REGIONAL RELEVANCY OF THE CIDA PRICE INDICES UNDER THE RESTRICTIONS URGED BY THE COVID-19 PANDEMIC

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ABSTRACT

CIDA price fluctuation formula and price indices provide considerable relief to the estimators in mitigating the risk due to the fluctuation of the price of construction inputs during project execution. But there is a huge outcry that the CIDA indices does not appropriately reflect the actual fluctuation of market prices especially during the period of pandemic. The aim of this research was to identify the appropriateness of CIDA indices in ascertaining the price fluctuation of construction material prices across the regions especially under the restrictions imposed by the Covid-19 pandemic.

The study was limited to analysis the regional behavior of material prices based on the significant materials. Market price of construction materials was collected from suppliers, constructors, and construction professionals who are currently involved in construction projects. The market prices were collected from nine provinces of the country for eight different types of significant materials during the period of pandemic.

Collected data were first observed for its behavior within and across the provinces to check the appropriateness to be represented by country wide common indices. This was done through the analysis of variance and through the checking of null hypothesis i.e., “always there is no difference in means between the provincial prices of a given material”.

Thereafter the fluctuation of provincial prices of given inputs were compared to the variation of respective CIDA indices with the corresponding time to check the parallelism and correlation.

In this research, it has been concluded that, there is a requirement for establishing regional monthly indices for construction inputs.

KEYWORDS: *CIDA indices, Construction materials, Province, Regional*

1 INTRODUCTION

Cost of construction materials is the highest component of the input and may vary from 40% - 60 % depend on the type of construction. Price fluctuation of construction materials is a risk associated with bidding and implementation of construction projects.

Generally, the price fluctuation risk is accepted by the employer through the introduction of price fluctuation formula to overcome difficulties faced by constructors. The price fluctuation calculation is based on the formula which associate with the indexation (Saman WijewardenaS, n.d.). CIDA publish countrywide index for the different construction inputs. The CIDA, former ICTAD, introduced bulletin of price and cost indices in the year 1990, capitalized it as the base year. CIDA indices reflects price fluctuation in each month and all the indices are expected to reflect the fluctuation of the actual market price of any given time. But there is a huge outcry that the CIDA indices does not appropriately reflect the actual fluctuation of market prices especially during the period of pandemic.

ISSN 2961-5011 | https://doi.org/10.54389/DCGT7296

Furthermore, there are concerns about using of single index for the entire country may not appropriately compensate the regional fluctuation of material prices.

Limited number of studies are available in Sri Lanka on regional variation of the construction materials prices. During this research prices for selected construction materials were collected from different regions in Sri Lanka. The objective of the research is to study, how regional prices of construction materials varied during the period of pandemic compared to the CIDA indices. It is also important to study the variation of regional prices to ascertain the validity of using single price indices. The specific objectives of this research are,

- Collect construction material prices for selected materials from various regions.
- Identify region to region price variations and analyze the price variance of each material across the regions.
- Find the correlation in-between CIDA national indices variation patterns and regional price variation patterns.

Study area was limited to building construction materials due to restriction imposed as a result of Covid19 pandemic situation (L.P.D.S, 2020). Collecting data from various suppliers and contractors was a challenge due to prevailing pandemic and lockdown situation in the country and therefore sample size was limited.

2 LITERATURE REVIEW

The price increase of construction materials, machineries and manpower is a major challenge and risk faced by constructors during the execution of projects. The challenge is mainly attribute to the estimation in forecasting the future trends in market prices of construction materials, manpower, machineries etc. This unpredictability can lead to greater prices and increased risk for suppliers, contractors, and owners, putting all parties engaged in the construction process in financial instability (Justin E. Weidman MSCM, Kevin R. Miller Ph.D, 2011). Construction expenses are always subject to changers. Estimated costs are predicted using construction cost indices (Alaloul et al., 2021).

It is very important to understand and seen market behaviors at the time of bidding by estimators. Inaccurate and estimate errors will finally result budgetary issues for contractors. As a result, material price fluctuation and shocks can be devastating (Al-Zarrad & Moynihan, 2015). Losses incurred because of pricing changes should be shared between the contractor and the owner (Ph.D., Minsoo Choi, Jinu Kim, 2006).

In any event of price increase or decrease, there are strategies that can be deployed to recover or compensate the price changes for the client or the contractor. There are no attempts to calculate or estimate the exact amount of the volatility or loss that occurred. The sums recovered using the formulas technique differ from those obtained using traditional methods. As a result, the traditional technique is thought to be superior to the formula method (Jayasinghe et al., 2015). CIDA price fluctuation formula is a simplified method to determine the escalation of contract prices. Saman Wijewardena, S. A. Y. B. Jayasinghe have done the study on actual price fluctuation and the amount determined using the ICTAD formula to evaluate the sensitivity of it with respect to various variables and how it has affected the contract price.

