THE TREND OF CONSTRUCTION COST INDICES AND THEIR APPLICATIONS

Yoo-Sub Lee [1], Seung-Hyun Lee[2], and Tai-Kyung Kang [3]

[1] Research Fellow, Korea Institute of Construction Technology, Ilsan, Korea
[2] Senior Researcher, Korea Institute of Construction Technology, Ilsan, Korea
[3] Senior Researcher, Korea Institute of Construction Technology, Ilsan, Korea
Correspond to slee413@kict.re.kr

ABSTRACT : Construction Cost Indices are values for measuring fluctuations in direct construction costs which include material costs, labor costs, and equipment costs for construction operations. In Korea, Korea Institute of Construction Technology (KICT) has been assessing and announcing these indices since January, 2004. The main goals of this paper are to look over the calculation process for those indices and then present the trend in construction costs according to the types of facilities with the past construction cost index data. Also, this paper traces the origin of the occurrence of significant changes on those indices through the further analysis of the trend. In addition, this paper shows the practicality of the indices and the way how to put them to practical use. An alternative estimate method using the indices is suggested for compensating the changes of construction costs caused by price fluctuations.

Key words : Construction Cost Index, Estimate System Using Historical Cost Data, Price Fluctuations, Modified Laspeyres Formula, Trend of Cost Indices

1. INTRODUCTION

An adjustment dealing with the changes in the construction cost of an item or group of items from one point in time to another is particularly important to accumulate construction cost data and put them to practical use (Ferry et al., 1999). It may indeed be necessary to adjust a contract price based on given price fluctuations since the date of contract as well.

Construction cost indices announced by Korea Institute of Construction Technology (KICT) since January, 2004 are values for measuring fluctuations in direct construction costs. KICT assess these values statistically by analyzing the cost data, which include material costs, labor costs, and equipment costs for construction operations, based upon the Leontief table and production price index of the Bank of Korea and the wage rates of construction work groups in an open market published by Construction Association of Korea.

Construction cost indices were developed in connection with the Estimate System Using Historical Cost Data (ESUHCD) that has been in force since 2004. It is currently applied to adjust the unit costs of subdivided items in the ESUHCD to the present costs. However, there is not yet some ground for adjusting a contract price according to the price fluctuations such as escalation.

This paper analyzes the trends of the fluctuating construction cost indices and clarifies the causes of their fluctuations. In addition, it discusses about the practicality of the construction cost indices that reflected the crisis in construction material cost at the first half of year 2004. Also, it suggests how to put the construction cost indices to practical use with minimum risk.

2. CONSTRUCTION COST INDICES

The construction cost indices are formed out by "Modified Laspeyres Formula." "Laspeyres Formula" considers the change of costs over time since a base date with the weighted values based on the quantity of commodities exchanges on the base date. On the other hand, "Modified Laspeyres Formula" is defined by substituting the costs for the quantities of commodities exchanges. It can be written as in Eq. (1).

$$\text{Modified Laspeyres Formula (L')} = \frac{\sum p_o q_o p_t / p_o}{\sum p_o q_o} = \sum w \frac{p_t}{p_o} / \sum w \qquad (1)$$

p: price
q: quantity
w: the weighted value based on the cost amount of a commodity exchange
o: a base date

