



National Statistics Office of Georgia  
(Geostat)

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# Construction Cost Index Technical Manual

The presented technical manual is prepared by the National Statistics Office of Georgia according to the international methods and practices and is based on the following handbooks:

1. ***“Producer Price Index Manual: Theory and Practice”***, *International Monetary Fund, 2004.*

Responsible organizations: International Labor Organization (ILO), International Monetary Fund (IMF), Organization for Economic Co-operation and Development (OECD), United Nations Economic Commission for Europe (UNECE) and World Bank;

<https://www.imf.org/en/Publications/Manuals-Guides/Issues/2016/12/30/Producer-Price-Index-Manual-Theory-and-Practice-16966>

2. ***“Sources and methods- construction price index”***.

Responsible organizations: Organization for Economic Co-operation and Development (OECD), European Statistical Office (Eurostat).

<http://www.oecd.org/industry/business-stats/2372435.pdf>

3. ***“Methodological aspects of construction price indices”***, *Eurostat, 1996.*

<https://publications.europa.eu/en/publication-detail/-/publication/6e9c8c74-95eb-42b0-bd3a-b0367b15e348/language-en>

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## 1. Introduction

### 1.1 Construction Cost Index and its use

The Construction Cost Index measures the average price level of construction materials and services used for the construction of a multi-dwelling residential building in the reporting period compared to the reference period. Along with this, the index does not reflect changes in the construction technologies or the productivity of the input materials.

The CCI covers the following cost categories:

- **Construction materials** - costs of materials used by construction organizations during the construction process;
- **Wages** - expenses for remuneration of workers employed in the construction process (does not include remuneration of project managers, architect, engineers and others similar positions);
- **Machinery** - expenses incurred on the use of machinery and equipment (crane, concrete mixer, excavator and other construction equipment) during the construction process. In case of rented equipment it implies the cost of the rent, while in case of the owned equipment the depreciation of the equipment is used (the expenses on construction machinery does not include the fuel and the labor costs associated with it);
- **Transportation, fuel and electricity;**
- **Other costs** - all other costs incurred during the construction process (does not include the costs of land and architectural project).

The Construction Cost Index is used for the following purposes:

1. The CCI has an important role in deflating different economic indicators;
2. The index is used for indexation of contracts in both public and private sectors;
3. The index is an analytical instrument for researchers and representatives of business sector.

### 1.2 Coverage of the index and the observable prices

For the purpose of compilation of the CCI, prices are collected from organizations operating across the country, for construction materials and services supplied by them on the market.

The observable price of a material (service) is the value of the construction material (service) purchased by a construction organization for construction of a multi-dwelling residential building in the specified period.

## **2. The selection of organizations and materials (services) for observation**

In order to select the observable construction materials and services and to identify their characteristics, on the first stage large construction companies operating in the country are surveyed through an additional questionnaire. In the questionnaire the companies are required to indicate the following information (according to the data of a multi-dwelling residential building constructed by them during the last 3 years):

- Main building materials used in the construction process, their detailed descriptions, measurement units, provider organization of the material and the total cost incurred on the specific type of material;
- Costs of remuneration of workers employed in the construction process (according to their positions);
- Expenditure on the use of machinery and equipment (crane, concrete mixer, excavator and other construction equipment);
- Costs of transportation, fuel and electricity;
- Other costs incurred during the construction process.

After the selection of construction materials and services, on the second stage of the survey the supplier companies are selected (based on the information from the additional questionnaires and the data of the enterprise statistics) for the purpose of further price observation of the construction materials and services provided on the market.

During the selection process of the construction materials and services maximally detailed specifications are determined for them. To follow the specifications is the most important part of price registration since the quarterly recorded difference between prices should be caused by the pure price change of a material or a service, rather than by changes in characteristics of the materials or services.

Relying on the obtained survey data, the prices for sampled construction materials and services are recorded quarterly.

For the purpose of price registration for construction materials and services, the sample of organizations is updated annually based on the data of enterprise statistics. In case a company

stops functioning in the reporting period, the substitution does not occur until the sample update.