The indices in the bulletin are to be used in calculations to determine the ultimate cost difference between actual and estimated costs. In the recent past, it was highlighted that the reported indices differed from actual price differences in building projects based on inflation, Covid-19's impact, and restrictions imposed by government for import and exports. The accuracy of the indices needs to be revisited, so that stakeholder's could be protected from the financial shocks due to the current pandemic (Notoatmodjo et al., 2014). Supply and demand are always altering, raw material prices fluctuate because of various elements colliding. As an example, weather conditions - political upheavals, and hydrocarbon prices are all short-term influences, while economic policies - trade policies, and technological innovation are long-term issues. As an example, factors that affect the short term – may be the dollar exchange rate, while economic conditions and technological growth are long-term variables (Trader, 2018).

Escalations are defined as an increase in the cost of construction items that are required for the initial contract during the construction phase (Awad S. Hanna, Unv of Wisconsin-Madison, Madison & Andrew N. Blair, Unv of Wisconsin-Madison, Madison, 1993). The ICTAD price adjustment is hugely

reliant on the appraised valuation, input percentages, PI, and fixed coefficient (FC) - 0.966. The latter is directly affected by the cost adjustment factor (CAF) and the rest adjustment factor (RAF) (Jayasinghe et al., 2015). Most countries consider location index, Sri Lanka has failed to do so and instead utilizes a single cost index that only considers the time factor, although location index is critical. To reduce that it is important to analysis and check the location factor (Parameswaran et al., 2019).

Location indices in Sri Lanka are necessary to increase the accuracy and efficiency of tender pricing (Abeysinghe, 2010). To identify the primary location elements that influence construction costs, investigate the impact of location factors on building construction costs in Sri Lanka, and a mechanism to investigate the impact of location factors on building construction costs in Sri Lanka are important in investigating the applicability of location factor (Parameswaran et al., 2019). Price fluctuation is a major risk factor in any construction project market. It's impossible to avoid, and difficult to forecast. The amount calculated using the CIDA price fluctuation formula approach and the real price fluctuation, however, are usually argued to be different (Janardana et al., 2021).

Individual industries, of course, have different locational needs in terms of processing and transfer costs. Regional disparities in processing costs, whether of labor or power, have a significant impact on the placement of some firms. Other factories are best positioned near raw material suppliers to reduce total transportation expenses (Harris, 2008). It was identified that regional relevancy will depend on geography of the country, resource availability and availability of infrastructure facilities (Transportation), Regional Wage differences etc. Construction prices are a function of many factors beyond pure material costs (Dr. Douglas D. Gransberg, 2008).

3 METHODOLOGY

CIDA indices for construction materials have been established based on collected data from various suppliers and contractors for previous 12 months. The same methodology was adopted for collecting regional prices. and basically, two methods were applied. Industry experts were method one is conducting interviewed gather views on suitability of CIDA indices.

The data collection was done through a questionnaire survey among contractors and suppliers. The goal of the study was to examine the relationships reginal prices and CIDA indices. Statistical method was used for the analysis of data. The research method type adopted in this regional relevance of the CIDA pricing indices investigation is quantitative research.

Participants were selected using non-probability Sampling methods. The snowball method is used for data collecting. Market prices of different inputs were collected through the questionaries. Only 30 responses were managed out of 40.

Selected materials were considered for the evaluation of price variation during the period of 2020 August to July 2021 from collected data from various suppliers and contractors. The collected data was processed by using Excel software. Selected research philosophy was pragmatism method. Deductive theory is used for theoretical approached and exploratory research design was selected to study the curiosity and better understanding of the applicability of CIDA single indices for entire country.

4 ANALYSIS AND DISCUSSION OF RESULT

4.1 Analysis of market price behavior

The analysis was carried out to check the price variation of selected samples within the region and across the regions. To compute the mean value and standard deviations from the collected data, the following formulas were used to compute the mean and standard deviation.

$$\bar{x} = \frac{x_1+x_2+x_3+\cdots+x_n}{n} \quad (1)$$

$$s = \sqrt{\frac{(x_1-\bar{x})^2+(x_2-\bar{x})^2\ldots+(x_n-\bar{x})^2}{n}} \quad (2)$$

4.1.1 Price behavior pattern of construction materials within the province

Below table 1 shows the statistical data of construction materials in all provinces.

