-Jan***	***Mar-Feb***	***Apr-Mar***	***May-Apr***	***Jun-May***	***Jul-Jun***
Percentage change						
2 standard errors more (a)						
2 standard errors less (b)						
Spread (a)-(b)						

Detecting errors

The above examples illustrate how possible errors can be detected by calculating standard errors. High values are very likely to indicate some kind of error.

Errors are extremely common. This author is always making them. The main job of the statistician is to detect and correct them wherever possible. Data must be examined in a number of ways to see if they make sense. They should be compared with other sources. They should be compared with what you would expect.

Sometimes the unexpected happens. If a new industry starts up (for example if natural gas is discovered and extracted), its growth rate may be enormous at first. With prices, huge changes are unlikely, unless inflation is out of control. Nine times out of ten, an odd price will be the result of an error.

Exercise 4

List six different sources or kinds of error in statistics

Chapter 6: Indices of Industrial Production

Learning objectives

At the end of this chapter the students will be able to

- construct a quantity index such as the Index of Industrial Production

Indices of industrial production

The purpose of a quantity index, such as an Index of Industrial Production (IIP), is to measure the changes in the quantities of a range of goods and/or services over a period of time, for example, the output of manufacturing industry.

The obvious way to construct such an index is to apply the Laspeyres formula (method 1) to data on quantities:

$$QI_{0,t}^{L} = 100 \sum w_0 * r_{0,t}$$

where

- $r_{0,t} = q_t \,/\, q_0$ is the quantity relative for one item, relative to the base period
- $w_0 = v_0 \,/\, V_0$ are the weights based on values (see below)

For an Index of Industrial Production (IIP), it is usual to base the weights on the **value added** associated with the production of the product, that is, the total value of the output *minus* the value of the inputs of goods and services used in the production (intermediate consumption). This methodology corresponds to that used for estimating GDP.

Difficulties with quantity indices

There are three major problems with the construction of a quantity index which make it far more difficult than the construction of a price index.

The first is this. Users will expect such an index to reflect changes in the **total** production going on, while a price index reflects changes in an **average** price per unit of quantity. There is a huge difference between these requirements, because (except in times of very high inflation) price changes can be accurately measured with a relatively small sample of observations. Total quantities, however, are intrinsically far more variable than prices are. The quantities (and the value) of a given commodity produced by different establishments may vary widely (while the prices per item will be very similar). Where the output is produced by two or three large enterprises, all willing to supply data, then this is not a problem. But if a large, unknown number of producers are involved, the accuracy of the estimate is very likely to be poor.

The second problem is that most production is not homogeneous, or not of uniform quality. To be sure, some products can be considered as homogeneous (near enough), such as rice, cement, beer, petroleum products, electricity. But many are not: clothes, shoes, furniture, chemical, pharmaceutical products (and of course many types of services). Measuring the quantities of such products is not easy, and sometimes impossible.

Finally, the most serious problem is how to incorporate new businesses and new products into the index, if production starts after the base period when the quantity produced was zero. No guidelines are available for doing this, and most Indices of Industrial Production compiled in this way suffer from this fundamental problem. It is not a matter of substitution (like that used in a price index). Additional production needs to be added in, but how?

Deflating sales data

The international recommendations, designed to overcome the last two of these difficulties, are as follows. First, the total **value** of the turnover of all establishments in a given sub-sector should be established for each time period. This single figure is relatively easy to obtain, compared with detailed figures on the quantities of each item produced. It can be obtained either by means of a survey, or by exploiting administrative data such as VAT returns. In any event it is crucial that new businesses are included as soon as possible after they start operating. Good relations with a reliable administrative sources are the only way for the statistical service to become aware of them quickly.

Once the total values have been established for each sub-sector, they are turned into value index numbers and deflated using corresponding Producer Price Indices (PPIs). The results are quantity indices for each sub-sector that can be weighted together as usual.

While this methodology involves a number of assumptions, it overcomes the most important source of bias, that which results from not including the activities of new businesses (or the production of new products by existing businesses) in the index.