### 3. Price collection fieldworks

During the price collection fieldworks the representative of the organization fills the questionnaire published on the Geostat website. The price collection fieldworks are conducted from the 1<sup>st</sup> to the 8<sup>th</sup> of the month following the reporting period (quarter). The questionnaire contains the following information: description of the selected construction material (service), measurement unit, the prices in the reporting, reference and the previous quarter (the average selling price for construction material or service provided by organization) and also, in the case of a price change the reason of this change.

The information about the prices of construction material and service provided by organizations is confidential and is protected by the “General Administrative Code of Georgia” and article 28 of the “Law of Georgia on Official Statistics”.

Unless otherwise provided for by the legislation of Georgia, legal entities registered in the Register of entrepreneurial and non-commercial legal entities are obliged to provide Geostat, upon Geostat’s written request, including such request in electronic form, with the available information (including confidential information) in paper or electronic form.

### 4. Validation procedures

The CCI validation procedures are conducted in two stages:

**On the first stage** validation takes place simultaneously with the price registration fieldworks. In the case of a price change, the person responsible for filling the questionnaire is required to define by a comment the reason of the change. After the data is sent to the central office, a responsible employee conducts analysis and logical control of the data.

**On the second stage** the accuracy of the prices, which are extremely deviated from the previous quarter, is checked after calculating the indices.

## 5. Weights

Weights for an individual material/service in the Construction Cost Index represent the share of the cost of the material/service in the overall expenditures incurred on the construction of a multi-dwelling residential building.

The information is obtained from the additional questionnaires. The weights are updated once every 5 years, based on the cost of multi-dwelling residential buildings constructed by construction organizations. During updating the weights the list of materials and services included in the index may change.

## 6. Price imputation techniques

During the calculation of the CCI, if in the reporting period no price is recorded for one of the materials or services, an imputation method will be used - repeating the latest recorded price before the reappearance of the real price.

## 7. Quality adjustment

If in the reporting period an organization stopped selling the observable material or service but sells another similar material/service, it is possible to replace the old material or service with a new one.

If the characteristics of the observable material/service have changed, but the criteria for comparison is not violated, it is allowed to compare the old and new material/service. In this case, it is important that the price change caused by quality change is not reflected in the index.

In order to compare registered prices it is necessary to use a quality adjustment method, for which a conditional base price is calculated using the following methods:

1. If in the reporting quarter a replacement material is qualitatively different from the material in the previous quarter, and the value of the difference is evaluated, the base price for the replacement material is calculated using the previous quarter's price and the qualitative difference defined by the person, responsible for filling the questionnaire (Table 1):

Table 1.

| Material                           | Base price (the 4 <sup>th</sup> quarter of the previous year) | Price in the 2 <sup>nd</sup> quarter | Price in the 3 <sup>rd</sup> quarter | Qualitative difference | Price ratio (the 3 <sup>rd</sup> quarter/the 4 <sup>th</sup> quarter of the previous year) |
|------------------------------------|---|--------------------------------------|--------------------------------------|------------------------|--|
| Material A                         | 4.55  | 4.50                                 | -                                    |                        |  |
| Qualitatively different Material B | 5.86*   | -                                    | 8.50                                 | 1.30                   | 8.50/5.86≈1.45   |

\*Imputed base price

The imputed base price for material B is calculated as follows:

$$\text{Base price} = (4.50 + 1.30) / (4.50 / 4.55) \approx 5.86$$

2. If in the reporting quarter it is possible to define previous quarter's price for the replacement material, the base price for it is calculated using this price and the index of the previous quarter (Table2).