Table 1. Standard deviation and mean

Material		Nothern Province	Nothern Central Province	Nothern Western Province	Central Province	Easten Province	Uva Province	Western Province	Sabaragamuwa Province	Southern Province
SAND	Mean	13187.50	10604.17	13250.00	14687.50	9270.83	12416.67	15777.78	14104.17	13760.42
	Standard deviation	649.52	445.41	923.19	501.42	561.13	243.86	686.57	310.03	614.01
RUBBLE	Mean	3737.50	4603.13	3395.83	4875.00	3802.08	3447.92	3090.28	3822.92	3632.81
	Standard deviation	22.61	227.27	128.73	376.89	90.11	158.64	300.38	64.37	144.82
¾"METAL	Mean	6427.08	7209.72	6291.67	7093.75	6770.83	6958.33	5548.61	6347.92	6343.75
	Standard deviation	495.60	245.51	396.48	297.36	380.02	462.62	351.87	286.53	267.17
RED EARTH	Mean	1250.00	1240.28	991.67	2229.17	1366.67	956.25	1744.44	1054.17	1383.33
	Standard deviation	0.00	31.95	36.93	198.24	55.05	38.62	745.50	78.21	41.74
ABC	Mean	7500.00	6080.21	6187.50	6037.50	5447.92	5416.67	4905.56	5541.67	5927.08
	Standard deviation	0.00	52.08	386.20	369.27	64.37	257.46	137.31	257.46	321.83
BRICKS	Mean	18354.17	10970.83	9250.00	17166.67	8020.83	8895.83	13312.50	9520.83	12791.67
	Standard deviation	568.67	288.87	261.12	1094.06	249.05	128.73	892.68	198.24	257.46
RAINFORCEMENT STEEL	Mean	6859.17	6849.17	6837.92	6841.67	6856.67	6856.67	6829.17	6837.92	6856.67
	Standard deviation	1376.83	1376.83	1376.83	1376.83	1376.83	1376.83	1376.83	1376.83	1396.89
CEMENT	Mean	42300.00	41200.00	40850.00	41650.00	42450.00	43850.00	41150.00	41300.00	41150.00
	Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

From the above table, it is shown that how material prices are varied from province by province and price volatility of construction materials province to province.

4.1.2 Price variation behavior patterns across the provinces

Interpretation of standard deviation and mean across the provinces

Analysis reported to observe the price behavior across the province. And it was analysis based on the market prices of different materials.

Observation of average prices across the provinces

The average of the annual prices within the provinces of each material were analyzed through the Standard Deviation and mean to observe the behavior.

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Table 2. Observation of average prices across the provinces.

Material	Avarage Standerd deviation	Avarage mean value
SAND	548.35	13006.56
RUBBLE	168.20	3823.05
¾" METAL	353.68	6554.63
RED EARTH	136.25	1357.33
ABC	205.11	5893.79
BRICKS	437.65	12031.48
RAINFORCEMENT STEEL	1379.06	6847.22
CEMENT	0.00	41766.67

Below box charts shows the spread of the standard deviation. Figurer 1 reinforcement shows equal standard deviation in all province and red earth under figure 2 shows high standard deviation in western province. Wide array of standard deviations reported for sand as per figure 3 sand box chart.