Exercise

Suppose the prices charged by the manufacturers of a certain category of products move in approximately the same way (key assumption). Which of the following further assumptions are needed for the deflation method to give acceptable results?

1 No new products are produced	Needed ☐	Not needed ☐
2 The cheapest product is not discontinued	Needed ☐	Not needed ☐
3 The turnover excludes sales of goods made by others	Needed ☐	Not needed ☐
4 The value added to turnover ratio is roughly the same for all products	Needed ☐	Not needed ☐
5 The best selling product is always the same one	Needed ☐	Not needed ☐

Illustrate your conclusions with some artificial data.

Chapter 7: Rebasing techniques

Learning objectives

At the end of this chapter the students will know how to

- re-weight a price index
- link previous indices to the new ones
- re-reference a price index

Rebasing

In a changing world, it does not take very long before an index becomes out-of-date, for two main reasons:

- the weights no longer reflect the patterns of expenditure, output or trade
- new products come on to the market that did not exist before

Traditionally, index number systems have been up-dated through a process of "rebasing". This process involves revising the weights (in the light of more recent data), introducing new products into the data collection process and resetting the index to 100 in the new "base year".

These days, it is not however regarded as essential to re-weight and re-reference an index at the same time. Indeed, several countries update the weights of (and products included in) their CPI every year, thus ensuring that the index always reflects recent spending patterns. However, it would clearly be very confusing for users if the reference period (in which the index equals 100) were also changed every year. So the reference period is kept the same, and the re-weighted index is linked to the old one to form a chained Lowe-type index.

Unfortunately, many systems put in place for producing indices do not provide facilities for regular re-weighting, with the result that re-weighting (or rebasing) is more difficult for National Statistical Offices to achieve.

First reread the following extract from the CPI manual

Sources of data for CPI expenditure weights

Household expenditure surveys and national accounts

The principal data source for household consumption expenditures in most countries is a household expenditure survey (HES). An HES is a sample survey of thousands of households that are asked [for details] of their expenditures on different kinds of consumer goods and services [during] a specified period of time, such as a week or longer. The size of the sample obviously depends on the resources available, but also on the extent to which it is desired to break down the survey results by region or type of household. HESs are costly operations.

This [chapter] is not concerned with the conduct of HESs or with general sampling survey techniques or procedures. There are several standard texts on survey methods to which reference may be made. Household expenditure surveys may be taken at specified intervals of time, such as every five years, or they may be taken each year on a continuing basis.

HESs can impose heavy burdens on the respondents, [and they] tend to have some systematic biases. For example, many households either deliberately, or unconsciously, understate the amounts of their expenditures on certain "undesirable" products, such as gambling, alcoholic drink, tobacco or drugs. Corrections can be made for such biases. Moreover, the data collected in HESs may also need to be adjusted to bring them into line with the concept of expenditure required by the CPI. For example, the imputed expenditures on the housing services produced and consumed by owner-occupiers may not be collected in HESs.

The use of the commodity flow method within the supply and use tables (SUTs) of the System of National Accounts enables data drawn from different primary sources to be reconciled and balanced against each other. The commodity flow method may be used to improve estimates of household consumption expenditures derived from expenditure surveys by adjusting them to take account of the additional information provided by statistics on the sales, production, imports and exports of consumer goods and services. By drawing on various sources, the household expenditure data in the national accounts may provide the best estimates of aggregate household expenditures, although the classifications used may not be fine enough for CPI purposes… It is important to note, however, that national accounts should not be viewed as if they were an alternative, independent data source to HESs. On the contrary, HESs [are a major] source for the expenditure data on household consumption used to compile [benchmark estimates of GDP].

Household expenditure surveys in many countries may not be conducted as frequently as might be desired for CPI, or national accounts, purposes…[As a result,] CPIs in many countries are Lowe indices that use the quantities of some base period b that precedes the price reference period 0 [by a year or more] and period t by many years.