Table 1. Organization of the Construction Cost Indices

	2004. 11	2004. 12	2005. 1	2005. 2	2005. 3	2005. 4
Construction	127.9	127.8	127.9	128.0	128.3	128.6
Building and building maintenance	126.3	126.2	126.4	126.5	126.8	127.0
House buildings	126.0	126.0	126.1	126.2	126.4	126.6
RC/structural steel	126.4	126.4	126.5	126.6	126.8	127.0
Others	120.2	120.0	120.2	120.2	120.5	120.6
Non-house buildings	127.5	127.4	127.5	127.7	128.0	128.2
RC/structural steel	127.7	127.7	127.8	128.0	128.3	128.5
Others	123.1	122.8	122.9	123.2	123.4	123.7
Building maintenance	123.6	123.5	123.8	123.9	124.2	124.4
Building maintenance	123.6	123.5	123.8	123.9	124.2	124.4
Heavy construction	129.7	129.6	129.7	129.8	130.1	130.5
Transportation facilities	130.0	129.9	130.1	130.1	130.4	130.6
Roadway facilities	129.2	128.9	129.2	129.3	129.4	129.6
Railway facilities	133.3	133.4	133.3	133.3	134.0	134.0
Subway facilities	133.0	133.2	133.2	133.1	133.4	133.5
Seaport facilities	131.0	130.4	130.7	131.0	131.4	132.4
Airport facilities	128.0	127.7	128.0	128.2	128.5	129.4
Other facilities	129.6	129.5	129.6	129.8	130.0	130.6
Waterway facilities	127.1	126.7	127.0	127.0	127.4	128.1
Water supply/sewer facilities	134.9	134.6	134.8	134.9	135.2	137.5
Agriculture and forestry /marine facilities	127.4	127.0	127.2	127.3	127.6	127.8
Urban heavy construction	130.6	130.3	130.5	130.6	131.0	131.4
Electric power facilities	126.6	127.0	126.7	127.3	127.6	127.8
Communication facilities	124.1	124.8	124.2	124.2	124.4	124.7
Other facilities	132.3	132.1	132.2	132.3	132.5	132.7

t: a point in time for comparing costs

The weighted values for drawing up the construction cost indices are obtained from the weighted values regarding construction related items on the Leontief table and production price index of the Bank of Korea. Changes in costs are calculated based upon the production price index and the wage rates of construction work groups assessed by Construction Association of Korea. All of the weighted values and the cost changes of construction related items are not employed to develop the construction cost indices, but seventy-five items on the Leontief table with the weighted values over 1/1,000 and two hundreds thirty two items, which is relating to those seventy-five items, are utilized.

The base date of the construction cost indices is as of year 2000 like the production price index and the Leontief table and is given the value of 100. All increases or decreases of cost indices are related to this figure, and they are announced every month.

The construction cost indices are written according to the seventeen different types of facilities which are exhibited on the Leontief table. All of twenty five indices are given by including the construction cost index at the top level of indices. The construction cost indices are organized as

	Production Price Index	Customer's Price Index	Construction Cost Index
2004. 1	104.3	112.7	119.2
2004. 2	105.6	113.2	121.1
2004. 3	106.6	114.3	123.2
2004. 4	107.1	114.3	124.0
2004. 5	107.4	114.2	125.5
2004. 6	107.3	114.2	125.3
2004. 7	107.7	114.9	125.4
2004. 8	108.7	115.9	125.5
2004. 9	109.1	115.9	126.7
2004.10	109.2	115.9	127.5
2004.11	109.2	115.2	127.9
2004.12	108.4	115.4	127.8
2005. 1	108.6	116.2	127.9
2005. 2	109.0	116.9	128.0
2005. 3	109.5	117.8	128.3
2005. 4	110.2	117.9	128.6

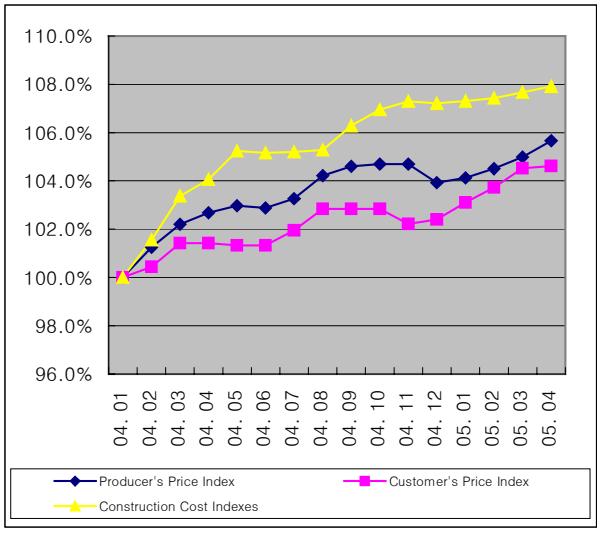

Figure 1. Major Indices and their Increasing Rates by Percentage (’04.01 ~ ’05.04)

shown in Table 1.