Table2.

| Material               | Base price (the 4 <sup>th</sup> quarter of the previous year) | Price in the 2 <sup>nd</sup> quarter | Price in the 3 <sup>rd</sup> quarter | Price ratio (the 2 <sup>nd</sup> quarter/the 4 <sup>th</sup> quarter of the previous year) | Price ratio (the 3 <sup>rd</sup> quarter/the 4 <sup>th</sup> quarter of the previous year) |
|------------------------|---|--------------------------------------|--------------------------------------|--|--|
| Material A             | 4.55  | 4.50                                 | -                                    | 4.50/4.55≈0.99   |  |
| Replacement material B | 5.26*   | 5.20                                 | 5.50                                 |  | 5.50/5.26≈1.05   |

\*Imputed base price

Imputed base price for material B is calculated as follows:

$$\text{Base price} = 5.20 / (4.50 / 4.55) \approx 5.26$$

3. If in the reporting quarter a price enumerator discovers that material A will no longer be supplied on the market in the reporting quarter, and it is impossible to get information on the previous quarter's price and the value of qualitative difference for the replacement

material B, the difference between current quarter's price of material B and previous quarter's price for material A will be totally treated as qualitative difference.

Imputed base price of the replacement material is calculated based on the current quarter's index and the price of material B (see table 3).

*Table3.*

| Material               | Material's weight, % | Base price | Price in the 2 <sup>nd</sup> quarter | Price in the 3 <sup>rd</sup> quarter | Long term index in the 2 <sup>nd</sup> quarter | Long term index in the 3 <sup>rd</sup> quarter |
|------------------------|----------------------|------------|--------------------------------------|--------------------------------------|--|--|
| Material A             | 0.051                | 4.55       | 4.50                                 | -                                    | 4.50/4.55≈0.99                                 |  |
| Replacement material B | 0.051                | 6.09**     | -                                    | 7.00                                 |  | 7.00/6.07≈1.15*                                |
| Material C             | 0.032                | 5.20       | 5.20                                 | 5.50                                 | 5.20/5.20=1.00                                 | 5.50/5.20≈1.06                                 |
| Material D             | 0.067                | 5.00       | 4.50                                 | 5.50                                 | 4.50/5.00=0.90                                 | 5.50/5.00=1.10                                 |

\*Imputed long term index

\*\*Imputed base price

Imputed base price for material B is calculated as follows:

1. Group long term index in the 3<sup>rd</sup> quarter =  $1.06 \times \frac{0.032}{0.032+0.067} + 1.10 \times \frac{0.067}{0.032+0.067} \approx 0.34 + 0.74 = 1.08$ ;
2. Group long term index in the 2<sup>nd</sup> quarter =  $1.00 \times \frac{0.032}{0.032+0.067} + 0.90 \times \frac{0.067}{0.032+0.067} \approx 0.32 + 0.61 = 0.93$ ;
3. Group short term index in the 3<sup>rd</sup> quarter =  $\frac{1.08}{0.93} \approx 1.16$ ;
4. Imputed long term index for material A =  $1.16 \times 0.99 \approx 1.15$ ;
5. Imputed base price for material B =  $7.00/1.15 \approx 6.09$ .

## 8. Calculation of the Construction Cost Index on different levels

### 8.1 Calculation of the lowest level index

An index calculated for an individual material or service represents the lowest level index. Graph #1 shows the structure of the Construction Cost Index, where the elementary aggregate index is the index calculated for reinforcing bar, square tube and other metal materials. The lowest level long term index is obtained from the ratio of the average geometric prices for comparable types of materials/services in the reporting ( $t$ ) and reference ( $0$ ) periods.

$$I_i^{t/0} = \left( \prod_{j=1}^n \frac{p_j^t}{p_j^0} \right)^{1/n} = \frac{(\prod_{j=1}^n p_j^t)^{1/n}}{(\prod_{j=1}^n p_j^0)^{1/n}}$$

where:

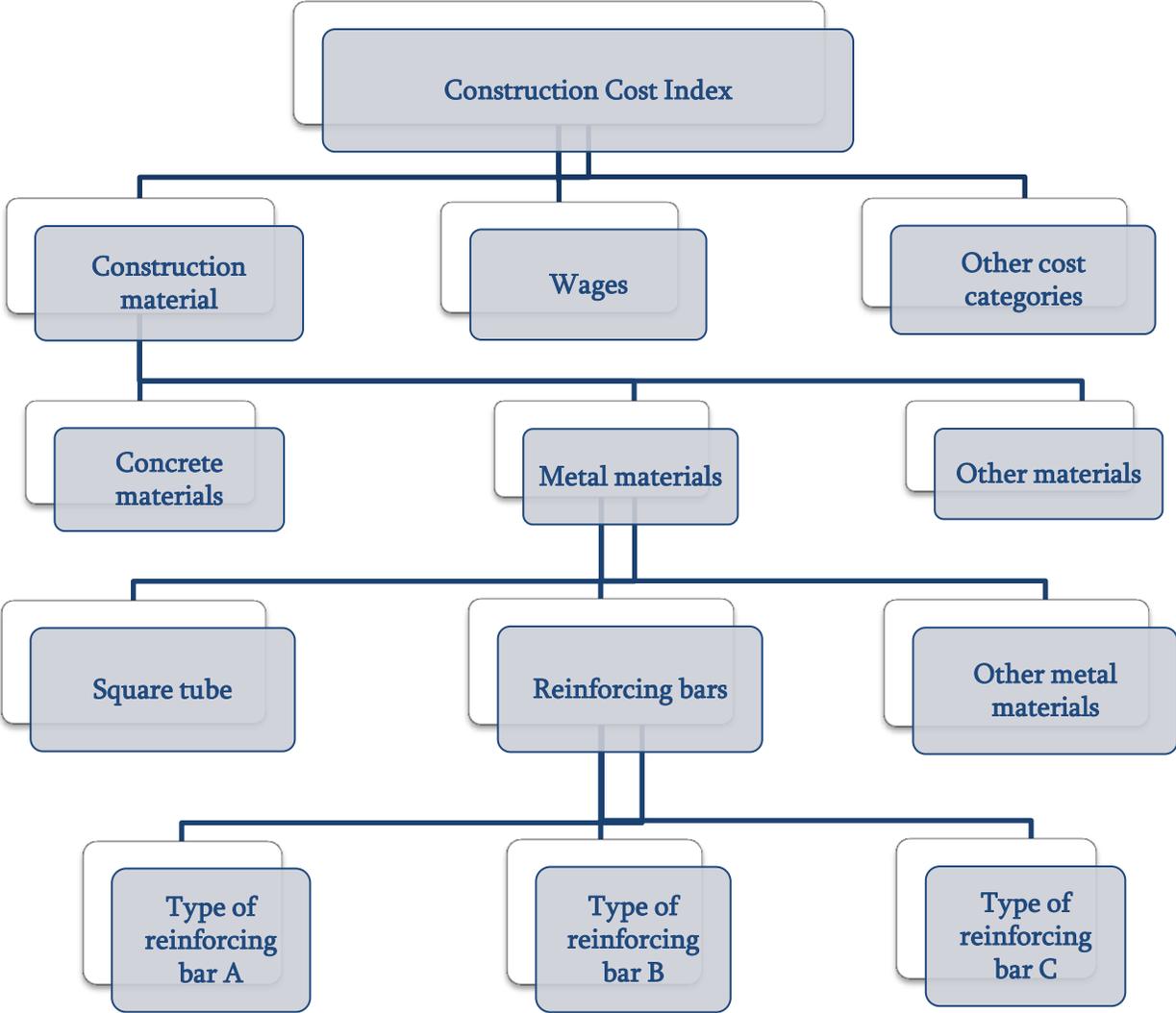
$I_i^{t/0}$  is the lowest level index for construction material/service  $i$  in the reporting period  $t$ , compared to the index reference period  $0$ ;

$j$ - type  $j$  of material/service for which a comparable price is registered;

$p_j^t$ - type  $j$  of the material/service in period  $t$ ;

$p_j^0$ - price of type  $j$  of the material/service in the reference period  $0$ .

