Compilation Method

I. Theoretical Foundation

Productivity can be measured in terms of "average productivity" and "marginal productivity". In practice, the marginal productivity is still at the stage of theoretical discussion only. The present labor productivity statistics are all calculated by dividing "total input" into "total output".

For labor productivity derived from production value-added, the part of output refers to the real gross domestic product (GDP) obtained from the national income production account (NIPA) while the part of input is computed on the basis of the number of persons and working hours of employees, employers, own-account workers, and unpaid family workers, with data obtained from establishment and household surveys. The calculation formulas are shown as follows:

(1) Labor Productivity Index

$$= \frac{\text{Real GDP Index}}{\text{Labor Input Index (working hours} \bullet \text{ employed persons} \bullet \text{ equi-employed persons)}} \times 100$$

(The base year of the indexes is 2011 and output is real GDP in chained 2011 dollars.)

(2) Labor Productivity

$$= \frac{\text{Real GDP}}{\text{Labor Input (working hours} \bullet \text{ employed persons} \bullet \text{ equi-employed persons)}}$$

(Output is real GDP in chained 2011 dollars.)

II. Industry Scope

"All industries" mentioned in this report include three sectors, such as "Agriculture, Forestry, Fishing & Animal Husbandry Sector", "Industrial Sector" and "Services Sectors". "Industrial Sector" covers 5 section industries, such as "Mining & Quarrying", "Manufacturing", "Electricity & Gas Supply", "Water Supply & Remediation Activities" and "Construction". "Services Sector" covers 11 section industries, such as "Wholesale & Retail Trade", "Transportation & Storage", "Accommodation & Food Service Activities", "Information & Communication", "Financial & Insurance Activities", "Real Estate Activities", "Professional, Scientific & Technical Activities", "Support Service Activities", "Human Health Activities", "Arts, Entertainment & Recreation" and "Other Service Activities".

Furthermore, "Manufacturing" covers 25 division industries, such as "Manufacture of Food Products", "Manufacture of Beverages & Tobacco Products", "Manufacture of Textiles", "Manufacture of Wearing Apparel & Clothing Accessories", "Manufacture of Leather, Fur & Related Products", "Manufacture of Wood & of Products of Wood & Bamboo", "Manufacture of Paper & Paper Products", "Printing & Reproduction of Recorded Media", "Manufacture of Petroleum & Coal Products", "Manufacture of Chemical Material", "Manufacture of Chemical Products", "Manufacture of Pharmaceuticals & Medicinal Chemical Products", "Manufacture of Rubber Products", "Manufacture of Plastics Products", "Manufacture of Other Non-metallic Mineral Products", "Manufacture of Basic Metals", "Manufacture of Fabricated Metal Products", "Manufacture of Electronic Parts & Components",

"Manufacture of Computers, Electronic & Optical Products", "Manufacture of Electrical Equipment", "Manufacture of Machinery & Equipment", "Manufacture of Motor Vehicles & Parts", "Manufacture of Other Transport Equipment & Parts", "Manufacture of Furniture" and "Other Manufacturing".

Since the coverages of output are different from those of input in "Education" and "Social Work Activities", these two industries are excluded in statistical results of this report for consistency. Besides, "Other Manufacturing" includes "Repair & Installation of Industrial Machinery & Equipment" in line with the coverage of output.

III. Output

In order to eliminate the effects of price fluctuation, the labor productivity index computed from production value should have been based on the real GDP derived from the NIPA. Since some items of the NIPA, such as ownership of dwellings, public administration & defence; compulsory social security, value-added tax, import duties and statistical discrepancy, are included in the components of the GDP and they cannot find their counterpart items of labor input, thus these items are not included in the output for measuring productivity.

1. Ownership of Dwellings

This item refers to the rent for a house which is either leased or used by the owner himself. This item of output has no counterpart item of labor input and is accordingly excluded from the scope of output.

2. Public Administration & Defence; Compulsory Social Security

This item refers to the administration of general public services, national defence and so forth, defence institutions and non-market non-profit institutions. This item of output is measured according to the settlement statement of all government agencies, and its amount of output equals to the expenses of consumption of fixed capital, compensation of employees and taxes on production and imports. This item of output also has no counterpart item of labor input and is excluded from the scope of output.

3. Value-Added Tax

This tax only applies to the added value, which is defined as all sales amounts of goods and services of a business entity after the deduction of expenses relating to the goods and services that were purchased from other taxable entity. Since value-added tax is no longer included in the output of every industry, thus this item is accordingly excluded from the scope of output.

4. Import Duties

This item comprises customs duties, harbor construction dues, import commodity duties and so forth. Because of some revision in the System of National Accounts (SNA), this item is no longer included in the output of every industry. Nowadays, there is no appropriate method used to include, and thus this item is excluded from the output of every industry.

5. Statistical Discrepancy

Although there is a conceptual consistency between three measures of GDP, such as output measure, expenditure measure and income measure, however these three measures often differ in practice. This is

because of the wide disparity of data sources that must be called on and the fact that any error in any source will lead to a difference between at least two of the GDP measures. It is inevitable that many such data errors will exist and will become apparent in exercises. Since statistical discrepancy is not included in the output of every industry, thus this item is accordingly excluded from the scope of output.