Countries that conduct continuous expenditure surveys are able to revise and update their expenditure weights each year so that the CPI becomes a chain index with annual linking. Even with continuous expenditure surveys, however, there is a lag between the time at which the data are collected and the time at which the results are processed and ready for use, so that it is never possible to have survey results that are contemporaneous with the price changes. Thus, even when the weights are updated annually, they still refer to some period that precedes the time reference period. For example, when the price reference period is January 2007, the expenditure weights may refer to 2004 or 2005, or perhaps both years. (Some countries prefer to use expenditure weights that are the average rates of expenditure over periods of two or three years in order to reduce "noise" caused by errors of estimation (the expenditure surveys are only samples) or erratic consumer behaviour over short periods of time.)

Source: *Consumer price index manual: Theory and practice (Chapter 1)* ILO, Geneva, 2004

Re-weighting

In effect, re-weighting the CPI means starting again for calculation purposes with a given period as 100. The usual source of data for weights is a Household Expenditure Survey (HES, see chapter 3). If this is the source, the first task will be to match the codes used in the HES to the sample of prices used in the CPI.

Exercise 1

Here is an example from Tanzania. The CPI codes on the right have to be allocated to the HES codes on the left. Try it.

HES Code	Description	CPI code
	Cereals	
10101	Paddy	
10102	Rice, husked	
10103	Green maize cob	
10104	Maize, grain	
10105	Maize, flour	
10106	Millet, grain	
10107	Millet, flour	
10108	Sorghum, grain	
10109	Sorghum, flour	
10110	Wheat, grain	
10111	Wheat, flour	
10112	Barley and other cereals	
10113	Cost of grinding	
	Cereal Products	
10201	Bread	
10202	Baby foods excluding milk	
10203	Biscuits	
10204	Buns, cakes, small breads, etc	
10205	Macaroni, spaghetti	
10206	Cooking oats, corn flakes and other cereal products	
etc		

CPI code	Description
01.01.1	Cereals
01.01.11	Rice
01.01.12	Maize grain
01.01.13	Maize flour
01.01.14	Cost of grinding
01.01.15	Wheat flour (other)
01.01.2	Cereals Products
01.01.21	Bread
01.01.22	Buns, Cakes
01.01.23	Spaghetti
01.01.24	Biscuits

The next step is to obtain a table of HES data for each HES code (average expenditures per household) and then find the totals for each CPI code. The Excel SUMIF function could be used to do this. Finally the values can be converted into weights. This systematic approach provides a clear record of the decisions taken to obtain the new weights.

New price relatives are now calculated by reference to the new base period. They are aggregated using the new weights. The result is a fully rebased index.

Linking to the previous base

In order to avoid changing the reference period too frequently, the new indices may each be linked to the old index. First it is necessary to know the values I_b of the old indices in the new base period. Then one can multiply each new index number by the corresponding value I_b and divide by 100. This provides a re-weighted index number based on the old reference period.

Exercise 2

This example comes from Malawi.

http://www.nso.malawi.net/data_on_line/economics/prices/national_cpi.htm

CPI (2000=100)	Weight	2000	2001	2002	2003	2004	2005
All Items	**100.0**	**100.0**	**122.7**	**140.8**	**154.3**	**172.0**	**198.5**
Food	58.1	100.0	117.6	136.4	146.3	154.4	181.0
Beverage &Tobacco	5.9	100.0	131.0	136.7	165.8	196.5	240.6
Clothing & Footwear	8.5	100.0	130.5	152.7	166.8	179.5	192.8
Housing	12.1	100.0	132.9	156.6	180.0	211.7	236.9
Household operation	4.1	100.0	129.3	143.8	172.9	218.3	269.0
Transport	5.1	100.0	129.5	143.9	172.1	202.8	230.1
Miscellaneous	6.2	100.0	122.1	134.4	148.3	169.1	182.6

Question 1

One figure in the above table has been *deliberately* misprinted for the purpose of this exercise. Check that the "All Items" index has been correctly calculated as a weighted average of the components. This can be done using the Excel SUMPRODUCT function. In which year is the misprint? (If you have access to the web, you could identify it.)

Question 2

Calculate ***price-updated*** weights for the year 2005. To do this multiply the weight of each component by the 2005 index and divide by 100. Make a total. Find the share of each category in this total. (Note these weights could be replaced if a new HES has been done.)

CPI (2000=100)	**Weight (a)**	**2005 (b)**	**a*b/100**	**% share**
All Items	**100.0**	**198.5**	∑	**100.0**
Food	58.1	181.0	105.1	
Beverage &Tobacco	5.9	240.6		
Clothing & Footwear	8.5	192.8		
Housing	12.1	236.9		
Household operation	4.1	269.0		
Transport	5.1	230.1		
Miscellaneous	6.2	182.6		

Question 3

Suppose now that a new HES had been conducted to give new weights for the year 2005, shown below. Price relatives for each category for the year 2006 are also shown.

- Calculate the new all items index using the new weights and price relatives.
- Link the new index to the old, so that the 2000 reference period is retained. (The all items index must be linked in the same way as for the components.)

CPI	**2005=100**			**2000=100**	
	Weight	**2005**	**2006**	**2005**	**2006**
All Items	**100.0**	**100.0**		**198.5**	
Food	53.2	100.0	115.6	181.0	209.1
Beverage &Tobacco	6.5	100.0	113.7	240.6	
Clothing & Footwear	4.1	100.0	108.3	192.8	
Housing	18.0	100.0	112.7	236.9	
Household operation	6.2	100.0	116.5	269.0	
Transport	6.6	100.0	113.7	230.1	
Miscellaneous	5.4	100.0	108.2	182.6	

In practice, re-weighting is done at a much more detailed level. And of course the calculations would need to be done monthly.

Linking old series to a new base

If it is decided to change the reference period of a index number (in which the index is equal to 100), the previous series should be re-scaled so that users have a continuous series from which to determine the change in prices between any two periods.

Rescaling a series of numbers does not affect the percentage changes (except perhaps for rounding error).

Exercise 3

Here are the Malawi data from 2000 to 2005. Suppose they were rebasing the series on 2005.

CPI (2000=100	2000	2001	2002	2003	2004	2005
All Items	**100.0**	**122.7**	**140.8**	**154.3**	**172.0**	**198.5**
Food	100.0	117.6	136.4	143.6	154.4	181.0
Beverage &Tobacco	100.0	131.0	136.7	165.8	196.5	240.6
Clothing & Footwear	100.0	130.5	152.7	166.8	179.5	192.8
Housing	100.0	132.9	156.6	180.0	211.7	236.9
Household operation	100.0	129.3	143.8	172.9	218.3	269.0
Transport	100.0	129.5	143.9	172.1	202.8	230.1
Miscellaneous	100.0	122.1	134.4	148.3	169.1	182.6

Using Excel, rescale all the series so that they equal 100 in 2005. Use the price-updated old weights for 2005 (Qu 2 above) and the SUMPRODUCT function to recalculate the all items index based on 2005. Do you get the same answers as the rescaled series?

CPI (2000=100	2000	2001	2002	2003	2004	2005
All Items (scaled)						**100.0**
All Items (recalculated)						**100.0**
Food						100.0
Beverage &Tobacco						100.0
Clothing & Footwear						100.0
Housing						100.0
Household operation						100.0
Transport						100.0
Miscellaneous						100.0

Changing the classification

Rebasing provides an opportunity to review the classification scheme. If it is decided to revise the scheme, it is not quite so easy to link the old series to the new ones. However, it can be done, by reworking the old series according to the new categories. For example, one could estimate what weights and price relatives would have been appropriate in the old base year for each new major (published) category.

Review

This chapter has covered issues associated with rebasing a CPI.

First of all, rebasing involves starting again with new weights from a new Household Expenditure Survey (HES). If the base period is not the same as the period during which the HES took place, the weights should be ***price-updated*** to the base period.

Once the new series have been calculated using the new weights and base period, there is a choice between the following options:

- The reference base period can be kept the same as it was, useful when the weights are revised frequently. In this case the new series can be rescaled so that they link on to the old.
- The reference base period can be changed to reflect the date from which the latest weights have been used. In this case it is helpful to users if the previous series are rescaled so that they are linked to the new base.

Both of these techniques have been illustrated.

Classification

The classification of household expenditures used in a CPI provides the necessary framework for the various stages of CPI compilation. It provides a structure for purposes of weighting and aggregation. The goods and services covered by a CPI may be classified in several ways: not simply on the basis of their physical characteristics but also by the purposes they serve and the degree of similarity of their price behaviour. Product-based and purpose-based classifications differ but can usually be successfully mapped onto each other. In practice, most countries use a hybrid classification system in which the breakdown at the highest level is by purpose while the lower-level breakdowns are by product type.

[The] internationally agreed Classification of Individual Consumption according to Purpose (COICOP) provides a suitable classification for CPI purposes… It is desirable for the price movements of the individual products within the elementary aggregates to be as homogeneous as possible.

Source: *Consumer price index manual: Theory and practice (Chapter 1)* ILO, Geneva, 2004

A summary of the COICOP classification is given in the Annex to these notes

Discussion point

How suitable is COICOP for countries in the Asia & Pacific region?

Annex – COICOP version 1.1

- 01 - Food and non-alcoholic beverages
    - 01.1 - Food
    - 01.2 - Non-alcoholic beverages
- 02 - Alcoholic beverages, tobacco and narcotics
    - 02.1 - Alcoholic beverages
    - 02.2 - Tobacco
    - 02.3 - Narcotics
- 03 - Clothing and footwear
    - 03.1 - Clothing
    - 03.2 - Footwear
- 04 - Housing, water, electricity, gas and other fuels
    - 04.1 - Actual rentals for housing
    - 04.2 - Imputed rentals for housing
    - 04.3 - Maintenance and repair of the dwelling
    - 04.4 - Water supply and miscellaneous services relating to the dwelling
    - 04.5 - Electricity, gas and other fuels
- 05 - Furnishings, household equipment and routine household maintenance
    - 05.1 - Furniture and furnishings, carpets and other floor coverings
    - 05.2 - Household textiles
    - 05.3 - Household appliances
    - 05.4 - Glassware, tableware and household utensils
    - 05.5 - Tools and equipment for house and garden
    - 05.6 - Goods and services for routine household maintenance
- 06 - Health
    - 06.1 - Medical products, appliances and equipment
    - 06.2 - Outpatient services
    - 06.3 - Hospital services
- 07 - Transport
    - 07.1 - Purchase of vehicles
    - 07.2 - Operation of personal transport equipment
    - 07.3 - Transport services
- 08 - Communication
    - 08.1 - Postal services
    - 08.2 - Telephone and telefax equipment
    - 08.3 - Telephone and telefax services
- 09 - Recreation and culture
    - 09.1 - Audio-visual, photographic and information processing equipment
    - 09.2 - Other major durables for recreation and culture
    - 09.3 - Other recreational items and equipment, gardens and pets
    - 09.4 - Recreational and cultural services
    - 09.5 - Newspapers, books and stationery
    - 09.6 - Package holidays
- 10 - Education
    - 10.1 - Pre-primary and primary education
    - 10.2 - Secondary education
    - 10.3 - Post-secondary non-tertiary education
    - 10.4 - Tertiary education
    - 10.5 - Education not definable by level
- 11 - Restaurants and hotels
    - 11.1 - Catering services
    - 11.2 - Accommodation services
- 12 - Miscellaneous goods and services
    - 12.1 - Personal care
    - 12.2 - Prostitution
    - 12.3 - Personal effects n.e.c.
    - 12.4 - Social protection
    - 12.5 - Insurance
    - 12.6 - Financial services n.e.c.
    - 12.7 - Other services n.e.c.