Graph #1. The structure of the Construction Cost Index



## 8.2 The Construction Cost Index for separate cost categories and the whole building

The long term CCI for the whole building compared to the price reference period is calculated using the following Laspeyres-type formula:

$$I^{t/0} = \sum_{i=1}^n (I_i^{t/0}) \times s_i^b, \text{ where:}$$

$I_i^{t/0}$  is the lowest level long term index for material/service  $i$  compared to the price reference period (0);

$s_i^b = \frac{p_i^b q_i^b}{\sum p_i^b q_i^b}$  is the weight of material/service  $i$  in the weight reference period, which represents the share of expenditure on material/service  $i$  in the total cost, where  $\sum_{i=1}^n s_i^b = 1$ .

$p_i^b$  - the price of material/service  $i$  in the weight reference period ( $b$ );

$q_i^b$  - quantity of material/service  $i$  in the weight reference period ( $b$ ).

The same formula is used for calculating all upper level indices. For example, the type of material (e.g. metal materials) index is calculated by weighting the long term indices of all materials within this group, where the sum of the weights of the indices is 1.

A short term index compared to the previous quarter is obtained from the ratio of long term indices in the reporting and previous periods, calculated comparing to the price reference period.

## 8.3 Chain index

During the update of weights the list of construction materials and services may also be updated. At this time prices are collected for types of materials and services both in the old and new samples, which enables chain-linking of indices calculated for different samples. Chaining enables to calculate indices with a long term reference period.

For example, before the 4<sup>th</sup> quarter of 2018 the index was calculated compared to the 4<sup>th</sup> quarter of 2017, using  $w_i$  weights, whereas starting from 2019 the index is calculated compared to the 4<sup>th</sup> quarter of 2018, using  $k_i$  weights (see table 4).

$X_1$  is the chain index for the 1<sup>st</sup> quarter of 2019, which is calculated with the reference period of the 4<sup>th</sup> quarter of 2017 and is calculated as follows:

Table 4.

| IV.2017=100  | IV.2018=100   |
|--|---|
| IV.2018: $I^{IV.18/IV.17} = \sum_i I_i^{IV.18/IV.17} \times w_i = 106$ | IV.2018: $I^{IV.18/IV.18}=100$                                      |
| $X_1$  | I.2019: $I^{I.19/IV.18} = \sum_i I_i^{I.19/IV.18} \times k_i = 102$ |

$$\frac{106}{X_1} = \frac{100}{102}, \text{ resulting } X_1 = \frac{106 \times 102}{100} \approx 108$$

The following result is derived from the chain-linking as well:

$$I^{IV.18/IV.17} \times I^{I.19/IV.18} = 106 \times 102/100 \approx 108$$

## 9. Publication

### 9.1 Press release

A press release for the Construction Cost Index is published quarterly through the Geostat website. It contains information about quarterly and annual index data and contributions of cost categories to the index formation.

#### 9.1.1 Contribution of groups to the percentage change of the overall index

Calculation of contributions of certain costs categories to the percentage change in the index provides a powerful analytical tool for analyzing the CCI. The contribution of a material or service to the change in the total index is defined as the percentage change of the overall index caused by the price change of the given material/service only, providing the permanence of prices of the other materials/services.

The contribution of an index for any material or service to the change in the overall index is calculated using the following formula:

$$\text{Contribution of a material/service to the quarterly index} = \left( \frac{I_t^i}{I_{t-1}^i} - 1 \right) \times 100 \times \frac{I_{t-1}^i}{I_{t-1}^a} \times w_t^i$$

where:

$I_t^i$  - is the index of material/service  $i$  in period (quarter)  $t$ ;

$I_{t-1}^i$  - the index for material/service  $i$  in period  $t-1$ ;

$I_{t-1}^a$  - the CCI in period  $t-1$ ;

$w_t^i$  - the weight of material/service  $i$  in period  $t$ .

Contribution of certain cost categories to the quarterly index represents the sum of contributions of each material and service included in it.

