Course Title: Course number 2.7 according to the classification of the statistical activities (CSA rev1. October Version 2009) entitled "Price Statistics".

Contents

A. Course Objective

The objective of this Course is to provide to learners (beneficiaries) with a complete introduction about the basic concepts and the methods of calculating of the various types of price index in order to be able to apply them later for economic analysis. The aim of the Course will thus be devoted to the learning of price indexes, with their application in various fields (consumer price, producer price, construction costs, purchasing power parity). The approach will consist of combining theoretical methods and practical applications of these methods to concrete empirical situations while insisting on calculation and analysis.

B. Description of the Course Contents

The Course will primarily focus on the indices in a general way (definitions, uses, advantages, limits) and on the price indices in a specific way. At one stage, the general information on indices will be successively discussed, in order to provide the beneficiaries with the opportunity to better learn significance of the price indices. At a second stage, the various price indices (consumer price, production price, purchasing power parity) will be tackled by focusing on the possible calculation methods and their uses. Practical examples will be given to make the consolidation of knowledge after each stage possible.

1) GENERAL INFORMATION ON INDICES

a. Definitions

The elementary index of a X scale in the period t (current) compared to period 0 (reference) is defined as the relationship between the value of variable X to the date t (current value) and the value of the same variable to the date 0 (basic value). The base period or reference period is called the initial period. The current period refers

to the second date or period. If we note this elementary index by $I_{t/0}$ then the calculation formula is written:

$$I_{t/0} = \frac{Valeur\ courante}{Valeur\ de\ base} \text{x}100.$$

If we note the current value with X_t and the value basic with X_0, the calculation formula will be written: $I_{t/0} = (X_t/X_0)$. It is the index of 100 base of variable X to date 0.

The objective is to compare digital scales which evolve in the course of time or space.

Example:

If the electrical production of urban area passes from 475 Kwh in 2009 (date 1) to 531 in 2010 (date 2), we can deduce two indices according to the base period.

- The production index of 100 base electricity is 2009 (date 1) is $I_{2/1} = (X_2/X_1)x100 = (531/475)x100 = 111,8$
- The production index of 100 base electricity is 2010 (date 2) is $I_{1/2} = (X_1/X_2)x100 = (475/531)x100 = 89$.

Thus, to define or calculate an index, it is necessary to fix the base period according to which all other scale values will be reported.

b. Interpretation of an index

If $I_{t/0}$ is the elementary index of X scale to the date t (with base 100 date 0), its variation $\Delta = I_{t/0} - 100$. Interpretation is the function of the Δ sign.

- ✓ Indeed, if $\Delta<0$ we can say that the X scale value dropped by Δ% between the current period and the base period;
- ✓ If, on the other hand, $\Delta>0$ we can say that the X scale value increased by Δ% between the current period and the base period.

If we refers to the previous example, we can say that the production index of base 100 electricity = 2010 (date 2) decreased from $(I_{1/2} - 100) = 89 - 100$, that is to say a fall of 11% between 2009 and 2010.

Or that the production index base 100 electricity = 2009 (date 1) increased from de $(I_{2/1} -/X_1)*100= (531/475)*100=111,8$

c. Overall rates

An overall rate is a composite scale which summarizes a set of simple indices based on scales not being able to be added.

For example how can we obtain the trend of the food consumer prices (bread, meat, cereals, salt,…) in a concise way.

Example N°1: the following table provides prices for various products over three years in local currency in a given city

	2012 (0)	2013 (T)
Sheep meat	14	18
Bread containing barley	7	7
Electricity	11	13
Oil pump	14	12

Which conclusion can we draw based on the summarized change in food prices in this city within these three years.

In order to draw a valid conclusion, it will be necessary to calculate an overall rate summarizing the change of these overall prices in just single information.

The aim here is to establish a mean of simple indices calculated for each product.

i) Arithmetic Mean (Simple)

$$I_{i/0}^{p} = 100 * \frac{1}{N} \sum_{n=1}^{N} \frac{p_i^k}{p_0^k}$$

N: Total number of related goods;
p_i^k: Price of goods k at time t_i;
p_0^k: price of goods k at the base period (reference) t_0

Application to the example:

$$I^{p}_{2013/2012} = 100 * \frac{1}{4} \sum_{k=1}^{4} \frac{p_i^k}{p^k_{2012}}$$

N: total number of related goods equal 4 products;
p_i^k: price of goods k in 2013;
p_0^k: price of goods k in 2012 (100 base =2012)

$$I^{p}_{2013/2012} = 100 * \frac{1}{4} \left(\frac{18}{14} + \frac{7}{7} + \frac{13}{11} + \frac{12}{14} \right)$$

$$I^{p}_{2013/2012} = 100 * \frac{1}{4} (1{,}285 + 1 + 1{,}182 + 0{,}857)$$

$$I^{p}_{2013/2012} = 100 * \frac{1}{4} (4{,}325) = 108{,}1$$

We can say that food prices increased by 8.1% between 2012 and 2013.

