Improving Construction Cost Escalation Forecasting Using Multivariate Time Series Models

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Recently, the accuracy of construction cost estimates has been significantly affected by fluctuations in construction costs. Construction cost fluctuations have been larger and less predictable than was typical in the past. Cost escalation has become a major concern in all industry sectors, infrastructure, heavy industrial, light industrial, and building. Construction cost variations are problematic for cost estimation, bid preparation and investment planning. Inaccurate cost estimation can result in bid loss or profit loss for contractors and hidden price contingencies, delayed or cancelled projects, inconsistency in budgets and unsteady flow of projects for owner organizations. The major problem is that construction cost is subject to significant variations that are difficult to estimate. The objective of this research is to create multivariate time series models for improving the accuracy of construction cost escalation estimation through utilizing information available from several indicators of macroeconomic condition, energy price and construction market. An advanced statistical approach based on multivariate time series analysis is used as a main research methodology. The first step is to identify explanatory variables of construction cost variations. A pool of 16 candidate (potential) explanatory variables is initially selected based on a comprehensive literature review about construction cost variations. Then, the explanatory variables of construction cost variations are identified from the pool of candidate explanatory variables using empirical tests including correlation tests, unit root tests, Granger causality tests, and Johansen's cointegration tests. The identified explanatory variables represent the macroeconomic and construction market context in which the construction cost is changing. Based on the results of statistical tests, several multivariate time series models are created and compared with existing models for estimating construction cost escalation. These models take advantage of contextual information about macroeconomic condition, energy price and construction market for estimating cost escalation accurately. These multivariate time series models are rigorously diagnosed using statistical tests including Breusch–Godfrey serial correlation Lagrange multiplier tests and Autoregressive conditional heteroskedasticity (ARCH) tests. They are also compared with each other and other existing models. Comparison is based on two typical error measures: out-of-sample mean absolute prediction error and out-of-sample mean squared error. Based on the correlation tests, unit root tests, and Granger causality tests, consumer price index, crude oil price, producer price index, housing starts and building permits are selected as explanatory variables of construction cost variations. In other words, past values of these variables contain information that is useful for estimating construction cost escalation. Based on the results of cointegration tests, Vector Error Correction models are created as proper multivariate time series models to estimate cost escalation. Our results show that the multivariate time series models pass diagnostic tests successfully. They are also more accurate than existing models for estimating cost escalation in terms of out-of-sample mean absolute prediction error and out-of-sample mean square error. It is expected that proposed cost escalation estimation models enhance the theory and practice of cost escalation estimation and help cost engineers and capital planners prepare more accurate bids, cost estimates and budgets for capital projects in various industry sectors.

Key Words: Construction Cost Escalation, Forecasting, Multivariate Time Series Models