IV. Labor Input

1. Working Hours

  Generally, the change in working hours is a better input to show the movement of productivity than the change in the employed persons. The working hours should refer to the time used to do a job, rather than just the working time with pay. Because the GDP is used as the output data, the labor input should be the working hours dedicated by the employed persons (including not only man-hours of employees but man-hours of employers, own-account workers and unpaid family workers). The results produced in this way will then be able to meet the needs required in the analysis on productivity.

  Currently, the DGBAS has collected data on employed persons and working hours obtained from household surveys. However, statistics on working hours of employees obtained from establishment surveys should be able to reflect the movement of productivity more accurately. Consequently, the labor in this case includes non-agricultural employees, employers, own-account workers and unpaid family workers obtained from Manpower Survey. The labor input, with adjusted working hours obtained from Employees' Earnings Survey, is calculated on the basis of the following formulas:

(1) Prior adjusted working hours of non-agricultural employed persons
(including employers, employees, unpaid family workers and own-account workers) ×

$$\frac{\text{Working hours of employees}}{\text{Working hours of employed persons in labor force}}$$

 =Adjusted working hours of non-agricultural employed persons.

(2) Prior adjusted weekly working hours of agricultural employed persons
(including employers, employees, unpaid family workers and own-account workers) ÷ 7 ×

the number of days of the current month

 =Adjusted monthly working hours of agricultural employed persons.

2. Employed Persons

  In view of the fact that some countries are still using the simpler indicator "output per employed person" to measure the movement of labor productivity, this report also present this indicator for readers to use in their own applications and make the international comparison. (The employed persons herein include employees, employers, own-account workers and unpaid family workers obtained from household surveys).

3. Equi-employed Persons

  In order to transfer the employed persons of different working hours into the standard employment, the so-called "equi-employed persons", some standardization must be proceeded for employed persons. The standardized steps are shown as follows:

(1) Compute the average working hours of full-time workers (NH) from Manpower Survey.

(2) Compute the average working hours for each class of employed persons from Manpower Survey, for example, own-account workers (AH_1), employers (AH_2), employees (AH_3) and unpaid family workers (AH_4).

(3) Compute the ratio for each class of equi-employed persons; that is,

$$R_i = \frac{AH_i}{NH}, \ i = 1, 2, 3, 4.$$

(4) Multiply the ratio R_i by each class of employed persons E_i (the data of employees obtained from Employees' Earnings Survey) to derive the number of equi-employed persons $E_i^{'}$, $E_i^{'} = R_i \times E_i$.

(5) The number of equi-employed persons for each industry is $E^{'}$, $E^{'} = \sum_{i=1}^{4} E_i^{'}$.

V. Unit Labor Costs

The "unit labor costs" are mainly designed to indicate the movement of production costs of the business firms. It is calculated by dividing the output (real GDP) index into the total earnings index. The formula is shown as follows:

$$\text{Unit Labor Costs Index} = \frac{\text{Total Earnings Index}}{\text{Real GDP Index}} \times 100$$

(The base year of the indexes is 2011 and output is real GDP in chained 2011 dollars.)

An increase in the unit labor costs index indicates that more labor costs should be paid to produce a unit of output, or that the same amount of labor costs can produce less amount of output. As employers, own-account workers and unpaid family workers do not get paid, the total earnings index in the above formula, given the base year of 2011, is derived from multiplying the average earnings of employees by the number of employees, and then adding total imputed earnings of non-employees (including employers, own-account workers and unpaid family workers). Total earnings of non-employees are imputed by the following method:

Total imputed earnings of employed persons of non-employees

$$= \frac{\text{Average working hours of non-employees}}{\text{Average working hours of employees}}$$

$\times$ Average earnings of employees

$\times$ Number of non-employees.

Besides, the average monthly earnings of employees in the agricultural sector are re-estimated as follows:

1. Adjusted average monthly earnings of agricultural employees (M_t)

$=$ Average monthly income of major job for agricultural employees (in May)

$\times \dfrac{\text{Average monthly earnings of non-agricultural employees (in May)}}{\text{Average monthly income of major job for non-agricultural employees (in May)}}$

2. Average monthly earnings of agricultural employees for base period (May, 2011)

$$M_t^{'} = \frac{M_{t\text{-}1} + M_t + M_{t+1}}{3}$$

3. Re-estimated average monthly earnings of agricultural employees

= Average monthly earnings of agricultural employees for base period ($M_t^{'}$)

× Index of price paid for wage by farmers.

Note:

※The source of "Average Earnings of Agricultural and Non-agricultural Employees" are "*Report on the Manpower Utilization Survey*" published by the Directorate-general of Budget, Accounting and Statistics, Executive Yuan.

※The source of "Index of Price Paid for Wage by Farmers" is "*Monthly Bulletin of Agricultural Statistics*" published by the Council of Agriculture, Executive Yuan.