3. THE TRENDS OF CONSTRUCTION COST INDICES AND THEIR FURTHER ANALYSIS

The construction cost index is compared with the production price and the customer's price indices from January, 2004 to April, 2005 and is shown in Figure 1. The percentage increasing rate of each index from the base date as of January, 2004 is presented as well. The construction cost index had been increased from 119.2 to 128.6 for fifteen months. Its percentage increasing rate was 7.9% and exceeded the percentage increasing rates of production price (increase of 5.7%) and the customer's price indices (increase of 4.6%) for the same period. It is recognized that the increasing level of construction related cost is higher than that of general price. Specifically, the percentage increasing rate of the construction cost index reached as much as 5.3% for the past four months from January, 2004 to May, 2004. On the other hand, the percentage increasing rate of the customer's price index was only 1.3% for the same period.

A main factor that caused the large variance in the construction cost index was a steel and material crisis, which became a social problem at the first half of the last year. It implies that the construction cost index reflects the trend of construction price variations thoroughly.

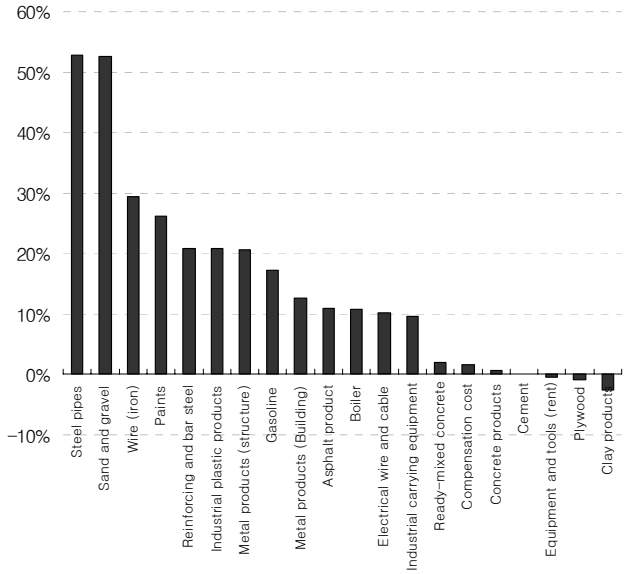

Figure 2. Cost Fluctuations of Main Items ('04.01~'05.04)

Figure 2 illustrates the fluctuation rates of material costs by percentage. The increasing rate of construction labor cost (compensation cost), which takes normally a biggest share of construction cost, was only 1.5%. On the other hand, other principal material costs such as steel pipes (52.7%), sand and gravel (52.6%), wire products (29.3%), paints (26.1%), reinforcing and bar steel (20.9%), gasoline (17.1%), and asphalt products (11.0%) shot up. Some material costs such as plywood (-0.8%) and construction clay product (-2.5%) were on the downside, but the range of their decreasing was tiny. This fact means that an upward tendency of principle material costs raised construction cost excessively. In general, a hike in labor cost raised construction cost.

The increasing rates of the construction cost indices can be drawn up by categorized facilities as illustrated in Figure 3. In this figure, the increasing rate of the construction cost index for water supply/sewer facility is the highest. The followings are subway, railway, electric power facility, airport, and seaport in sequence. The increasing rate of the agriculture and forestry/marine facility is the lowest.

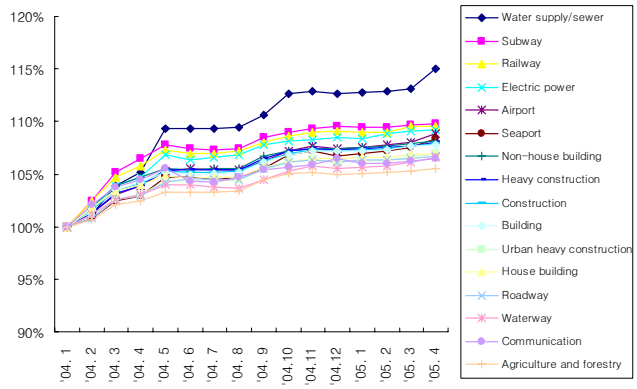

Figure 3. Increasing Rates of the Construction Cost Indices by Different Types of Facilities

The reason why the increasing rates of the construction cost indices were different is caused by the different schemes for weighted values. For example, the increasing rate of the cost index for the water supply/sewer facility was the highest since the cost for installing steel pipes took much larger portion in the construction cost of water supply/sewer facility than other facilities.

Accordingly, the construction cost indices are better to track the fluctuations of construction cost than the production price index or customer's price index. Also, these indices reflect well the changes of costs in different types of facilities.

4. APPLICATIONS OF THE CONSTRUCTION COST INDICES

The construction cost indices are worthy of three basic roles: a criterion for analyzing the fluctuations in construction work costs, a basic resource for making existing historical construction cost data into the current value, and a foundation for improving the basic resources for adjusting contract prices (Korea National Statistical Office, 2004). The construction cost indices are practically used for the first two basic roles, but it is not fully applicable for the last basic role.

The indexation method ruled by the law of national contract can be classified roughly into two types. One type applies the adjustment rate for each item at the point of price fluctuation by determining the range of the fluctuation based upon three calculation criteria. This method modifies a contract price by recalculating the unit prices for remaining work quantities. The other type uses the indices of items of

expenditure and calculates the change of contract price caused by price fluctuation. This method estimates the weighted values for the items, such as labor, equipment, mining product, etc., of remaining construction costs at the point of price fluctuation, and then it determines the increasing rate by assessing the weighted average of corresponding increasing rates of production price index. Eq. (2) shows the formula for modifying the increasing rate.

$$K = a\frac{A_1}{A_0} + b\frac{B_1}{B_0} + c\frac{C_1}{C_0} + d\frac{D_1}{D_0} + e\frac{E_1}{E_0} + f\frac{F_1}{F_0} + g\frac{G_1}{G_0} + h\frac{H_1}{H_0} + z\frac{Z_1}{Z_0} - 1 \quad (2)$$

The following symbols are used in this formula:

A: labor cost, B: equipment cost, C: mining product, D: industrial product, E: electric power/water supply/gas, F: agriculture and forestry/marine product, G: insurance cost against as a guard against industrial accidents, H: safety management cost, and Z: other items of expenditure

a, b, c, …, z - weighted values

A_0, B_0, C_0, D_0, E_0, F_0, G_0, H_0, Z_0 - index at the base date

A_1, B_1, C_1, D_1, E_1, F_1, G_1, H_1, Z_1 - index at the point in time as price fluctuating.

In relation to the above method, the production price index corresponding to each item of expenditure that does not reflect the features of construction cost accurately continues to be a controversial issue (Park, et. al 2003; Park, et. al 2005; Cho, et. al 2002). Accordingly, suggestions to improve the indexation were made, and they were basically similar. It is developing the advanced construction cost indices which reflect the fluctuations of construction costs thoroughly with more accurate system of weighted values. The cost amount of incensement could be estimated based on these indices.

Ultimately, KICT intends to use the simple estimation system of the index adjustment ratio (K-value) like other research studies for the applications of the construction cost indices as shown in Eq. (3)

$$K = \frac{I_1}{I_0} - 1 \quad (3)$$

I_0: construction cost index at the base date

I_1: construction cost index at the point in time as cost fluctuating

The existing method by adjusting indices has a limitation that its indices cannot reflect the fluctuations of construction price appropriately. However, its weighted value system can reflect more accurately the features of different construction works and their system of remaining construction costs at different points of time. Of course, there might be a controversy if the estimated cost by this method will reflect the actual construction cost, but it may be difficult to find better alternatives. Also, a general practice in public construction sector hinders the improvement of the existing method. Considering these circumstances, this paper suggests to apply an alternative estimation method for the index adjustment ratio (K-value) as shown in Figure 4.

The main points of this estimation method are minimizing the confusion of practical use caused by rapid changing of the existing system and extending the applications of the construction cost indices gradually.

The ESUHCD which brought the development of the construction cost indices has been in force since 2004, but the estimated amount applied by the ESUHCD is currently about 20% only. Accordingly, this paper suggests to allocate the cost amount coming under the applications of the ESUHCD to the other items of expenditures (Z) for the time being and then assess the increasing rate of the other items' cost. This suggestion has a couple of advantages. First, there is no need to calculate the index for the other items of expenditure separately. Second, the problem that the index is calculated based upon the index of labor cost or material cost can be solved. Third, it is possible to examine the

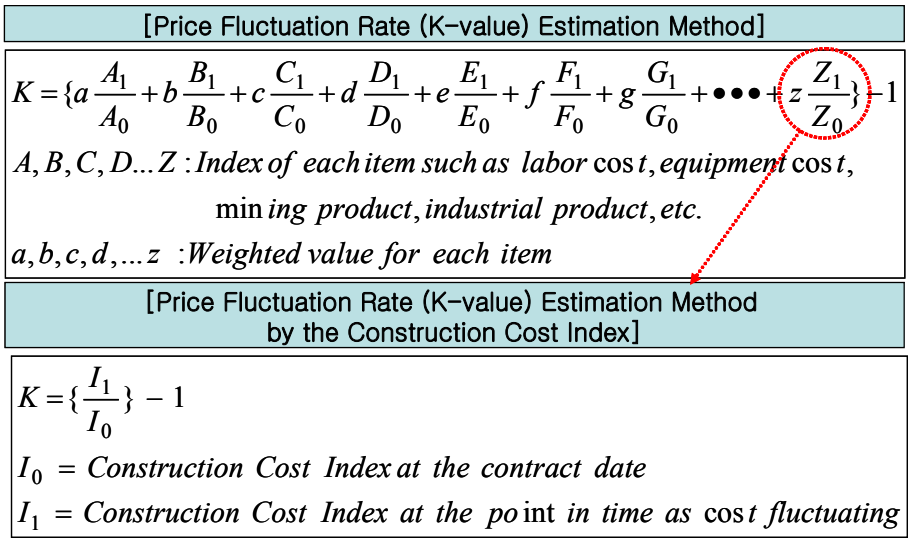

Figure 4. Suggested Estimate Method for Modifying the Construction Cost Indices

practical applicability of the construction cost indices with minimum risk. In addition, there is a significant contribution to reduce a burden of the government and owners in public sector because the applications of the construction cost indices will be extended naturally as the application portion of the ESUHCD is getting bigger.

5. CONCLUSIONS

The construction cost index were developed to convert existing historical construction cost data into the current value and to use as a basic resource for analyzing fluctuations in construction work costs, but there was no practical use in a formal way yet. However, this paper exemplified how the construction cost indices are useful by analyzing their trends.

Construction projects which are long lasting go with the price fluctuations in general. Therefore, it is very important to develop a system for adjusting construction costs depend upon the price fluctuation, especially when the range of fluctuation is big.

It is desirable to develop a simple estimate system, like advance countries, for adjusting construction costs according to the increasing rates of specific indices in a long term view. However, the rapid change of the system may cause the practical confusion in the conservative public sector. Thus, this paper suggested an alternative estimation method for the index adjustment ratio. This method can be applied to practical use without confusion and keep face with the operation of the ESUHCD.

REFERENCES

[1] Cho, H. H. and Doe, G. Y., "Improvement of Contract Sum Adjustment Method caused by Price Fluctuation using Construction Cost Index", *Korean Journal of Construction Engineering and Management*, Vol. 6 (1), pp. 162-168, 2005.

[2] Cho, H. H., Lee, Y. S. and Kang, T. K., "Case study on Development of Residential Building Cost Index Compilation Model", *Korean Journal of Construction Engineering and Management*, Vol. 4 (4), pp. 220-226, 2003.

[3] Ferry, D. J., Brandon, P. S. and Ferry, J. D., *Cost Planning of Buildings*, BSP Professional Books, pp. 188-189, 1999.

[4] Korea Institute of Construction Technology, *Construction Cost Index*, http://kict.re.kr, January, 2004-April, 2005.

[5] Korea National Statistical Office, *Korea Statistical Survey Status Report (II)*, Kang-Moon Publisher., pp. 909-913, 2004.

[6] Park, J. H., Bae, K. and Lee, T. S., "Development of a Cost Index for Road Construction Project", *Journal of the Korean Society of Civil Engineers*, Vol. 22 (4D), pp. 707-719, 2002.

[7] Park, J. H., Lee, T. S. and Kim, H. C., "Cost Index for the Site Developing Projects", *Journal of the Korean Society of Civil Engineers*, Vol. 23 (2D), pp. 223-233, 2003.

[8] Park, J. W., Son, B. S. and Lee, H. S., "A Budget Estimation Model for Military Facility Construction Using Cost Index", *Journal of the Architectural Institute of Korea*, Vol. 21 (2), pp. 111-121, 2005.