ii) ***Geometric Mean of Rates (Simple)***

$$I^{p}_{i/0} = 100 * \left[\prod_{k=1}^{N} \frac{p_i^k}{p_0^k} \right]^{\frac{1}{K}}$$

p_i^k: k Product Price in period k (current period);
p_0^k: k Product Price at the period of reference

Application to the example:

$$I^{p}_{2013/2012} = 100 * \sqrt[4]{\frac{18}{14} * \frac{7}{7} * \frac{13}{11} * \frac{12}{14}}$$

$$I^{p}_{2013/2012} = 100 * \sqrt[4]{1{,}068}$$

$$I^{p}_{2013/2012} = 100 * 1{,}096 = 109{,}6$$

We can say that food prices increased by 9.6% between 2012 and 2013.

The two simple means (arithmetic and geometrical) have the advantage of being easily calculated. However, these simple means give the same weight (importance)

to each product whatever is its importance in the total budget. But in reality, if we consider the case of consumed food products by households, the monthly total expenditure on products is different. The total expenditure on rice is different from those spent on chicken meat, and different from that related to electricity.

Where comes the idea to introduce weightings for each product according to its importance in use.

d. Weighted Average Rates

Weighted arithmetical mean

It is simply a question of introducing weighting for each product by using the arithmetic mean.

$$I_{i/0}^{p} = 100 * \frac{1}{\sum_{k=1}^{N} w_k} \sum_{k=1}^{N} \frac{p_i^k}{p_0^k} \cdot w_k$$

N: total number of related goods;
p_i^k: price of goods k at time t_i;
p_0^k: price of goods k at base period (reference) t_0;
w_k: the k product weight.
$\sum_{k=1}^{N} w_k$: Total expenditure on N related products.

Weighted geometric mean

It is a simple matter of introducing weightings for each product by using the geometric mean.

N: total number of related goods;
p_i^k: price of goods k at time t_i;
p_0^k: price of goods k at the base period (reference) t_0;
w_k: the k product weight.
$\sum_{k=1}^{N} w_k$: Total expenditure on the N related products.

$$I_{i/0}^{p} = 100 * \left[\prod_{k=1}^{N} \left(\frac{p_i^k}{p_0^k} \right)^{w_k} \right]^{\frac{1}{\sum_{k=1}^{N} w_k}}$$

Example N2: the following table gives prices for various products consumed by the inhabitants of a given city. The weights of each product (wk) in total consumption are given by the first column of the board:

	Weight (w_k)	2012 (P_0^k)	2013 (P_i^k)
Sheep meat	304	14	18
Bread containing barley	175	7	7
Electricity	239	11	13
Oil pump	282	14	12
Total	1000	-	-

Which conclusion can we draw based on the summarized change in food prices in this city within these three years.

Weighted arithmetical mean:

$$I^{p}_{2013/2012} = 100 * \frac{1}{\sum_{k=1}^{4} w_k} \sum_{k=1}^{4} \frac{p_i^k}{p_0^k} . w_k$$

4: is the total number of related goods;
p^k_{2013}: price of k goods in 2013;
p_0^k: price of goods k at the base period (reference) 2012;
w_k : the k product weight.

$$\sum_{k=1}^{4} w_k = 1000 = \text{ total spending on 4 related products.}$$

$$I^{p}_{2013/2012} = \frac{100}{1000}\left(1{,}285 * 304 + 1 * 175 + 1{,}182 * 239 + 0{,}857 * 282\right)$$

$$I^{p}_{2013/2012} = \frac{100 * 1089{,}8}{1000} = 108{,}9$$

Using the weighted arithmetical mean, the obtained results indicate 8.9% price increase of the related products between 2012 and 2013.

Weighted geometric mean

4: is the total number of goods concerned;
p^k_{2013}: price of k goods in 2013;

p_0^k: price of k goods at the base period (reference) 2012;
w_k: the k product weight.

$$\sum_{k=1}^{4} w_k = 1000 = \text{dépense totale affectée aux 4 produits concernés.}$$

$$I_{i/0}^{p} = 100 * \left[\prod_{k=1}^{4} \left(\frac{p_i^k}{p_0^k} \right)^{w_k} \right]^{\frac{1}{\sum_{k=1}^{4} w_k}}$$

$$I_{2013/2012}^{p} = 100 * \left(\left[\frac{18}{14} \right]^{304} * \left[\frac{7}{7} \right]^{175} * \left[\frac{13}{11} \right]^{239} * \left[\frac{12}{14} \right]^{282} \right)^{(1/1000)}$$

$$I_{2013/2012}^{p} = 100 * \left(\left[\frac{18}{14} \right]^{304} * \left[\frac{7}{7} \right]^{175} * \left[\frac{13}{11} \right]^{239} * \left[\frac{12}{14} \right]^{282} \right)^{(1/1000)}$$

$$I_{2013/2012}^{p} = 107,5$$

Using the weighted geometric mean, the obtained results indicate a 7.5% price increase of the consumed products between 2012 and 2013.

e. Goods index

According to specialists, to help with decision making, the indices must satisfy certain essential mathematical goods. These goods are qualified "axiomatic qualities".

1) **Identity:** The index of one scale to the date base (reference) is equal to 100. Indeed, $I_{0/0} = \frac{Base\ Value}{Base\ Value} x100 = (P_0/P_0)*100 = 100$.

2) **Reversibility:** Reversibility means that if we swap the base period and the current period, the index is overridden by its reverse: $I_{t/0} = (10^4/ I_{0/t})$.

$I_{t/0}$ x $I_{0/t}$=$((P_t/P_0)*100)$ *$((P_0/P_t)*100)$ = $(P_t/P_0)*(P_0/P_t)*(100*100)$

$=(P_t/P_t)*(P_0/P_0)*(100*100)=1x1x100x100=10^4$

Knowing the X scale between 0 and t, one can thus deduce the scale between t and 0.

3) **Homogeneity:** Homogeneity means that the index is a size without units and thus its calculation is independent of units

4) **Determination:** The index can never be null, indefinite or unspecified.

5) **Circularity:** The elementary indices are connected by multiplication among them. Indeed, the index measuring is $I_{t/0}$ the development of ***I*** scale between period 0 and the period t and $I_{t'/t}$ the index measuring the development of the same I scale between the period t_and the period ***t',*** then the index $I_{t'/0}$ which measures the development of the scale between period 0 and t' is obtained by the product of the two indices:

$$I_{t'/0}= I_{t/0}* I_{t'/t}.$$

In other words, if variable X takes the values X_0, X_t and $X_{t'}$ to 0 instant, t and t' are then: $It/0= I_{t/t'}* I_{t'/0}*1/100$.

Example: The production of an industrial enterprise increased by 30% in 2012 to 2013 and this same production dropped by 25% from 2013 to 2014. Which conclusion can we draw from the development of this production between 2012 and 2014.

It would be sufficient to calculate the three indices to be able to draw a conclusion:

- $I_{13/12}= 130$ which represents the elementary index between 2012 and 2013;
- $I_{14/13}= 75$ which represents the elementary index between 2013 and 2014;

- From where the index $I_{14/12} = I_{14/13} * I1_{3/12} * 1/100 = (75*130)/100 = 97.5$, is a decrease of (100 - 97.5). What corresponds to a decrease of the interpose production of 2.5% between 2012 and 2014.

On the whole, we can use this property to measure the development between successive periods passing from a mobile base to a fixed base. For example, if $I_{1/0}$, $I_{2/1}$, $I_{3/2}$….$I_{i/j}$……. $I_{t/t-1}$ are indices measuring the successive development between the basic base period (t) and period (0): $I_{t/0} = I_{1/0}. I_{2/1}. I_{3/2}….I_{i/j}……. I_{t/t-1}$.

f. Traditional indices

i) Laspeyrs Indices

The index of Laspeys supposes that weightings by reference quantities do not vary when the prices change.

- **Laspeyrs Price Indices:**

$$L^{P}_{i/0} = 100 * \sum_{i=1}^{N} \frac{p^i_t q^i_0}{p^i_0 q^i_0}$$

- **Laspeyrs Quantity Indices:**

$$L^{q}_{i/0} = 100 * \sum_{i=1}^{N} \frac{p^i_0 q^i_t}{p^i_0 q^i_0}$$

N3 Example: the following table provides prices for various products consumed by the inhabitants of a given city. The consumed quantities of each product (Q_k) are stated for each year:

	2012		2013	
	(P2012i)	(Q2012i)	(P2013i)	(Q2013i)
Sheep meat	14	50	18	45
Bread containing barley	7	35	7	35
Electricity	11	45	13	75
Oil pump	14	100	12	80

To calculate the Laspeyrs indices of prices and quantities (base=2012).

- **Laspeyrs Price Indices:**

$$I^{p}_{i/0} = 100 * \sum_{i=1}^{N} \frac{p^{i}_{t} q^{i}_{0}}{p^{i}_{0} q^{i}_{0}}$$

$$Where, I^{p}_{2013/2012} = 100 * \sum_{i=1}^{4} \frac{p^{i}_{t} q^{i}_{0}}{p^{i}_{0} q^{i}_{0}}$$

$$I^{p}_{2013/2012} = 100 * \left(\frac{(18*45 + 7*35 + 13*75 + 12*80)}{(14*50 + 7*35 + 11*35 + 14*100)} \right)$$

$$I^{p}_{i/0} = 100 * \left(\frac{2990}{2840} \right)$$

$$I^{p}_{2013/2013} = 105,3$$

We can say that with constants quantity in 2012, the prices increased to 5.3% between 2012 and 2013.

Quantity Indices of Laspeyrs:

$$I^{q}_{2013/2012} = 100 * \sum_{i=1}^{4} \frac{p^{i}_{0} q^{i}_{t}}{p^{i}_{0} q^{i}_{0}}$$

$$I^{p}_{2013/2012} = 100 * \left(\frac{(14*45 + 7*35 + 11*75 + 14*80)}{(14*50 + 7*35 + 11*35 + 14*100)} \right)$$

$$I^{p}_{i/0} = 100 * \left(\frac{2820}{2840} \right)$$

$$I^{p}_{2013/2013} = 99,3$$

We can say that at constant price in 2012, the quantities decreased to 0.7% between 2012 and 2013.

ii) Indices of Paasche

The Laspeys index supposes that weightings by the quantities of reference do not vary when the prices change.

- **Paasche Price Indices:**

$$P_{i/0}^{p} = 100 * \frac{\sum_{i} P_t^i Q_t^i}{\sum_{i} P_0^i q_t^i}$$

- **Paasche Price Indices:**

$$I_{i/0}^{p} = 100 * \sum_{i=1}^{N} \frac{p_{2013}^i q_{2013}^i}{p_{2012}^i q_{2013}^i}$$

$$Where, I_{2013/2012}^{p} = 100 * \sum_{i=1}^{4} \frac{p_{2013}^i q_{2013}^i}{p_{2012}^i q_{2013}^i}$$

$$I_{2013/2012}^{p} = 100 * \left(\frac{(18*45 + 7*35 + 13*75 + 12*80)}{(14*45 + 7*35 + 11*75 + 14*80)} \right)$$

$$I_{i/0}^{p} = 100 * \left(\frac{2990}{2820} \right)$$

$$I_{2013/2013}^{p} = 106,03$$

We can say that with constants quantity in 2012, the prices increased to 6.03% between 2012 and 2013.

Paasche Quantity Indices:

$$P_{i/0}^{q} = 100 * \sum_{i=1}^{N} \frac{P_t^i q_t^i}{P_t^i q_0^i}$$

$$I_{i/0}^{p} = 100 * \sum_{i=1}^{N} \frac{p_{2013}^{i} q_{2013}^{i}}{p_{2013}^{i} q_{2012}^{i}}$$

$$Where, I_{2013/2012}^{p} = 100 * \sum_{i=1}^{4} \frac{p_{2013}^{i} q_{2013}^{i}}{p_{2013}^{i} q_{2012}^{i}}$$

$$I_{2013/2012}^{p} = 100 * \left(\frac{(18*45 + 7*35 + 13*75 + 12*80)}{(18*50 + 7*35 + 13*45 + 12*100)} \right)$$

$$I_{i/0}^{p} = 100 * \left(\frac{2990}{2930} \right)$$

$$I_{2013/2013}^{p} = 102,04$$

We can say that at constant price in 2012, the quantities increased to 2.04% between 2012 and 2013.

2) CONSUMPTION PRICE INDEX (CPI)

Consumption price index is an economic indicator (synthetic) which reflects in an objective way of the development of prices in time for a basket of goods and services which are bought by households and which are regarded as representative of their spending patterns.

The price in question is the nominal value of a specified unit of goods and consumption is relative to all the goods and services which are acquired, used but does not relate to the goods for regular commercial practices nor for wealth accumulation.

Caution: The consumption price index does not measure the price level but the development of this level between two periods. The CPI is not an index of cost of living. The cost of living is the cost of a set of consumer goods, corresponding to a certain level of satisfaction. The measurement of this cost is a function.

a. Use of consumer price indices

Consumption price index (CPI) is used to measure the goods and services variations of prices in the course of the time purchased by the population of reference for their own consumption. The consumption price index plays a particularly important part at the economic level (barometer of the development of the general level of prices, instrument of economic analysis, and deflator for certain statistical series) as to the social level (adaptation of wages, pensions and social allowances, rents, alimonies, etc).

b. Field of the CPI

The consumption price index covers the goods and services bought by households. According to its use, it is possible to produce several types of indices. It is the principal use of the CPI which determines the type of index to produce:

- ✓ The range (basket) of goods and services to be covered;
- ✓ The geographic coverage;
- ✓ Type of consumers to be targeted;
- ✓ Method of observation to be used;
- ✓ Formulas of calculation used.

The CPI measures only the variations of retail prices of goods and services consumed by households. Therefore, it does not cover capital properties (residences), nor goods and services consumed by corporations or the administration.

The theoretical field of the consumption price index consists of "household consumption within the scope of national accounts". This is related to the monetary spendings of final household consumption. However, the following spendings are excluded from the index theoretical field:

- ✓ the investment processes (purchases of residences or durable goods),
- ✓ financial transactions,
- ✓ operations of savings,
- ✓ direct taxes to other households.

Besides, other types of spendings are excluded because of international conventions. This is related to purchases of second hand goods or household self-consumption farming.

The population of reference obtained for the development of the consumption price index consists of the overall households (consumers) resident in the geographical zone to follow.

c. Classification of products (COICOP)

Classifications (nomenclatures) constitute instruments of coordination making it possible to exchange information in a common language. They are used to determine the contents of the various posts obtained by a system and better provide an account of reality and behaviours which characterize it. The main aim of nomenclatures is to harmonize the concepts for a better concern of comparability and coordination of the diffused data. We distinguish several types of nomenclature like those of activities and products.

Within the framework of the development of the consumption price index, we use the classification of households consumption functions (COICOP) which make it possible to decompose the household consumption per units of need.

The COICOP covers the categories of household expenses which are subdivided within a mutually exclusive structure treated on a hierarchical basis including four levels, which facilitates the data-collection, presentation and detailed analysis of consumption, in a homogeneous way and ensures comparability on an international level. We can thus summarize the characteristics of this nomenclature to the following elements:

- Exhaustive coverage of the observed universe;
- Mutually exclusive categories i.e. an element cannot be classified only in a single category;
- Existence of the methodological principles ensuring the coherent classification of elements in various categories of the nomenclature.

The COICOP is a hierarchical classification which makes it possible to present information to four overlapping levels of groups:

Divisions: first level including headings identified by a code of two digits which organize the household consumption according to use (food, transport, communication,…). The COICOP is composed of 12 job functions harmonized with the international level. A division consists of groups;

Groups: second level comprising of headings identified by a numeric code of three digits. The group is made of classes. The COICOP is composed of 37 groups;

Classes: fourth level comprising of headings identified by a numeric code of four digits. Each class is made up of homogeneous posts (vegetables, fruits, meats,…). The COICOP is set up of 86 classes formed by posts.

Posts: fourth level comprising of headings identified by a numeric code of five digits. Each class is made up of homogeneous products (carrots, mangos, fish,…). The COICOP is made up of 305 post varieties.

The following table has the structure of COICOP classification for the 12 functions. For the first division, we present the two groups as well as some examples of classes, posts and varieties.

Structure of household expenses classification (COICOP)

Division	Group	Classes	Posts	Varieties	Detailed wording
01					Food products and soft drinks
	01.1				Food products
		01.1.1			Bread and cereals
			01.1.1.1		Bread
				01.1.1.1 .1	Bread rolls
				01.1.1.1 .2	whole cereal bread
				…	
			…		
		01.1.2			Meat
			01.1.2.1		Beef
				01.1.2.1 .1	Beef to be roasted
				01.1.2.1 .2	Chopped Beef
		…	…	**…**	
	01.2				Soft drinks
		01.2.1			Coffee, tea and cocoa
		…			
02					Alcoholic beverages, tobacco and narcotics
03					Items of clothing and shoes
04					Housing, water, gas, electricity and other fuels
05					Pieces of furniture, items of household and home repairs
06					Health
07					Transport
08					Communication
09					Leisures and culture
10					Education
11					Restaurants and Hotels
12					Various goods and services

d. Weightings of the HICP

To calculate the consumption price index, it is necessary to have the structure of the household consumption expenditure. The estimates of the budgetary coefficients balancing the indices result from surveys on household consumption expenditure obtained from quantitative or qualitative available data sources (surveys on household expenses, statistics customs, agricultural statistics, industrial statistics,…).

These weightings cover household expenses living in places related with these indices. It is a matter of having spendings by products. Products being classified by post makes it possible to find weightings by function, group and by post.

Weightings of the CPI are the aggregate spendings that the households devote to a given category of goods and services, expressed as a total percentage of their monetary spendings of final consumption carried out on the economic field. These spendings are nets of received premium accounts, settlements, profits (games of luck) and resale (second hand goods).

Weightings of the varieties are obtained from the sample varieties obtained in each post.

The weight of the post is distributed among the selected varieties to represent the post according to the importance of each one. The weight of the group is constituted by the sum of weightings of the various posts composed of. Weightings of the function are obtained by adding those groups which compose this function.

The same variety can be observed in a different type of retail outlets (supermarket, market, shop,…) thus there are weightings of purchase area, geographical zone and if possible a weighting for the rural and urban area.

e. Price collections

The prices are recorded once or many times per month, always in the same places of registration (retail outlets), spread throughout the geographical zone, and this is for all possible forms of delivery (standard of retail outlets). Several retail outlets are visited and several prices recorded by agents of index during the same period of the month, in the geographical zone. We compare the recorded prices, the centralized prices (rents, of the purchase of new cars,…), tariffs of the post, trains, buses, subscriptions and taxes of radio-cable television, water, electricity.

f. Calculation of indices

The general way of calculating most references proceeds in two phases.
The CPI, is calculated with reference to the whole products. For a variety observed in various types of retail outlets, we proceed with an arithmetic mean of the various retail outlets (fixed base). The aggregate index of each post is calculated by using weightings of each variety.

The aggregate index of each class is calculated by using weightings of each post whose class is composed of. Similarly, the aggregate index of each group is calculated by using weightings of each class of the same group. In the same manner, we calculate the index of each division by incorporating the weighted index numbers of groups of each division.

The total index of the consumer prices is then obtained by making a weighted mean of divisions. Each division being balanced by the sum of weightings of which the groups are composed.

These weightings are based on the survey results on the household budget, generally realized by the National Institutes of Statistics.

Example: the following table provides the middle costs of products belonging to two posts of food consumption. While taking as a base 100 $=t_0$, to calculate the elementary indices of each variety, the index of each post as well as the weighted index number of these two posts (fruit and vegetables), Es weightings are displayed in the second column of the table.

		Mean costs on several retail outlets			
Varieties	**Weightings**	t_0	t_1	t_2	t_3
Mangos	240	350	390.1	403.5	403.0
Eggplants	80	102	113.2	116.4	125.0
oranges	60	85	80.5	70.6	87.3
Fresh tomatoes	450	165	157.1	172.2	168.0
Fresh salad	230	143	183.3	161.0	201.0
Bananas	280	205	266.2	280.6	243.0
Green onion	210	212	261.7	232.9	230.0
Fresh green cabbage	98	123	129.7	117.6	144.5

Fresh green beans	45	107	153.3	148.3	159

Corrections

To calculate the elementary indices, we do not need to use weightings. It will be sufficient, for each variety, to divide the price of each period by that of the base period (t_0), basic year.

$$It/_0 = I_t/I_{t0}.$$

Varieties	Weightings	Elementary indices (base=t_0)			
		t_0	t_1	t_2	t_3
Mangos	240	100.0	111.5	115.3	115.1
Eggplant	80	100.0	111.0	114.1	122.5
Oranges	60	100.0	94.7	83.1	102.7
Fresh tomatoes	450	100.0	95.2	104.4	101.8
Fresh salad	230	100.0	128.2	112.6	140.6
Bananas	280	100.0	129.9	136.9	118.5
Green onion	210	100.0	123.4	109.9	108.5
Fresh green cabbage	98	100.0	105.4	95.6	117.5
Fresh green beans	45	100.0	143.3	138.6	148.6
Total	**1693**				

To calculate the indices of each post, one reclassifies the varieties which belong to the same post as follows:

Varieties	Weightings	Elementary indices (base=t_0)			
		t_0	t_1	t_2	t_3
Fruit Index s (I_f)	580	100.0	118.6	122.4	115.5
Mangos **(I_m)**	240	100.0	111.5	115.3	115.1
Bananas **(I_b)**	280	100.0	129.9	136.9	118.5

Oranges **(I_o)**	60	100.0	94.7	83.1	102.7
Indices vegetables (I_l)	1113	100.0	111.3	108.4	115.8
Fresh tomatoes	450	100.0	95.2	104.4	101.8
Fresh salad	230	100.0	128.2	112.6	140.6
Eggplant	80	100.0	111	114.1	122.5
Green onion	210	100.0	123.4	109.9	108.5
Fresh green cabbage	98	100.0	105.4	95.6	117.5
Fresh green beans	45	100.0	143.3	138.6	148.6
Fruit Index and vegetables (I_i)	**1693**	100.0	113.8	113.2	115.7

The fruit index is an index number measured by the weight of each variety. That of vegetables is obtained through the same manner.

For a given year, the Fruit Index, $I_f = (240* I_m + 280*I_b + 60* I_o)/580$
For example for t_2, **$I_f = (240*115,3+ 280*136,9 +60*83,1)/580 =122,4$.** We can say that the index of the fruit price increased by 3.8% between t_1 and t_2.

The vegetable and fruit index is an aggregative index balancing each post by its weight.

For example, in t_1, **$I_f +1113* I_l)/1693 = I_i =(580* 118,6 +1113* 111,3)/1693 =113,8$**
We can say that the fruit and vegetable index increased by 13.8% between t_0 and t_1.

g. New products taken into accounts

The reference basket of a consumption price index is preserved as much as possible throughout the index. A product which disappears is replaced by an equivalent product, while a retail outlet which closes down is replaced by another of the same type presenting similar features.

Specific cases like residences, public tariffs (water, electricity.), seasonal products, and communication have particular processing depending on the countries.

3) INDUSTRIAL PRODUCTION INDEX (IPI)

In our case, we keep the case of implementation of an industrial production index.

a. Objectives and use of the IPI

The main aim is the compiling of indicators of monitoring the short-term economic conjuncture in industry. The Industrial Production Index (IPI) is an indicator which measures the development of the industry production. It covers all the products manufactured by industrial companies in a particular economy. The IPI is considered, along with the unemployment rate, the consumption price and the foreign trade indices short-term indicators to monitor the economic activity. The IPI is also used in the development of national accounts.

However, how to incorporate in a synthetic indicator all the observed developments being given the multiplicity of the productions and the diversity of measuring units of these productions: ton of cement, number television sets, ton of iron, quintals of semolina etc.

The only possibility of circumventing this difficulty is to pass through information in value without occulting the physical aspect quantity in the construction of the index. This way, the LASPEYRES or PAASCHE type indices constitute the adequate measuring instruments for calculation and the measurement of evolutions.

b. Choice of the base year

One base year is a reference through which any past or future state of a measured phenomenon will be reported. In theory, a base year can correctly play its part of reference only if it is fixed and well selected. A base year must be a median year, it should correspond neither to a year of strong growth, nor a year of weak growth. Thus, the stability of an index evolution will depend on its base year normality. The more particular the basic year is, the more important the fluctuations affecting the series will be.

c. Field of the IPI

The field of the IPI covers all the products manufactured in an economy. This is thus related to the products having followed a process of transformation by local companies.

d. Choice of Samples

During the choice of samples to be followed for the quarterly survey of economic situation, the turnover was obtained like a selection criterion making it possible to measure the performances of industrial companies. Indeed, the turnover is the criterion which presents fewer disadvantages. It is one of the many easiest to apprehend. It was used within the framework of this study like a criterion of general representativeness for i) - to measure the weight of the sample compared to the total population and ii) - to fix the threshold of representativeness.

To ensure a better representativeness, the sample must cover a significant volume of industrial activity, that is to say more than 90% of the industrial fabric activity. This way, the corporations must be classified in accordance with the used nomenclature. The coverage relates to mining, all manufacturing industry and energy.

e. Product Classifications (ISIC and CPC)

The nomenclature used for the development of an IPI is that of activity which consists of a coherent and homogeneous classification structure of economic activity being based on a unit concerted within the international plan concepts, definitions, principles and rules of classification. It represents an integrated framework in which the economic situation can be collected, processed and diffused according to the needs of analysis and economic piloting.

The classification of references, globally elaborated, central nomenclature of the activities, is a standard international classification, by industry, of all the branches of economic activity (ISIC) which is used as a framework power post for the classification of the United Nations system economic activities and (ii) - a central nomenclature of products, CPC (Central Product Classification) as tallies of

reference of the product and service classification elaborated by the United Nations system. The ISIC rev4 comprises a four level hierarchical structure:

Sections: first level including the headings identified by an alphabetic code;

Divisions: second level comprising the headings identified by a two digit numeric code;

Groups: third level comprising the headings identified by a three digit numeric code;

Classes: fourth level comprising the headings identified by a four digit numeric code.

The IPI makes use of a part of this classification especially sections B, C, D and E according to information available by each country.

f. Weightings and base year

One base year is a reference through which any past or future state of a measured phenomenon will be reported. In theory, a base year can correctly play its part of reference only if it is fixed and well selected. A base year must be a median year; it should correspond neither to a year of strong growth, nor a year of weak growth. Thus, the stability of an index evolution will depend on its base year normality. The more particular the basic year is, the more important the fluctuations affecting the series will be. According to the availability of financial data on corporations, we can use the value-added or the turnover by products and corporations in order to determine weightings. Moreover, it is necessary to have economic information of corporations related to gross output, physical productions by product, trades in quantity as well as trades in value.

In theory, weightings must be evaluated according to the contribution of value-added respectively from the by-product to the product, from the product to the division and from the division to global industry. However, taking into account the difficulty of calculating a value-added related to the infra-division level, we can also

be satisfied with the distribution of the turnover on the by-product and product level.

Thus, weighting coefficients were calculated starting from the next series. We, thus, pass from an evolution observed on the level of the series followed in the survey to that of the whole industry, by following fitment product $\subset$ division $\subset$ industry. Sectoral weighting was obtained by cumulating weightings by products.

Thus, knowing the level of the indices of various divisions, we calculate the total industry index by submitting the report of the scalar product between the weighting vector and the index vector per 1000.

The choice of the sample to be followed for the calculation of the IPI can be based on two objective criteria (I) the constraint of general representativeness, the sample data must cover a significant volume of the industrial activity and take account of the development amongst corporations (suspensions, creations) and (II) the constraint of sectoral representativeness: the analyses must be carried out on each principal industrial sector. More precisely the hard copy is initially carried out on the level under division. Indeed, for a given division or subdivision it is necessary:

- to classify the corporations of division (sub-division) according to the decreasing turnover or the decreasing value-added;
- to calculate the weight of each corporation according to the turnover (Sales turnover of Corporation)/(Sales turnover of Division) or (VA of the enterprise/VA of division);
- to calculate the turnover total weight and to select the companies which account for at least 90% of the turnover in each branches of activity (at least 90% of the added-value). So all the large corporations (most important on a given division) are automatically selected in the sample which will be the object of a permanent follow-up.

g. Formulas and methods of calculation

The final objective is to produce an overall significant indicator of the industrial development follow-up. In other words, it is a question of summarizing in only one

figure rather representative of the movements observed within the industrial activity of an economy.

The calculation of the IPI is carried out initially on the level of the pilot series (elementary indices), then aggregate indices are calculated on the level of the subdivisions and divisions. The calculation of the index will be carried out in the following way:

Are Q_0 and Q_{nk} the quantities produced respectively during the base period and of k period k (quarter, month,…) year n, the simple index is written: $I_{nk}^{s} = \frac{Q_{nk}}{Q_0} x100$

Taking into account the mode of selection, all the sampled products cannot be made up of only one by-product. It is necessary thus if we wants to calculate the index on the level of this product to balance the simple indices of the by-products by the respective weights of the component by-products.

If we define P_0^{isp} as being the weighting of the i^{ème} by-product of the produced p-^{ème}, by-products being followed in the survey, the index I_{nk}^{p} which describes the development of the production of under division is written:

$$I_{nk}^{p} = \frac{\sum_{i=1}^{s} P_0^{isp} x I_{nk}^{s}}{\sum_{i=1}^{s} P_0^{isp}}$$

In the same way, we define P_0^{jp}, as being the weighting of the j-ème under division with p under division, the index I_{nk}^{b} which describes the development of division b is written:

$$I_{nk}^{b} = \frac{\sum_{j=1}^{p} P_0^{jp} x I_{nk}^{p}}{\sum_{j=1}^{p} P_0^{jp}}$$

Lastly, to calculate the production index on the overall industry, it is necessary to balance the division indices by the relative weight of these divisions in industry. Thus, knowing the level of the indices of various divisions, one calculates the total index of industry by submitting the report of the scalar product between the weighting vector and the index vector by the sum of weightings. If we have b divisions in industry, the industrial production index of the quarter k of year n is written:

$$I_{nk} = \frac{\sum_{l=1}^{b} P_0^{lb} x I_{nk}^{b}}{\sum_{l=1}^{b} P_0^{lb}}.$$

4) ISSUES UNDER CONSIDERATION

4.1 Exercice 1

The following table gives the trends of the average costs observed on a given market. The equivalent quantities are also given.

	t_0		t_1		t_2	
	(P_0^i)	(Q^i_0)	(P_1^i)	(Q_1^i)	(P_2^i)	(Q_2^i)
Products 1	12	46	11	50	14	45
Products 2	15	20	16	20	14	20
Products 3	25	45	24	40	25	48
Products 5	18	30	18	28	18	25
Products 6	14	54	12	52	13	50

i) To calculate the elementary indices (simple) for each product (base 100= t_0) and comment.
ii) To calculate the indices of Laspeyrs and Paasche (base 100= t_0) and to comment on.
iii) To represent the developments of these two indices on the same bar chart.

4.2 Exercice 2

Table 1 presents the prices of the principal products consumed by the resident populations. A survey budget consumption, carried out in 2012, has made it possible to calculate weightings of each products.

Products	**Weightings**	**2012**	**2013**	**2014**
Local rice in bulk	330	174.9	174.7	176.0
Grain Millet inin bulk	120	207.9	207.9	208.5
Grain Corn in bulk	90	208.3	208.3	208.3
Flour of Millet in bulk	85	223.3	221.9	223.3
Flour of Wheat in bulk	68	280.8	277.3	275.0
Beef	138	255.7	256.8	260.0
Turkey Meat	100	269.3	269.3	268.4
Chicken Meat	50	225.7	241.4	210.2
Fresh Lamb Meat	266	138.4	185.6	93.9
Fresh Lamb Meat	206	94.8	157.8	35.7

We consider 2012 as a base year, use the indices of Laspers to answer the questions.

1. To calculate and analyse the annual indices of un-processed cereal (i) posts, (ii) flours and (iii) meat.
2. To represent these indices on the same figure (bar chart).
3. To prepare a board on which annual indices of the posts (i) cereals and (ii) meat will be calculated.
4. To analyse

5) Principal references

a. Handbook of the Consumption Price Index: Practical Theory and, (OECD, ILO, IMF, World Bank), 2004;
b. Report III: Consumption Price Index, (ILO, 2003);
c. Elementary and Synthetic indices, Jean François Coeurjolly,
d. Purchasing Power Parity, Follow-up of the Bank of CANADA, 2002;
e. Introduction to the Practice of Statistical Indices, INSEE,
f. Analysis of the Economic Conditions: Approaches the Purchasing Power Parity, Finances Quebec, 2003;
g. Handy guide for the Establishment of Consumption Price Index

6) Corrected examinations