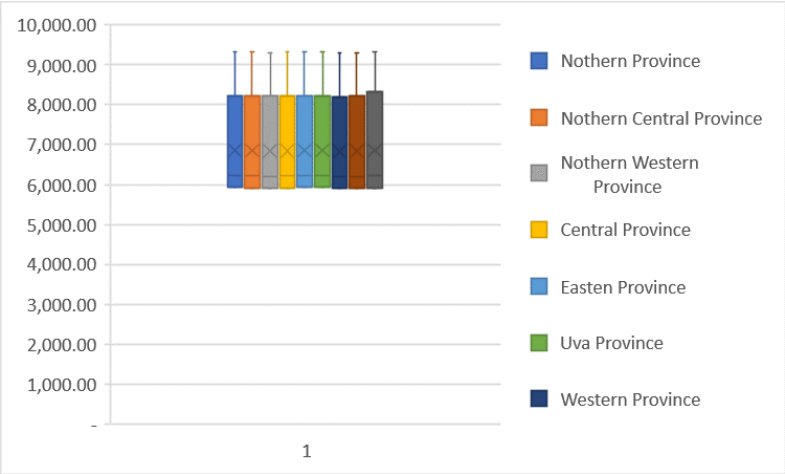

Figure 1. Reinforcement, box chart

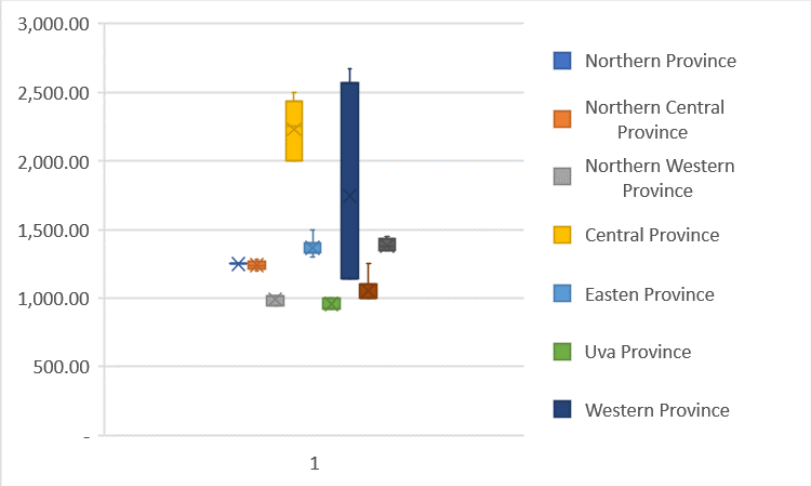

Figure 2. Red earth, box chart

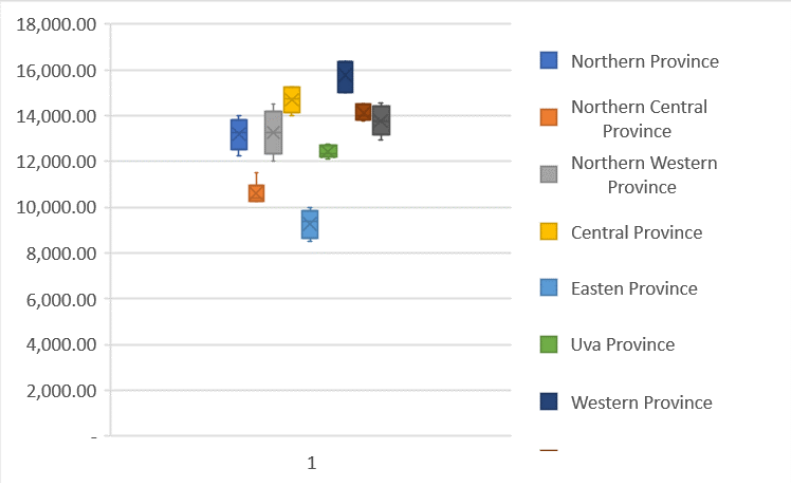

Figure 3. Sand, box chart

From the above Table 2. standard deviation and mean values analysis, the results may not appropriately represent the actual variance since the analysis was done for the average prices of the provinces. Therefore, in order to derive a batter analysis of the realistic behavior across the provincial prices, for the study was done based on ANOVA as deiminated under subtopic of analysis of variance.

4.1.3 Analysis of Variance (ANOVA)

To verify the results of standard deviation and slope described in previous chapters, Analysis of variance test (ANOVA) is used to make a confident and reliable decision. ANOVA test is a statistical technique that is used to check if the means of two or more groups are significantly different from each other. ANOVA checks the impact of one or more factors by comparing the means of different samples.

The F value is used in ANOVA and is calculated by dividing two mean squares. It determines the ratio of explained variance to unexplained variance. F critical is obtained from F table to determine given parameters effects are significant or not.

The P value is defined as the probability under the assumption of no effect or no difference (Null hypothesis). P value can take any value between 0 and 1. Table 3 shows the F, F crit and P value of the data set.

Table 3. F and P- value

Material	***F***	***F crit***	***P-value***
Cement	65535	2.033295	#DIV/0!
Sand	143.9502	2.033295	5.35E-51
3/4" Metal	24.04067	2.033295	4.23E-20
6" X 9 " Rubble	98.38396	2.033295	1.23E-43
ABC	104.8125	2.033295	7.69E-45
Red earth	29.27446	2.033295	6.59E-23
Bricks	557.9417	2.033295	9.6E-79
Reinforcement	0.000745	2.033295	1

The null hypothesis, (H0) is that all provinces have same mean. H1 is at least one province is different from other provinces with respect to means.

From above table F < F crit is only for reinforcement and P value is 1. Refer to the figure 1 box chart, mean value has almost equal value hence null hypothesis fail to reject.

P value for cement is an infinity value and F value is larger than F crit. The reason for is the government control price cement for the whole of the country. Under such, can reject the null hypothesis significantly.

All materials except reinforcement, F value is larger than F critical and P value is almost close to zero hence null hypothesis failed to reject.

As per the above analysis that there are significant evident to reject null hypothesis and to accept the alternative hypothesis. We can conclude that a common index may not reflect the price fluctuation of the different provinces. which urge the requirement of reginal indices.

4.2 Observation of CIDA indices against the provincial price behaviors

The comparison of monthly price changers and monthly changers of the CIDA indices done based on the slope (to check the parallelly) and correlation comparison is done based on the relative price changers within different month compared to the average price or average index (in case of CIDA index) this is done in order to make the comparison on same platform.

4.2.1 Slope

Array formula method was deployed to derive the slope, and intercept of each data set taking the month as the independent variable (months are label as 1 to 12).

Table 4. Slope

Material		Northern Province	Northern Central Province	Northern Western Province	Central Province	Easten Province	Uva Province	Western Province	Sabaragamuwa Province	Southern Province
SAND	Slope	0.0125	0.0106	0.0178	0.0091	0.0160	0.0051	0.0103	0.0056	0.0121
	CIDA indicers Slope	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
RUBBLE	Slope	0.0010	0.0124	0.0090	0.0197	0.0056	0.0115	0.0231	0.0040	0.0095
	CIDA indicers Slope	0.0165	0.0165	0.0165	0.0165	0.0165	0.0165	0.0165	0.0165	0.0165
¾"METAL	Slope	0.0201	0.0086	0.0164	0.0113	0.0127	0.0181	0.0151	0.0101	0.0114
	CIDA indicers Slope	0.0096	0.0096	0.0096	0.0096	0.0096	0.0096	0.0096	0.0096	0.0096
RED EARTH	Slope	0.0000	(0.0048)	0.0085	0.0231	(0.0046)	(0.0096)	(0.1006)	(0.0141)	0.0073
	CIDA indicers Slope	0.0222	0.0222	0.0222	0.0222	0.0222	0.0222	0.0222	0.0222	0.0222
ABC	Slope	0.0000	0.0022	0.0148	0.0139	0.0028	0.0113	0.0067	0.0110	0.0129
	CIDA indicers Slope	0.0128	0.0128	0.0128	0.0128	0.0128	0.0128	0.0128	0.0128	0.0128
BRICKS	Slope	0.0080	0.0068	0.0023	0.0169	0.0019	0.0005	0.0171	0.0054	0.0007
	CIDA indicers Slope	0.0137	0.0137	0.0137	0.0137	0.0137	0.0137	0.0137	0.0137	0.0137
RAINFORCEMENT STEEL	Slope	0.0464	0.0464	0.0465	0.0465	0.0464	0.0464	0.0466	0.0465	0.0469
	CIDA indicers Slope	0.0239	0.0239	0.0239	0.0239	0.0239	0.0239	0.0239	0.0239	0.0239
CEMENT	Slope	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	CIDA indicers Slope	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

$$m = \frac{(Y2-Y1)}{X2-X1} \tag{3}$$

From table 4, it is showing variance slope variance from province to province with respect to the CIDA indices slopes except for cement which is with control price. This mean that at least one province doesn't vary on par with other provinces. Which means a common index may not reflect the price Fluctuations of different provinces, which proves the requirement of provincial indices

4.2.2 Correlation

The relationship between CIDA indices and each provincial prices are plotted on scatter graph, and it is shown in below figure numbers. It shows relationship between two variables of CIDA indices and provincial price variation. A scatter graph indicates the strength of the co-relationship between two variables of CIDA indices.

$$r_{Xy} = \frac{\sum(X_i-\bar{X})(y_i-\bar{y})}{\sqrt{\sum(X_i-\bar{X})^2\sum(y_i-\bar{Y})^2}} \tag{4}$$

Positive Correlation

Figure number of 4 for construction material of sand and other ¾" metal, Rubble and Bricks in Northern, Southern, Uva and Northern Provinces respectively shows positive gradients which shows one variable increase the other increases. All points lie close to the straight line.

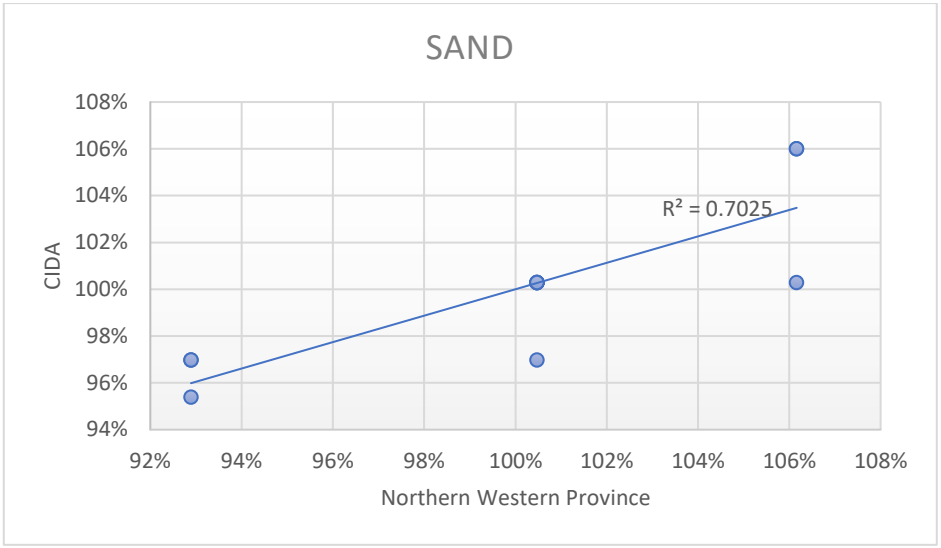

Figure 4. Sand

Negative Correlation

Figure number of 5 and for construction material of red earth in Western and Sabaragamuwa Provinces respectively shows negative gradients which shows one variable increase the other decreases. All points lie close to the straight line.

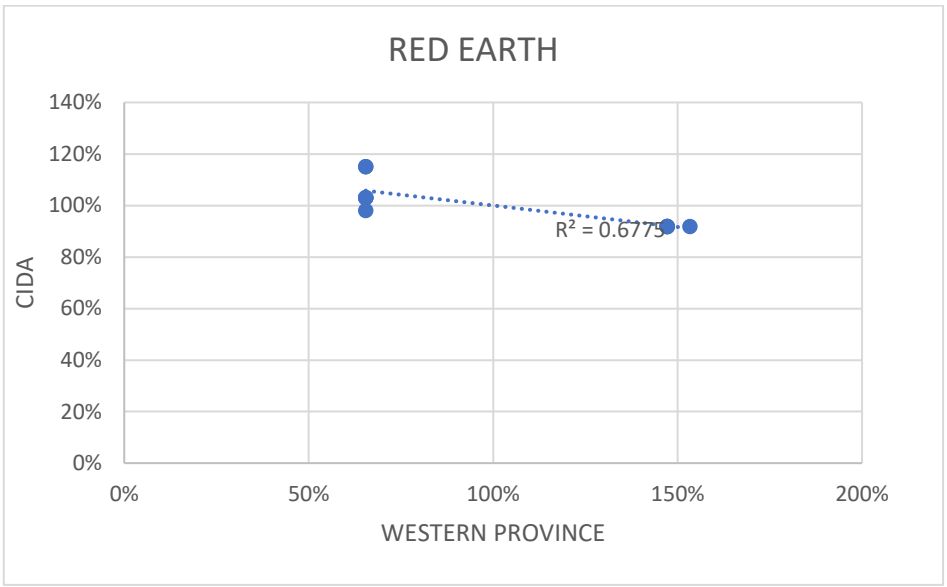

Figure 5. Red earth

Corelation is shown in below Table number 5 numerically as coefficient of corelation, slope and interception respective construction materials in each province. From the table corelation coefficient varies from -1 to +1. A corelation of -1 indicates a perfect negative corelation, that means one variable goes up other goes down. A corelation of +1 indicates a perfect positive corelation, that means one variable goes up, the other goes up.

Table 3. Interception, slope, and correlation

Material		Nothern Province	Nothern Central Province	Nothern Western Province	Central Province	Easten Province	Uva Province	Western Province	Sabaragamuwa Province	Southern Province
SAND	Interception	0.919	0.931	0.884	0.941	0.896	0.967	0.933	0.963	0.922
	Slope	0.013	0.011	0.018	0.009	0.016	0.005	0.010	0.006	0.012
	CORREL	0.838	0.865	0.851	0.818	0.864	0.830	0.714	0.791	0.852
RUBBLE	Interception	0.994	0.919	0.941	0.872	0.963	0.925	0.850	0.974	0.938
	Slope	0.001	0.012	0.009	0.020	0.006	0.012	0.023	0.004	0.009
	CORREL	0.572	0.920	0.838	0.840	0.838	0.895	0.838	0.838	0.838
¾" METAL	Interception	0.870	0.944	0.893	0.927	0.918	0.882	0.902	0.934	0.926
	Slope	0.020	0.009	0.016	0.011	0.013	0.018	0.015	0.010	0.011
	CORREL	0.775	0.841	0.775	0.859	0.732	0.844	0.807	0.618	0.828
RED EARTH	Interception	1.000	1.031	0.945	0.850	1.030	1.062	1.654	1.092	0.952
	Slope	0.000	-0.005	0.008	0.023	-0.005	-0.010	-0.101	-0.014	0.007
	CORREL		-0.606	0.689	0.869	-0.420	-0.824	-0.823	-0.705	0.882
ABC	Interception	1.000	0.986	0.904	0.910	0.982	0.927	0.957	0.928	0.916
	Slope	0.000	0.002	0.015	0.014	0.003	0.011	0.007	0.011	0.013
	CORREL		0.886	0.833	0.772	0.833	0.833	0.833	0.833	0.833
BRICKS	Interception	0.948	0.956	0.985	0.890	0.988	0.997	0.889	0.965	0.996
	Slope	0.008	0.007	0.002	0.017	0.002	0.000	0.017	0.005	0.001
	CORREL	0.850	0.778	0.538	0.896	0.492	0.406	0.897	0.810	0.406
RAINFORCEMENT STEEL	Interception	0.699	0.698	0.698	0.698	0.699	0.699	0.697	0.698	0.695
	Slope	0.046	0.046	0.047	0.046	0.046	0.046	0.047	0.047	0.047
	CORREL	0.974	0.974	0.974	0.974	0.974	0.974	0.974	0.974	0.969
CEMENT	Interception	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Slope	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CORREL									

Reinforcement

Slope of reinforcement in all provinces are almost at constant value with a positive trend and CIDA indices in all provinces are also at a constant value with a positive trend. Slope of the CIDA indices in reinforcement shows a lesser slope than provincial prices and therefore both lines are not parallel in each other. As such in actual scenario CIDA indices are not matching with provincial prices.

Bricks

Slope of CIDA indices is at a constant value of 0.0137 for all provinces. From the table its highlighting that slope of brick prices is showing less gradients in Northern. North Central, Northwestern, Eastern, Uva, Sabaragamuwa and Southern Province with a positive trend and showing higher gradient in Western and Central Provinces with a positive trend. In this case also, it is observed that CIDA indices are not reflecting the actual scenario of price variation in all provinces.

Except for Northern Province, all other provinces exhibit a perfect positive correlation. And ¾" metal is having relatively perfect positive correlation except for Eastern and Sabaragamuwa Provinces. In Eastern and Sabaragamuwa Province also shows relatively positive perfect correlation. The table shows red earth is having positive perfect correlation only in southern province, perfect negative co-relationship. ABC has a perfect positive correlation across all provinces according to the correlation calculations. Bricks is having relatively perfect positive correlation in northern and eastern provinces and strong correlation in all other provinces. And according to the table the reinforcement is having perfect positive correlation in all provinces. And cement also having a perfect positive correlation in all provinces.

4.3 Analysis summary

Analysis of collected data were carried out by using following methods.

1) Analyzing price variation from region to region with standard deviation and mean values
2) Comparing Price behavior pattern of construction materials within the province with respect to the standard deviation.
3) Comparing price variation behavior patterns province to province with respect to the mean value.
4) Analyzing CIDA national indices pattern and regional price variation patterns with the slope.
5) Analyzing correlation between the CIDA indices and provisional variations of the prices across the different provinces.
6) Analyze of Variance (ANOVA) Test

5 CONLUSION

Following finding were identified during the research on the variation of prices from region to region and with respect CIDA material indices.

1) As described in 4.1 and Table 1, it is evident, significant variance can be identified in the price fluctuation patterns of the different regions for construction materials selected in this research.
2) According to the derived data in Table 1 and figures no 1, 2 and 3, it showed that there is low papalism in price variation compared to the CIDA indices in many regions.
3) With the data analysis of the slope shown in Table 4, it is shown that there are positive and negative trends in price volatility with respect to the CIDA indices other than Cement in all provinces.
4) Correlation analysis also showing positive and negative trend in price volatility with respect to the CIDA indices in all regions.
5) ANOVA test proved that there are significant evident to reject null hypothesis other than cement. It is possible to conclude that government regulatory price of cement may be the reason for the no price volatility of cement all over the island.

It is clearly shows that the mere determination of price fluctuation with single price index for the whole country is not accurate representative for different regions. Weightage of province to province price volatility varies. This analysis leads to conclude that, there is a significant requirement to establishing in regional indices.

6 REFERENCE

Abeysinghe, A. (2010). *Appropriateness of using single construction cost index for Sri Lanka*. http://dl.lib.uom.lk/bitstream/handle/123/1922/94562.pdf?sequence=1&isAllowed=y

Al-Zarrad, M. A., & Moynihan, G. P. (2015). Guideline to apply hedging to mitigate the risk of construction materials price escalation. *11th Construction Speciality Conference*, *September*. https://www.researchgate.net/profile/M_Ammar_Alzarrad/publication/281100131_Guideline_to_Apply_Hedging_to_Mitigate_the_Risk_of_Construction_Material_Price_Escalation/links/5ba6a5ca299bf13e6045f26f/Guideline-to-Apply-Hedging-to-Mitigate-the-Risk-of-Constru

Alaloul, W. S., Musarat, M. A., Liew, M. S., Qureshi, A. H., & Maqsoom, A. (2021). Investigating the impact of inflation on labour wages in Construction Industry of Malaysia. *Ain Shams Engineering Journal*, *12*(2), 1575–1582. https://doi.org/10.1016/j.asej.2020.08.036

Awad S. Hanna, Unv of Wisconsin-Madison, Madison, U. S., & Andrew N. Blair, Unv of Wisconsin-Madison, Madison, U. S. (1993). *Computerized Approach for Forecasting the Rate of Cost Escalation in*. https://cedb.asce.org/CEDBsearch/record.jsp?dockey=0082133

Dr. Douglas D. Gransberg, P. C. and E. J. K. (2008). Quantifying uncertainty of construction material price volatility using Monte Carlo. *Cost Engineering*, *50*, 14. https://d1wqtxts1xzle7.cloudfront.net/33481574/Volatility_Paper_Published_062008-with-cover-page-v2.pdf?Expires=1643057806&Signature=QQdMHcjWX-

QNycwLnjsprwpSFY36LR98IKltXNBSZHORVqrA1xB~a1h7FIDV149npeLqHnyDtoQXynvE~xDHVme3ORGx1HlzBX0rAjkmIZ7M9ApH~TNjVsOX-2

Harris, C. D. (2008). The, Market as a Factor in the Localization of Industry in the United States. *Annals of the American Association of Geographers*, *44*(4), Pages 315-348. https://www.tandfonline.com/doi/abs/10.1080/00045605409352140?journalCode=raag20

Janardana, J. A. B., Samaraweera, A., & Jayasena, H. S. (2021). Suitability of ictad formula and cida price indices to calculate the amount of price escalated in construction projects. *World Construction Symposium, July*, 505–515. https://doi.org/10.31705/WCS.2021.44

Jayasinghe, S. A. Y. B., Alahakoon, C. S., & Wijewardena, L. S. S. (2015). Sensitivity of the ICTAD Price Fluctuation Formula Procedure for the True Material Price Fluctuations in Construction Industry Sensitivity of the ICTAD Price Fluctuation Formula Procedure for the True Material Price Fluctuations in Construction Industry. *Journal of Engineering and Technology*, *3*(January 2015), 19–40.

Justin E. Weidman MSCM, Kevin R. Miller Ph.D, J. P. C. P. . &Jay S. N. P. . (2011). Best Practices for Dealing with Price Volatility in Commercial Construction. *International Journal of Construction Education and Reserch*, *7*(4), 276–293. https://www.tandfonline.com/doi/full/10.1080/15578771.2011.552936?scroll=top&needAccess=true

L.P.D.S, P. (2020). Effect of COVID -19 and Strategic Response: A Review on Sri Lankan Construction Industry. *International Journal of Economics and Management Studies*, *7*(6), 73–77. https://doi.org/10.14445/23939125/ijems-v7i6p110

Notoatmodjo, 2014:141, Ferretti, F., Planzer, S., Wilson, T., Keyes, M., Tang, Z. S., Durovic, M., Micklitz, H. W., Baretić, M., Petrović, S., Kono, T., Hiscock, M., Reich, A., Geometry, R., Analysis, G., Ziegel, J. S., Lerner, S., م. و. د, عامر., Geometry, R., & Analysis, G. (2014). Evaluation, Verification and Reporting of the Data Collection and Computation of CIDA Price Indices, Guiding , Management and Monitoring of the Staff Assigned to Prepare Monthly Marketing Bulletin. *Proceedings of the 8th Biennial Conference of the International Academy of Commercial and Consumer Law*, *1*(hal 140), 43. http://www.springer.com/series/15440%0Apapers://ae99785b-2213-416d-aa7e-3a12880cc9b9/Paper/p18311

Parameswaran, T., Jayawickrama, T. S., & Melagoda, D. G. (2019). Analyzing the impact of location factors on building construction cost in Sri Lanka. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, *2019*(MAR), 2924–2934. http://www.ieomsociety.org/ieom2019/papers/622.pdf.%0A

Ph.D., Minsoo Choi, Jinu Kim, M. K. P. D. (2006). A study on the price escalation system in a construction contract. *KSCE Journal of Civil Engineering*, 227–232. https://link.springer.com/article/10.1007%2FBF02830776

Saman WijewardenaS, A. Y. B. J. (n.d.). *Sensitivity of the ICTAD price fluctuation formula used to determine escalation of prices of civil engineering contracts*. https://www.researchgate.net/project/Sensitivity-of-the-ICTAD-price-fluctuation-formula-used-to-determine-escalation-of-prices-of-civil-engineering-contracts

Trader, B. (2018). *Raw material prices - Causes of change*. https://www.centralcharts.com/en/gm/1-learn/9-economics/34-fundamental-analysis/614-raw-material-prices-causes-of-change