In the case of weights change, the contribution of material/service  $i$  to the annual index is calculated using the following formula:

Contribution of the material/service  $i$  to the annual index =

$$\left( \frac{I_L^i - I_{t-4}^i}{I_{t-4}^a} \right) \times w_{t-4}^i \times 100 + \left( \frac{I_t^i - 100}{I_{t-4}^a} \right) \times I_L^a \times w_t^i$$

where:

$I_L^i$  - is the index for material/service  $i$  in the weight change period;

$I_{t-4}^i$  - the index of material/service  $i$  in the period  $t-4$  (previous reference period=100)

$I_{t-4}^a$  - the CCI in period  $t-4$ ;

$w_{t-4}^i$  - the weight of the material/service in the period  $t-4$ ;

$I_t^i$  - index for material/service  $i$  in period  $t$ ;

$I_L^a$  - the CCI in the weights change period;

$w_t^i$  - the weight of material/service  $i$  in period  $t$ .

### Example: Calculation of contribution of cost categories in the case of weight change

Using the above formula, the contribution of price change for different categories of construction materials to the change in the index of the 4<sup>th</sup> quarter of 2018, considering the weights of 2017 and 2018 (0.35 and 0.28, respectively) can be calculated as follows (see table 5):

Table 5.

| Indices compared to the 4 <sup>th</sup> quarter of the previous year |                                 |                                 |                                 |
|--|---------------------------------|---------------------------------|---------------------------------|
|  | 3 <sup>rd</sup> quarter of 2017 | 4 <sup>th</sup> quarter of 2017 | 3 <sup>rd</sup> quarter of 2018 |
| Index for the categories of construction materials                   | 101.2                           | 101.7                           | 102.2                           |
| Overall index  | 101.6                           | 103.2                           | 101.8                           |

$$\text{Contribution} = \frac{(101.7 - 101.2)}{101.6} \times 0.35 \times 100 + \frac{(102.2 - 100)}{101.6} \times 0.28 \times 103.2 \approx 0.8\%$$

According to the given data, the contribution of categories of construction materials to the overall index of the 3<sup>rd</sup> quarter of 2018 amounted to 0.8 percentage points.

## 9.2 Time series of the Construction Cost Index

Along with the press release, different time series of the CCI are published on the website on a quarterly basis:

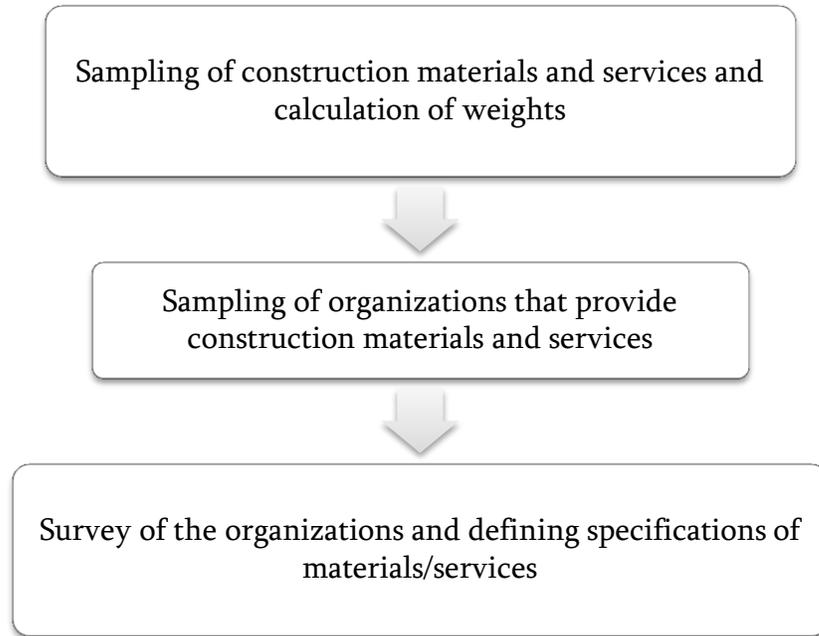
1. The CCI compared to the previous quarter;
2. The CCI to the same quarter of the previous year.

The published indices are rounded to four digits and are final data.

The CCI data is also disseminated through an android application.

Graph #2 represents the stages of the CCI calculation and its periodicity.

## Graph #2 Stages of the CCI calculation



### Quarterly activities:

