國立臺灣大學工學院土木工程學系

碩士論文

Department of Civil Engineering

College of Engineering

National Taiwan University

Master Thesis

營建成本指數及建築成本在台灣與越南間的比較

Comparisons of Construction Cost Index and Building Cost in Taiwan and Vietnam

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中華民國103年6月

June, 2014

國立臺灣大學碩士學位論文
口試委員會審定書

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Comparisons of Construction Cost Index and Building Cost in Taiwan and Vietnam

本論文係阮伯黃君（R01521724）在國立臺灣大學土木工程學系碩士班完成之碩士學位論文，於民國 103 年 06 月 16 日承下列考試委員審查通過及口試及格，特此證明

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ACKNOWLEDGEMENT

First of all, I would like to express my deepest appreciation to my advisor, Professor Sy-Jye Guo, who has the attitude and the substance of an inspired teacher. He has been a tremendous mentor to me, who continually and convincingly conveyed a spirit of adventure in regard to the research. His advice on my research was absolutely priceless. Without his guidance and persistent help this thesis would not have been possible.

I would like to thank all the professors of the Department of Civil Engineering of National Taiwan University and the National University of Civil Engineering of Vietnam for having given me a great opportunity to study here in one of the best universities in Asia as well as over the world.

Finally, a special thank to my family. Words cannot express how grateful I am to my family for their sacrifices that you have made on my behalf. I would also like to thank all of my friends who have supported me in writing and incented me so much to strive toward my goal

ABSTRACT

This study establishes a comparison approach for indexes between Vietnam and Taiwan, in order to determine the differences and similarities between indexes inside one country and with another. The study's database consists of Vietnam and Taiwan's statistical data of 8 years from 2006 to 2013. Base on the study's method, it is expected to predict the trend with a higher than 80% correlation between indexes. Therefore, the proposed method can be a promising tool to assist decision makers in construction management.

The empirical results of this study illustrate the relationships between construction and economic indicators between Vietnam and Taiwan. Base on the data collected it is possible to draw a short-term prediction of the Construction Cost Index and other indicators, which serves as a decent tool in public building cost estimations in Vietnam. Absolute number is not possible, however, for such a frequently high fluctuated but not yet technology familiar construction industry like Vietnam's, this simple method is a decent approach to the Construction Cost Index forecasting study, which is still new in Vietnam.

Key words: Comparisons; Construction Cost Index; Interest Rate; Materials Cost Index; Labor Cost Index; Building Costs; Vietnam and Taiwan.

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CHAPTER 1: INTRODUCTION

1.1 Research Background and Motivation

According to experts, in Vietnam, the total value of procurement packages applied in accordance with the Law on Tender accounts for some 20 percent of GDP, estimated at more than US$20 billion a year (Talk Vietnam, 2012). When it comes to public building construction bidding, the government, as the project owner will decide the bid winner based on the law of bidding, which is cost priority in Vietnam. Therefore, in order to win the bid, the contractors in Vietnam have to lower their bids to as low as possible and later increase the bids so that earn profit for the project. Actual evidence shows that many projects are won by bids that are deliberately lower, but which later apply for an adjustment in the scale of investment leading to increased levels of investment. In reality, the adjustment of prices has led to the situation where the prices of all projects have been driven up to levels higher than the bids with many contractors intentionally delaying the construction process to have the prices adjusted (VIR, 2013). One of the most important reasons for this problem is that the public project owners in Vietnam follow the most recent year's Construction Cost Index without being able to predict the upcoming fluctuation trend of the Index. As a result, contractors often fail to match the project owners in terms of price so that they have to win the bid first by lowering the bidding cost, then earn profit later by making later further requests. Real figure shows that 100% of the bid winners in Vietnam have at least 01 price adjust request after they have already been awarded with the bid (Vietnam Report JSC, 2012).

Taiwan is a developed country while Vietnam is still considered a developing country. On the contrary, the two countries do have similarities to share, not only because of the proximity in geography but their cultures also are similar. Taiwanese construction groups also have quite some large investments in Vietnam and they did win bids in Vietnam (CECI with their awarded bids in Kon Tum province in Dak Lak and Quy Hop district in Nghe An). However, Vietnam's construction industry does not have so many companies that are capable of building high-technology buildings or green buildings. That is the reason why overseas contractors are more likely to be awarded when it comes to high tech complex projects. However, most projects that have been awarded to overseas contractors are roads and bridges or industrial projects. As a matter of fact, this study is carried out in order to give the overseas contractors an image of how different the construction market in Vietnam is in compared with an oversea country (Taiwan) along with some predictions on how the Vietnamese construction market will change in the next few years. Therefore it will help construction companies in investing in Vietnam's construction market.

Cost is one crucial factor that decides the success of the bid and it is estimated based on the annual cost index published by the government. But one can only collect the data for a period of time while the company has to make estimations for the upcoming period. It is even more difficult for companies to make estimations when it comes to foreign biddings. It means that when a company chooses to invest in other countries, not only he has to compete with the other foreign investors but the company also has to compete with the domestic companies whose knowledge and domestic experience in their country surpasses him. In order to successfully win the bid in both domestic and foreign markets, one must be well prepared not only with the capitals, equipment and the resources but also he has to be well aware of the incoming fluctuation that he is going to face. In other words, in order to succeed, one must actively catch the trend before it comes. Therefore, predicting the fluctuation trend in order to well calculate the project cost plays a significant role for project owners and contractors. Accurate prediction of Construction Cost Index can result in preparing accurate bids and preventing under- or over-estimations. Variations of Construction Cost Index are challenging for cost estimation and bid preparation.

In summary, this study is an analysis of data collected from Vietnam and Taiwan, comparing them to determine both similarities and differences in order to illustrate a general image for Vietnam and Taiwan's construction companies. This image will help them to recognize some risks which they have to take into account when they decide to invest in the other country in the upcoming years.

1.2 Problem Statements

The nature of construction industry, which is characterized by constant variations in both domestic and international economic conditions, pressures to maintain schedules and costs under increasingly complex techniques, significantly hinders the accuracy of cost prediction process. Hence, it is not surprising that there are a large number of construction projects suffering profit lost due to cost overrun (Cheng. M. Y, 2011). The most traditional way for cost estimations are to base on the government's Construction Cost Indices that are annually published. However the costs of the current year are not published until the first or even the second quarter of the later year. As a matter of fact, depends on the size of the project and the time taken to estimate the costs, the final result might get a one or two years lag to the actual time that the project are being implemented. Typically, construction projects are executed over a long period of time and in addition to that, prices of resources may experience substantial fluctuations (Issa R.R.A, 2000).

Fu and Liu (2010) conducted a study on factors that impact regional construction prices. Results of this study suggested that construction prices in interconnected market places are highly correlated. The authors also mentioned that the understanding of links among markets can be helpful in order to discover and explore the variations of the construction prices.

An empirical study carried out by Ashuri (2012) investigated the influence of various economic, strategy, and market variables on Construction Cost Index Fluctuations. Capano and Karshenas (2003) have pointed out that standard economic indicators can be useful variables for predicting cost escalations in the construction industry.

To predict Construction Cost Indices, the time series method has been utilized by various scholars. This method focuses on estimating the cost index by analyzing its pattern in the past and the extrapolating that pattern into the future. However, it is noted that since models based on the time series method often operate under the assumption of continuity, they are not capable of predicting a shift in trend of cost escalation. (Hanna & Blair, 1993).

To summarize, it is possible to predict Construction Cost Indices based on the data collected from the previous years. Using softwares also gives positive results. However, when it comes to developing countries as Vietnam, such advanced softwares are still not widely used. It is not an optimized method for Vietnamese to get the first approach to predicting Construction Cost Indices. This research tends to use a different approach with a simpler method so that it better suits the conditions of Vietnam nowadays.

1.3 Research Objectives

Due to the complexity of the problem, and the lack of technology and software-base knowledge in Vietnam, this study only demonstrates a simple approach to determine the relationships between the economic and construction indicators in both Vietnam and Taiwan. Then base on the results to forecast a short-term upcoming fluctuation trend of the Construction Cost Indices using the data collected. All of the research objectives are listed as follows:

1) To determine the similarities and differences between the economic and construction indicators in Vietnam and Taiwan in order to point out the fluctuation trend of Vietnam and Taiwan's variables.
2) Help contractors from one country to have a general image of how the trend has been going in the recent years, therefore help them in investing in the other country's construction market.
3) To be able to predict the near upcoming fluctuation trend from the data collected, therefore assist in the cost estimation work.

1.4 Research Scope and Limitations

Cost estimation for construction projects has always been a challenge in construction industry. Construction Cost Index forecasting methods have been broadly researched by many previous construction management scholars. Forecasting Construction Cost Index using another factor such as Energy Price has been implemented (Associated Schools of Construction, 2013). However, these methods are researched and applied only in some specific countries, and none of the methods are ever applied in Vietnam. The comparisons between economic and construction factors are also have not been implemented in Vietnam or Taiwan.

For comparison, this research uses 5 dataset collected from Taiwan and Vietnam construction industry to determine the relationship between them and then predict the fluctuation trend in the short upcoming time. The datasets used are listed as follows: Building Cost Indexes; Construction Cost Indexes; Materials Cost Indexes; Labor Cost Indexes; Annual Bank Interest Rates. These data are collected from the genuine annual published information from Taiwan and Vietnam Government's sources. On the contrary, due to the lack of data storage, technology and proper classification from Vietnam's data source that these data were only taken from the 8 recent most years, just after when Vietnam joined WTO and started to join the global rule.

The research's analysis is for the residential reinforced concrete buildings, which is the most common type of public buildings in Taiwan and Vietnam. Lack of steel building construction technology in Vietnam in the past has caused the missing in the data from Vietnam in comparison to Taiwan's data. On the other hand, due to the method approach, it is not possible to accurately calculate how much the index will increase or decrease. It is only capable of forecasting the upcoming fluctuation trend for both the construction and economic indicators. Finally, long-term trend prediction is not promising due to the geopolitical risks and also the high uncertainty in the operation environment of both Vietnam and Taiwan. As a result, investors and contractors should consider the risks associate with the country in which they are going to put their investment in.

Bank interest rates is one of the first indicators that will affect a country's indexes directly. In construction industry, it affects the price of all the materials, equipment, machines and somehow affects labor costs. Therefore the total price of the building is increased. In Vietnam the building price is not only affected by the building cost, building locations are also taken into account when it comes to determine the price of the building. Price differs quite a large amount even in the same city or region. This study however, does not consider Building Price into account due to the complication of data classification.

1.5 Procedure of the Research

The procedure of this research is described in Figure 1.1. As can be seen in Figure 1.1, this research contains of 5 parts. Each part describes the main process which contributes to the final conclusion of the research.

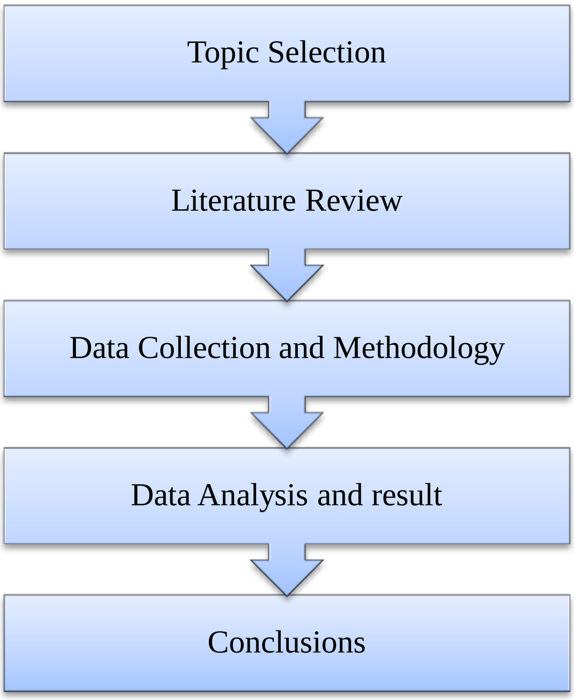

Figure 1.1: The procedure of research

1.6 Structure of the Research

Figure 1-1 shows procedure of this research. Base on the above steps, the framework of thesis is divided in five chapters as follows:

Chapter 1: Provides an overview, giving an account for the motivation and the objectives of this research, setting the research orientation, scope and discussing the research limitations, describing the research process and its structure.

Chapter 2: Reviews the past studies and methodologies on predicting Construction Cost Index using different construction and economic indicators. The scope of the literature review includes the whole industry and the construction industry.

Chapter 3: Explains the validity and the source that are used to collect the data. It also proposes the framework of methodology used in this research. Comparisons criteria are also mentioned in this Chapter.

Chapter 4: Bases on the collected data and shows the results completed by analyzing these data.

Chapter 5: Summarizes the research conclusions and suggestions.

CHAPTER 2: LITERATURE REVIEW

This Chapter describes the characteristics, the strengths and limits, empirical results, and development of different methods in forecasting the Construction Cost Indexes of the other previous scholars. The scope of literature review includes the whole industry and the construction industry.

2.1 Neural Network Models

From the late 1980s, artificial intelligence (AI), such as Artificial Neural Networks (ANN), was successfully applied to corporate financial distress forecasting. A large number of studies compared ANN's prediction performance with other classification methods and proved that ANN had better performance than other methods (Odom and Sharda, 1990; Coats and Fant, 1993; Zhang et al., 1999).

In the late 1990s, the Support Vector Machine (SVM), was introduced to deal with the classification problem. Fan and Palaniswami (2000) applied SVM to select the financial distress predictors. They pointed out that SVM created an optimal separating hyperplane in the hidden feature space in terms of the principle of structure risk minimization and used the quadratic programming to obtain an optimal solution.

Many studies which used ANN for prediction (Lin, 2009; Kim and Sohn, 2010; Muller el at., 2009; Neves and Vieira, 2006; Ahn et al., 2006; Want, 2005;…) rely on matched samples or partially adjusted unequal matched samples to test alternative methodologies or estimation methods. Zmijewski (2984) argued persuasively that this sample-matching method produces choice-based biases and sample selection biases.

Other ANN models include recursively partitioned decision trees, case-based reasoning (CBR) model, neural networks (NN), and genetic algorithms (GA). Researchers heavily rely upon computer programs to do Construction Cost Index prediction. Although many ANN models have been developed, they are still in the testing and improving stage.

2.2 The Russell – NCREIF Property Index

Since its inception in 1978, the Russell-NCREIF (RN) Index has become the most widely cited index of institutional-grade commercial property returns in the United States. It is based on the appraised values of unlevered properties held for institutional investors in the portfolios of the member firms of the National Council of Real Estate Investment Fiduciaries (NCREIF). The index now includes over 1800 properties appraised at over $23 billion by the fourth quarter of 1992.

Though a rich source of information, practitioners and academics alike have questioned the accuracy of the RN-Index due to its apparent smoothness and the perception that it lags declines in the property values. The quarterly RN-Index exhibits much less volatility than market value indices of other asset classes and at times has failed to register movements in real estate values that were widely perceived by market participants. For example, in the late 1980s the RN failed to register significant declines in commercial property values at a time when many financial institutions were being declared insolvent, with sharply falling real estate values often being cited as the primary cause of their insolvency.

2.3 Time Series Analysis of Construction Cost Index

Construction Cost Index is widely used to analyze the construction cost variation in time. It can convert the present construction cost to the future or to the past. The current practice of the future cost estimation is simply an extrapolation of the past Construction Cost Index (H. Nam, 2007). The advantages of the time series analysis are: Firstly they are fairly accurate in comparisons to other methods. Secondly, they can easily be implemented with computer software with proper monitoring. However, this method also has some noticeable disadvantages. This method requires a large collection of data in order to be proper calculated. If the data collected are not from the same classification, periods of time or is lacking, then the results will fail to demonstrate accuracy. Another advantage of this method is that it cannot be used to long-term forecast the fluctuation of the Construction Cost Index as it fails to take the uncertainty or risks in the operation environment into account.

Hana Nam, Seung Heon Han, Hyongkwan Kim (2007) have conducted a Time series analysis of Construction Cost Index using Wavelet Transformation and a Neural Network trying to forecast the Construction Cost Index using the Construction Cost Index data published in Korea. This official data have been published since February 2004 by the Korea Institute of Construction Technology (KICT). In this research they used the collected data, detected the fluctuations in the short periods of time and then use Wavelet transformation to de-noise the raw data. The raw data was first de-noised by fixed form thresholding in the wavelet domain.

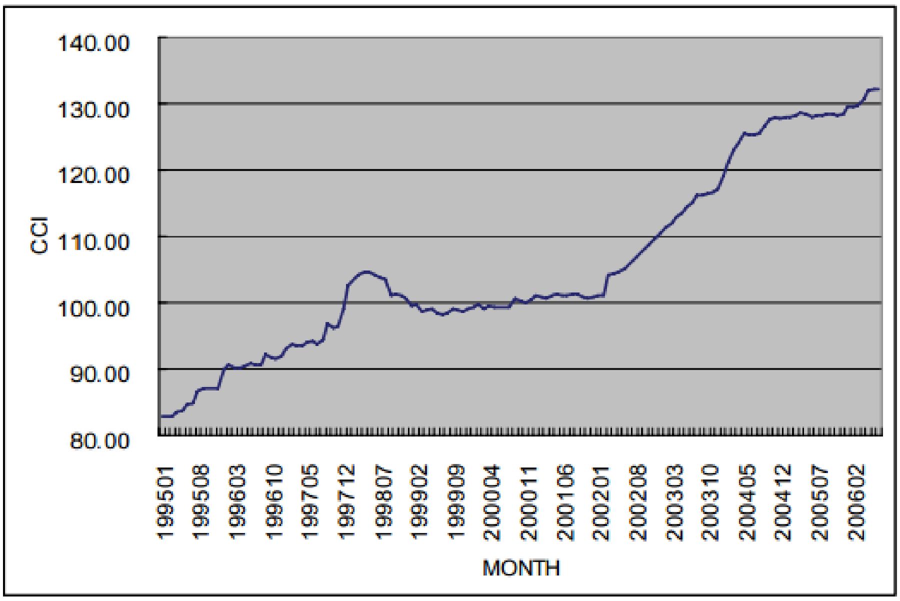

Figure 2.1. Construction Cost Index (Korea)

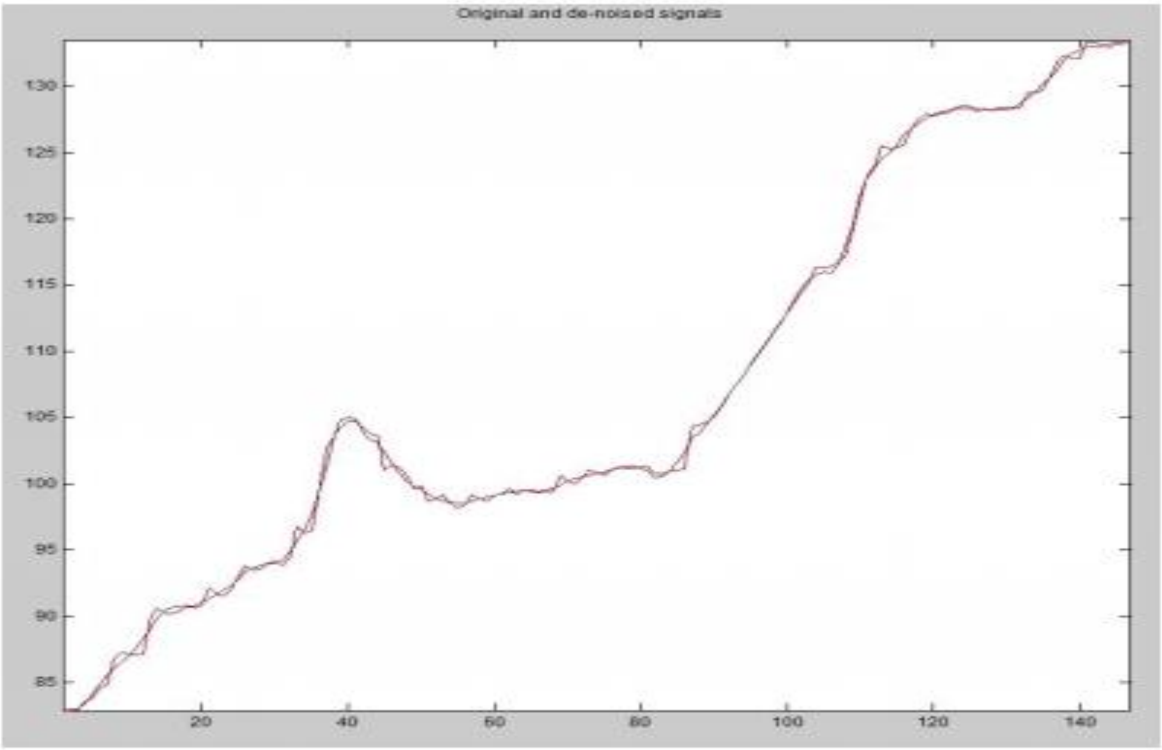

Figure 2.2. Original and De-noised CCI

(X axis: Month, Y axis: CCI)

Accordingly they used Artificial Neural Networks to predict Construction Cost Index in the periods of time then compared it with the actual indexes. A total of 147 months of Construction Cost Index data were used for neural network training and testing. Based on the de-noised Construction Cost Index data, a total of 130 training sets and seven testing sets were prepared. Table 2.1 shows the comparison of predicted Construction Cost Index and actual Construction Cost Index of the seven test sets.

Table 2.1. Construction Cost Index Comparison (Korea)

Month	Actual CCI	Predicted CCI	Difference
Sep.2006	133.3	133.4	0.1
Oct.2006	133.3	133.6	0.3
Nov.2006	133.2	132.9	-0.3
Dec.2006	132.9	133.1	0.2
Jan.2007	133.2	133.4	0.2
Feb.2007	133.2	133.7	0.5
Mar.2007	133.5	134.0	0.5

The Associated Schools of Construction (2013) in the 49th Annual International Conference Proceedings also have demonstrated Forecasting Construction Cost Index using Energy Price as an Explanatory Variable. In this research, four statistical tests are used to verify the relevance and examine the characteristics of crude oil price as the explanatory variable of Construction Cost Index. Pearson correlation analysis is used to study the linear relationship between the crude oil price and the Construction Cost

Index. The test statistic of this test is based on Pearson product-moment correlation coefficient and the hypothesis of the test is that there is no association between Construction Cost Index and the crude oil price.

Data from ENR monthly CCI from January 1975 to December 2008 are used as the CCI time series data for conducting the statistical tests. Crude oil price is also available for this period and the data is collected from the Energy Information Administration. Multivariate time series model including CCI and Crude Oil Price used in this research is Vector Error Correction (VEC) models. The following form of VEC Models is used in this study:

$$\Delta y_t = \sum_{i=1}^{p-1} A_i \Delta y_{t-i} + B y_{t-p} + C + \varepsilon_t \qquad (2\text{-}1)$$

Where y_t is the (2x1) vector of time series at period t, A_i (i=1,… , p-1) are (2x2) coefficient matrixes of endogenous variables, B is (2x2) coefficient matrix containing the cumulative long-run impacts, C is (2x1) vector of constants, and εt is (2x1) vector of error terms. Gaussian maximum likelihood (ML) procedure (Johansen, 1995) is used to estimate the coefficients of the VEC model.

In this research, statistical tests show that crude oil price is a consistent explanatory variable of Construction Cost Index. They also show that it is co-integrated with Construction Cost Index. Diagnostic tests also show that VEC model passes both diagnostic tests and therefore it is possible to forecast the Construction Cost Index using Energy Price as an explanatory variable.

S. M. Shahandashti and B. Ashuri in “Forecasting Engineering News-Record Construction Cost Index Using Multivariate Time Series Models” used Multivariate Time Series Models to forecast the Construction Cost Index using the monthly published in the United States by the Engineering News-Record (ENR) in 20 cities (ENR 2011). The purpose of the research is the show that the CCI predicted by these models is more accurate than the previously proposed univariate models. In this research, eight widely used and publicly available variables are typically used as the potential explanatory variables of Construction Cost Index. Based on the results of unit root tests and Granger causality tests, consumer price index, building permits, crude oil price, producer price index, and housing starts are selected as the explanatory variables for predicting CCI in this study. Based on the results of statistical tests, five VEC models are created and the coefficients are estimated by using a Gaussian maximum likelihood (ML) procedure. The predictability of the VEC models are compared with the existing univariate time series model. The two bivariate VEC models provide better forecasts than the existing univariate time series models.

2.4 Hybrid Intelligence Approach

Authors of this research stated that cost escalation is a major cause of project failure because construction prices fluctuate over time and are influenced by numerous factors. Therefore this study established a method for modeling construction price variations quantified by the Construction Cost Index. The database of the research consists of 122 historical cases.

In Taiwan, Construction Cost Index are employed to assess the variations of labor and material costs in the construction industry. They are recorded monthly and published by the National Statistic of Taiwan. In order to establish the Construction Cost Index prediction model, a set of input attributes have been taken into account. The research also reviews Differential Evolution (DE) proposed by Storn and Price (2005). The algorithm consists of five main stages: initialization, mutation, crossover, selection and stopping condition verification. Given that the problem at hand is to minimize a cost function f(X), where the number of decision variables is D, each stage of DE can be described in details in the following section.

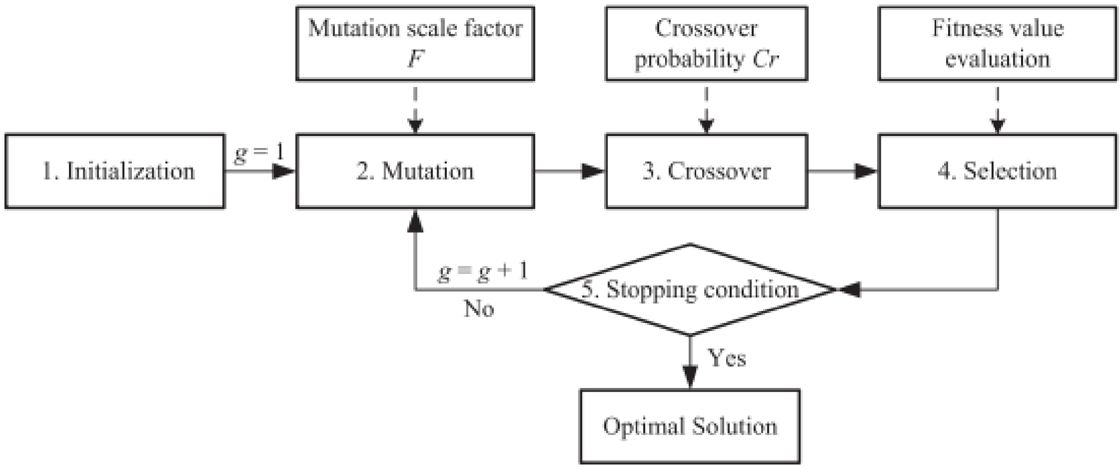

Figure 2.3 Differential Evolution algorithm

In order to validate the performance of ELSVM, its performance is compared to other benchmarked approaches. It is noted that the newly developed system is composed of LS-SVM and DE. To validate the superiority of the proposed ELSVM, two other machine learning techniques, namely Evolutionary Support Vector Machine Inference Model (ESIM) and Back Propagation Neural Network (BPNN), are utilized for result comparison.

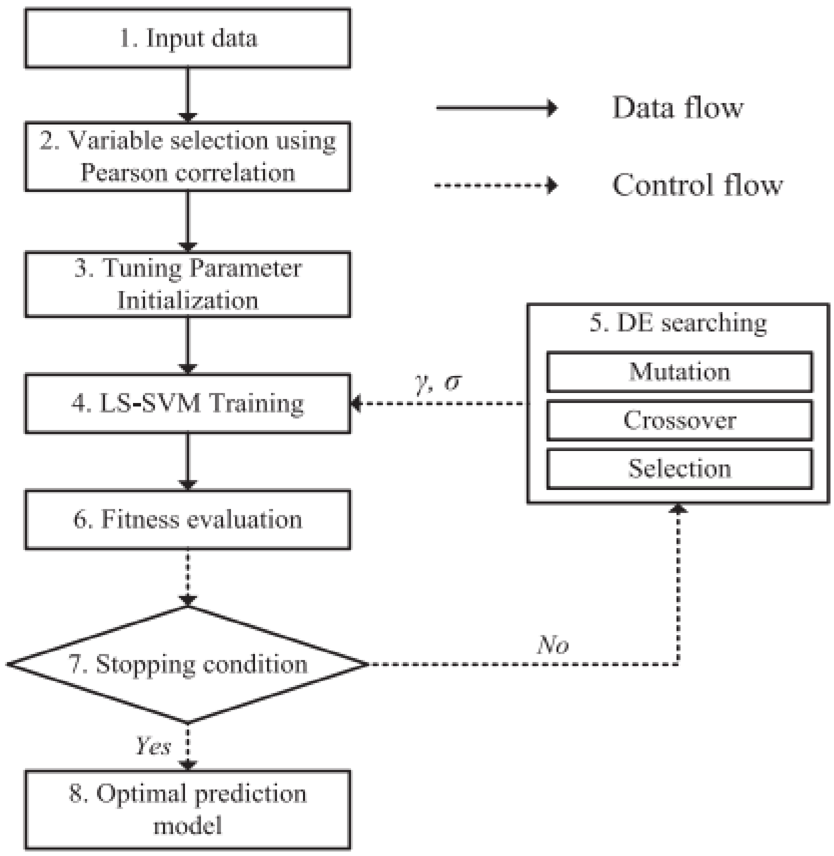

Figure 2.4 Evolutionary Least Squares Support Vector Machine (ELSVM) procedure

The research was able to demonstrate short-term prediction of the Construction Cost Index using the ELSVM (Evolutionary Least Squares Support Vector Machine) method but failed to implement long-term CCI prediction due to the high uncertainty in the operation environment.

CHAPTER 3: DATA COLLECTION AND METHODOLOGY

3.1 Source and validity of data

The investigation of this research considers different types of indicators. S. M. Shahandashti and B. Ashuri (2012), Consumer Price Index, Building Permits, Crude Oil Price, Producer Price Index, and Housing Starts are used as the explanatory variables for Construction Cost Index. The Associated Schools of Construction (2013) have used Energy price (crude oil price) also as the explanatory for the Construction Cost Index. These previous researches' data collected were from Engineering News Record (ENR)'s monthly CCI from 1975 to 2008.

The data of this research were taken from different valid sources from two countries' Government and Banks. Vietnam's data is taken from the annual published data from Vietnam's Ministry of Construction, Ministry of Planning and Investment and Ministry of Finance for the Construction Cost Index, Materials Cost Index, Labor Cost Index and the Building Costs. Taiwan's collection of data is from Taiwan's Ministry of Construction and Ministry of Interior. Both data about Bank Interest Rates were taken from each country's State Banks which are State Bank of Vietnam and Bank of Taiwan.

Other data is also collected in order to compare with the data from the official sources. Such real-time data collected by requesting consultant firms for cost estimations, building costs price are only for references.

Due to the limitation of technology, the data before 2006 in Vietnam are either not with the same classification, not with the same technology as from 2007 ahead or not available.

3.2 Principles of collecting data

The data collected are divided into five types. Collection period are from January 2006 to December 2013. The five types of data that have been collected are list as follows:

Building Costs, which is the real cost variable which reflects the unit price (price per square metre) of a public building. This data is collected and divided into different classifications based on the types of the buildings (office or residential buildings), and the number of floors the building has. Construction Cost Index, Material Cost Index, Labor Cost Index which are indicators of the average cost movement over time of a fixed basket of representative goods and services related to Construction Industry (Niranjan Swarup). Bank Interest Rates mentioned in the study are the bank’s 1-year deposit interest rate with the country’s local currency announced at the end of each year by the official published information from the country’s State Bank or Central Bank. This data does not include bonuses or under table deals from banks to their customers in order to attract them.

Due to some differences in the classifications of data between Vietnam and Taiwan, only the data with the same or close classification between the two countries’ classification systems will be taken.

Table 3.1 Sources of Data

	Vietnam	Taiwan
Building Cost	- Ministry of Construction - Ministry of Finance - Ministry of Planning & Investment	- Ministry of Construction - Ministry of Interior
Construction Cost Index		
Materials Cost Index		
Labor Cost Index		
Bank Interest Rates	- State Bank of Vietnam	- Bank of Taiwan

3.3 Research Methodology

This research illustrates a statistical analysis from a collection of data in the recent years, giving readers a basic abstract how building costs fluctuates over time, what relationship it might have with other variables and what happened in such time that might have caused such fluctuations.

3.3.1 Statistical comparisons:

Each country has 5 variables of similar types: Building Cost (BC), Construction Cost Index (CCI), Material Cost Index (MCI), Labor Cost Index (LCI) and Bank Interest Rates (IR). They are divided and numbered as in the table below. The unit price has been converted to NTD/m2 for both countries' Building Cost for the study's ease of comparison.

Comparisons are made for each pair of variables in each country, then for each variable between the two countries in order to determine any relationships in each comparison. Statistical software SPSS is used in order to assist the comparison work. There are 25 comparisons in total, which consists of 10 comparisons within Vietnam, 10 within Taiwan and 5 between Vietnam and Taiwan's variables.

Table 3.2 Variables for comparisons

VIETNAM					TAIWAN				
BUILDING COST (NTD/m2)	INTER -EST RATE	CCI	MATERIAL COST INDEX	LABOR COST INDEX	BUILDING COST (NTD/m2)	INTER -EST RATE	CCI	MATERIAL COST INDEX	LABOR COST INDEX
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

3.3.2 Comparisons' criteria:

In order to compare these variables from the two countries, first it is necessary to determine the relationships between the variables by comparing their increasing (or decreasing) speed from 2006 to 2013 (8 years). Then comparisons between each year and the whole period of time are made, not only to determine the difference between the short-time fluctuation speed but also the whole-time speed. Once the fluctuation trend is clear, shifting one variable a few years from another will then be implemented in order to find out any possible lags between them. Finally, any abnormal fluctuation period will be noted then be further analyzed.

To avoid sentiment conclusions, statistical software SPSS is used to assist the analysis. The method used to determine the correlation between the two variables' trends is "Paired Samples T Test" method. The output data used for analysis is "Paired Samples Correlations" (PSC)

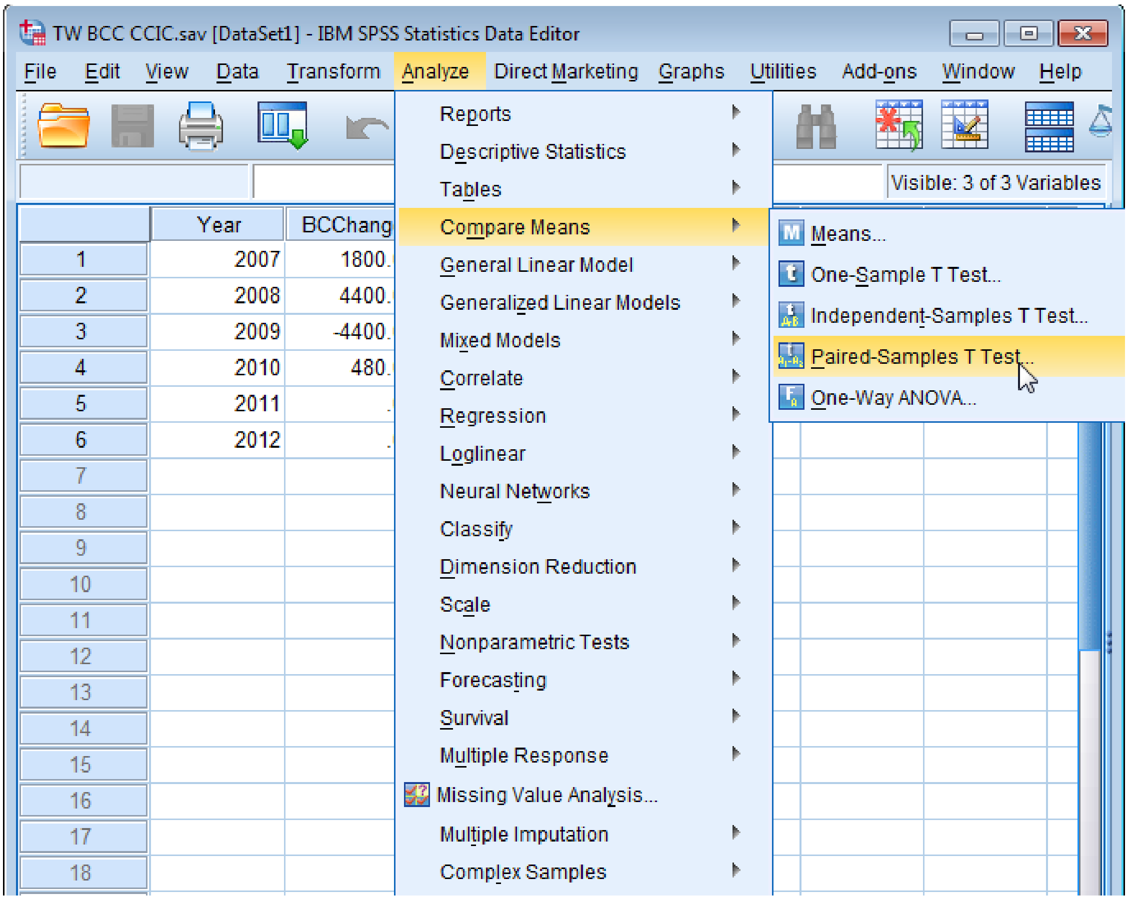

Figure 3.1 SPSS analysis method

Here is an example of the analysis result:

Table 3.2 Example of analysis result

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	BCChange & BIChange	7	.764	.046

The correlation of the two variables is determined by reading results of "Correlation" and "Sig.". The two variable's trends' correlation is considered more correlated, or, more similar if "Correlation" is close to 1.00. "Sig." is considered as a minor ratio which is used to determine the actual distance between the graphs of the two variables. In this method we consider the relationships between variables without caring for the Y-axis (unit). Therefore the analysis result of "Sig" can be omitted in the whole research.

CHAPTER 4: DATA ANALYSIS AND RESULTS

4.1 Data analysis

As mentioned in the chapter 3- Data Collection and Methodology, the analysis was conducted by making comparisons between each pair of variables. In this analysis, the comparisons are made for the most common building types in the two countries which are the public reinforced concrete residential buildings with 5 - 12 floors from year 2006 to 2013. Followed by are the comparisons made for other variables as well.

Table 4.1 Taiwan's Restated Standard of Public buildings

Project	**Unit**	**TAIWAN STANDARD (NT$/M2)**							
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
A, Office									
1 to 4 floors	M2	18,000	18,300	19,900	24,000	19,900	20,340	20,340	20,340
5 to 8 floors	M2	21,000	21,400	23,300	28,100	23,300	23,810	23,810	23,810
8 to 15 floors	M2	25,000	25,500	27,700	33,400	27,700	28,310	28,310	28,310
15+ floors	M2	28,500	29,000	31,600	38,100	31,600	32,300	32,300	32,300
B, Residential									
1 to 4 floors	M2	16,500	16,800	18,300	22,100	18,300	18,700	18,700	18,700
5 to 12 floors	M2	19,500	19,900	21,700	26,100	21,700	22,180	22,180	22,180
13 to 16 floors	M2	22,500	22,900	24,900	30,000	24,900	25,450	25,450	25,450
17+ floors	M2	23,500	23,900	26,000	31,300	26,000	26,570	26,570	26,570

Table 4.2 Vietnam's Restated Standard of Public buildings

Project	Unit	VIETNAM STANDARD (NT$/M2)							
		2006	2007	2008	2009	2010	2011	2012	2013
A, office									
1 to 4 floors	M2	3,261	3,435	6,391	7,261	9,000	11,304	11,536	11,609
5 to 8 floors	M2	4,014	4,174	7,754	8,145	10,000	12,464	12,725	12,986
8 to 15 floors	M2	4,362	4,493	8,536	9,043	11,710	14,667	14,942	15,116
15+ floors	M2	5,580	5,725	9,710	10,986	13,986	17,754	18,159	18,377
B, Residential									
1 to 4 floors	M2	3,232	3,435	6,362	7,087	8,971	11,232	11,362	11,739
5 to 12 floors	M2	3,986	4,174	7,478	8,304	10,551	13,261	13,406	13,855
13 to 16 floors	M2	4,333	4,493	8,391	9,348	11,826	14,783	14,942	15,478
17+ floors	M2	5,188	5,725	9,333	11,406	13,812	17,275	17,449	18,333

Combined with other variables we have the following summary table:

Table 4.3. Comparing variables between Vietnam and Taiwan

	VIETNAM					TAIWAN				
TYPES / TIME	BUILDING COST (NTD/m2)	INTEREST RATE	CCI	MATERIAL COST INDEX	LABOR COST INDEX	BUILDING COST (NTD/m2)	INTEREST RATE	CCI	MATERIAL COST INDEX	LABOR COST INDEX
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2006	3,986	7.60%	100.00	100.00	100.00	19,500	2.71%	100.00	100.00	100.00
2007	4,174	7.90%	117.45	119.29	120.14	19,900	3.63%	109.01	111.86	100.86
2008	7,478	18.67%	170.47	179.29	165.28	21,700	1.26%	124.25	137.88	102.34
2009	8,304	10.25%	163.09	181.43	172.92	26,100	1.26%	113.25	121.35	102.20
2010	10,551	12.50%	162.54	145.19	253.32	21,700	1.50%	116.86	126.26	102.69
2011	13,261	14.00%	200.13	179.25	301.50	22,180	1.88%	120.74	130.67	104.12
2012	13,406	9.00%	199.27	177.99	301.50	22,180	1.88%	121.75	132.48	105.88
2013	13,855	7.50%	194.88	170.52	301.50	22,180	1.88%	121.69	132.51	105.90

4.2 Analysis results

Out of the 25 comparisons being made, there are 14 comparison results that are worth notice: 4 among Vietnam's variables, 5 among Taiwan's variables and 5 among the variables between the two countries. The other comparisons resulted in nothing particular or related between the variables.

4.2.1 Comparisons among variables in Vietnam:

A. Building Cost Vs. Bank Interest Rate:

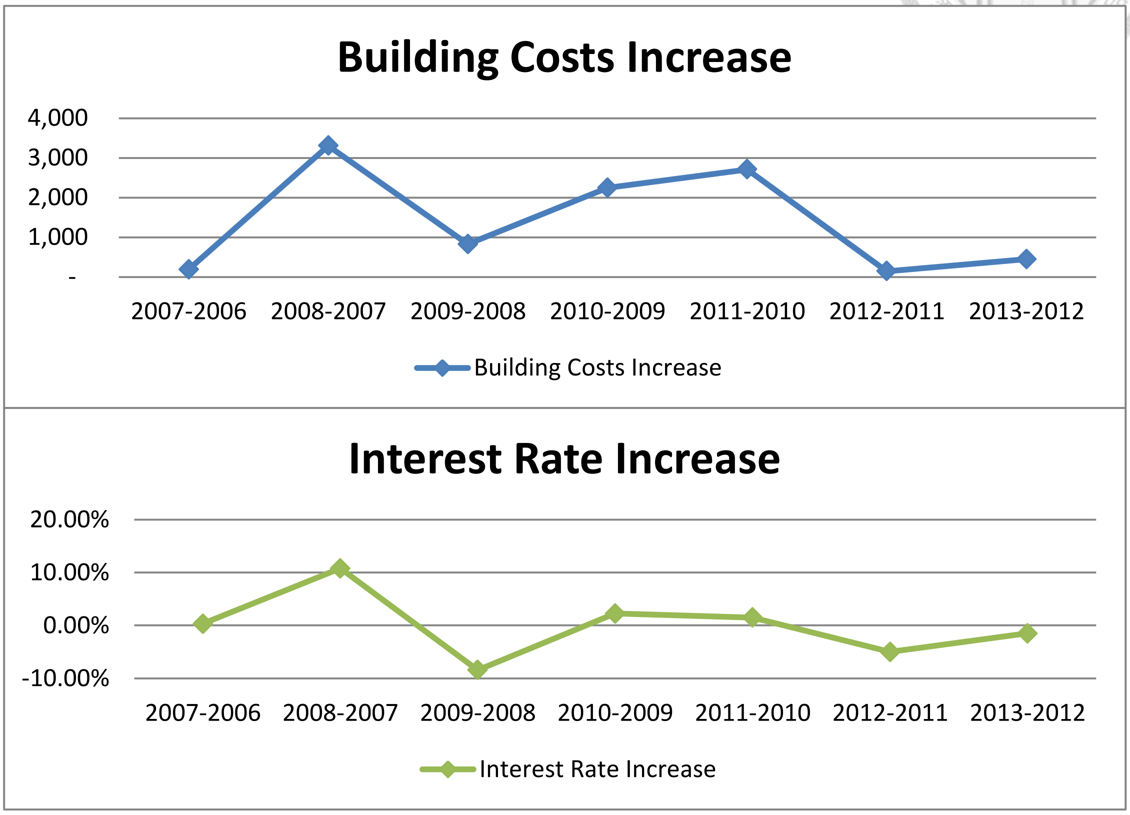

Figure 4.2 Vietnam's BC Increase vs. IR Increase

The above figure shows that Vietnam's Building Cost increase speed and Interest rate fluctuation has the same trend. In details, when the interest rate is high, the increasing speed of Building Cost also raises. However there is no decrease over years from Vietnam's Building Cost.

Table 4.4. PSC for Vietnam's BC Increase vs. IR Increase

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	BCChange & BIChange	7	.764	.046

SPSS analysis shows a quite high level of correlation between the two given variables trend (76.4%).

B. Building Cost Vs. Labor Cost Index:

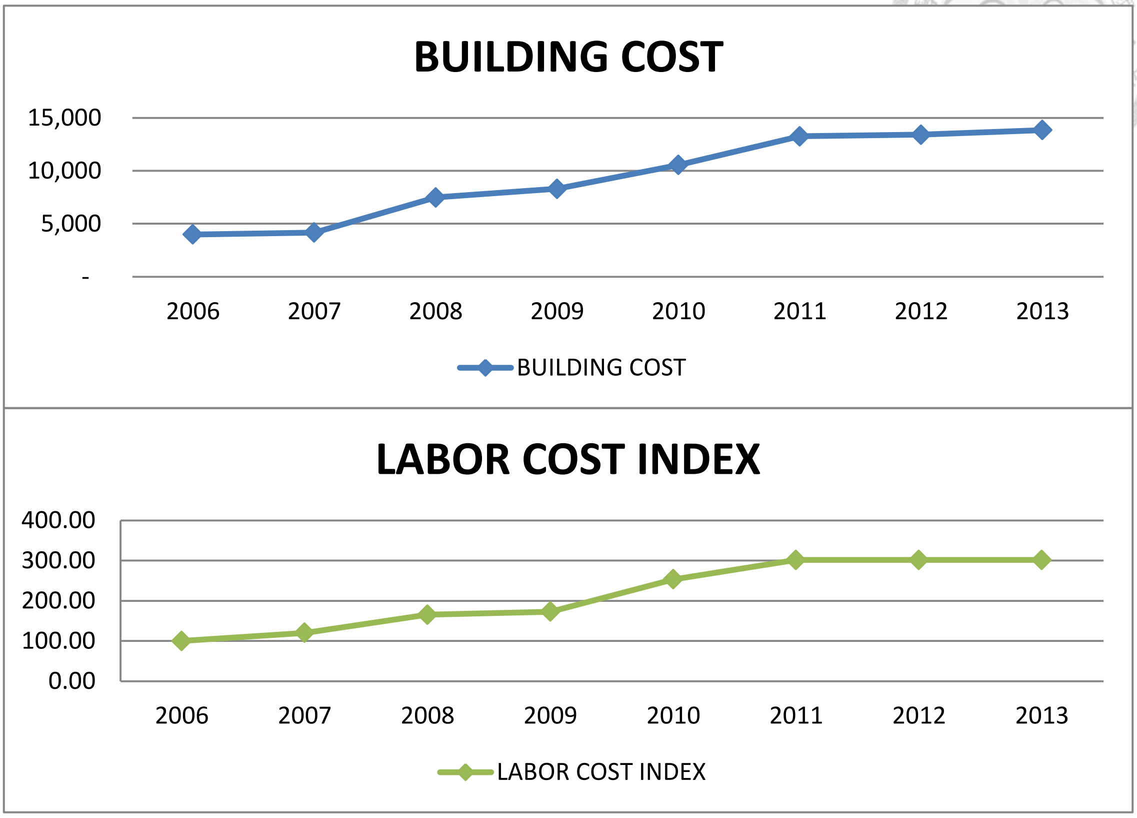

Figure 4.3 Vietnam's BC vs. LCI

Building Cost raised up to 347% at 2013 compared to its 100% in 2006 while the Labor Cost Index raised up to 301%. The same trend is also noticed in the above figure.

Table 4.5. PSC for Vietnam's BC vs. LCI

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	BC & LCI	6	.985	.000

While doing SPSS, the last 3 years when LCI stays the same while BC slightly increased was not count in the SPSS analysis. The result shows an almost absolute correlation between the given variables (98.5%).

C. Interest Rate vs. Construction Cost Index

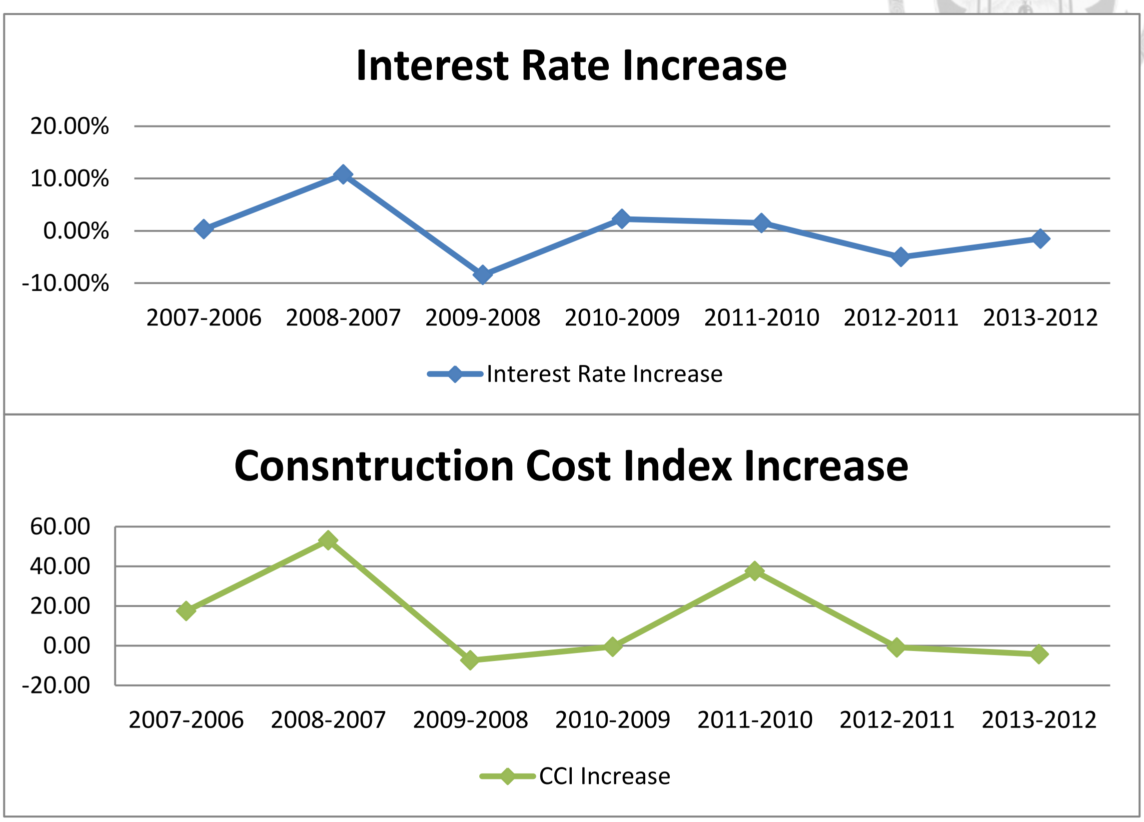

Figure 4.4 Vietnam's IR vs. CCI Increase

It shows that high Bank Interest fluctuation equals to fast Construction Cost Index increase. On the other hand, lower interest rate fluctuation means slower Construction Cost Index increase.

Table 4.6. PSC for Vietnam's IR Increase vs. CCI Increase

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	IRchange & CCIchange	7	.823	.023

SPSS analysis shows a high level of correlation between the two given variables trend.

D. Interest Rate vs. Materials Cost Index

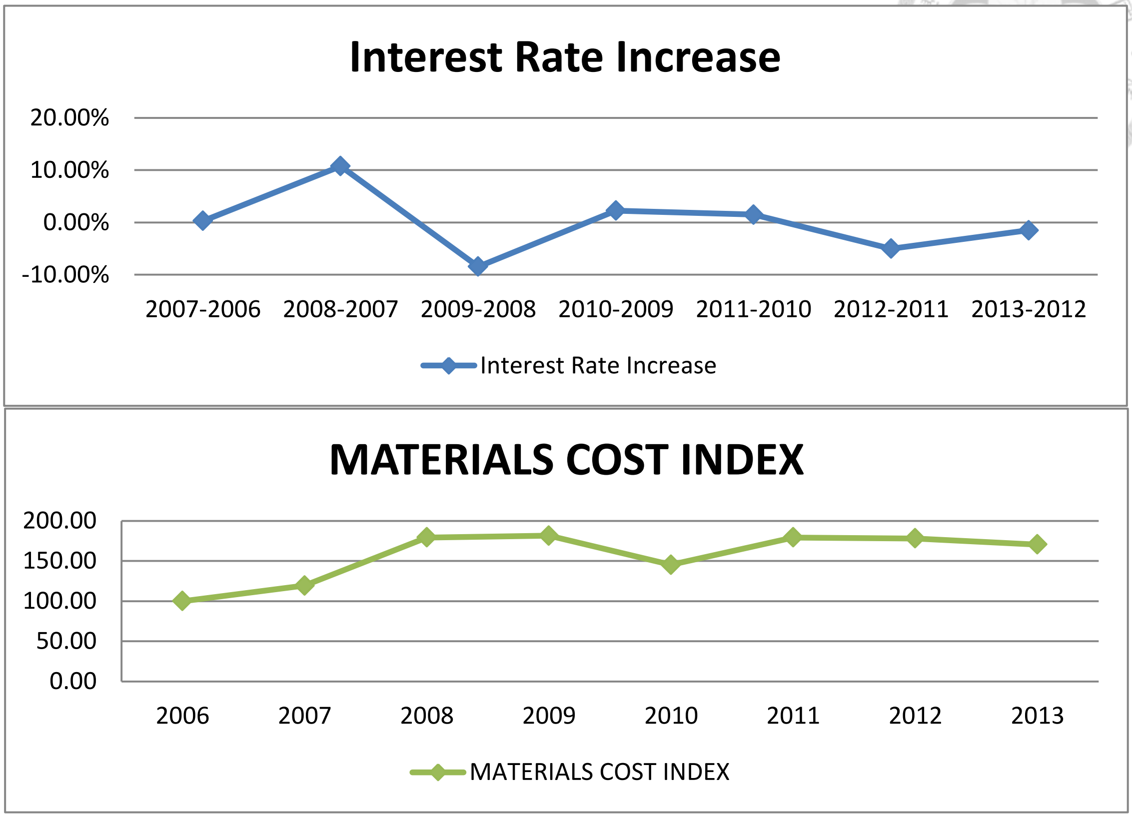

Figure 4.5 Vietnam's IR Increase vs. MCI

It shows that high Bank Interest fluctuation equals to fast Materials Cost Index increase. On the other hand, lower interest rate fluctuation means slower Materials Cost Index increase.

A noticeable decrease from Materials Cost Index has been reported in 2010 due to the suffering of the last year of the economic crisis series of years from 2007 to 2009.

4.2.2 Comparisons among variables in Taiwan:

A. Building Cost Vs. Construction Cost Index:

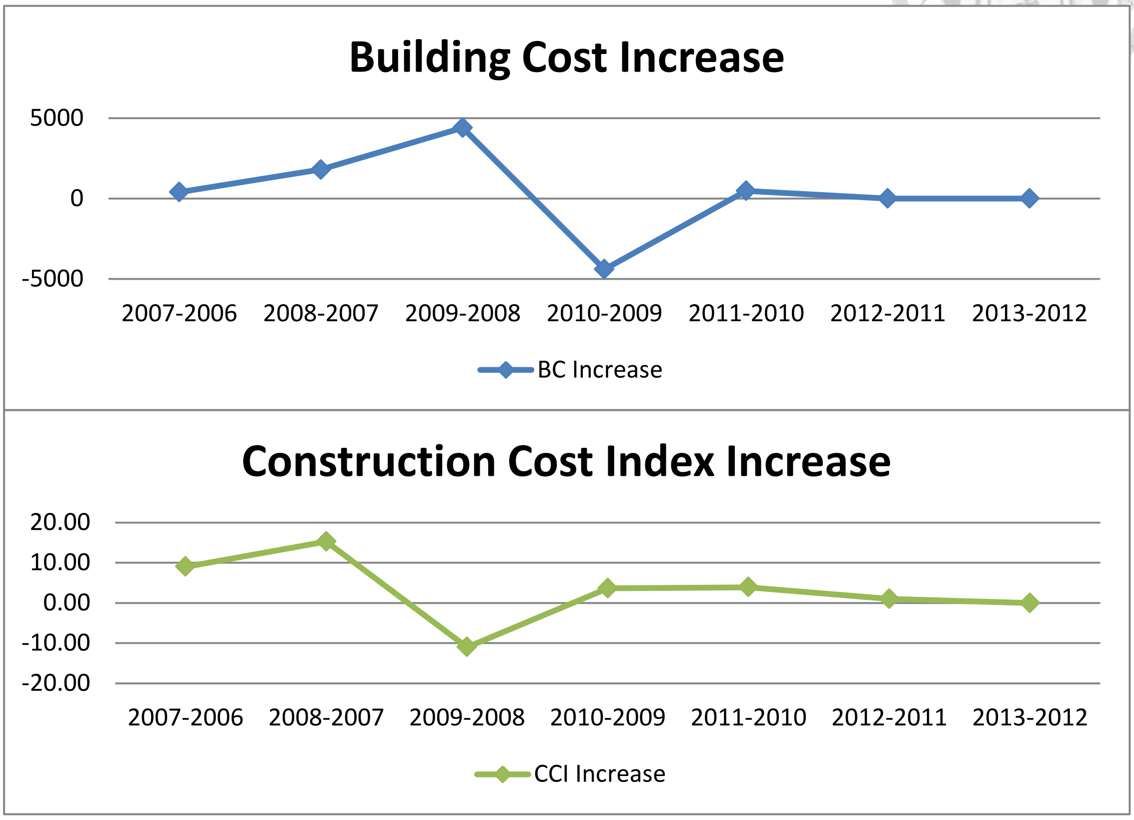

Figure 4.6 Taiwan's BC Increase vs. CCI Increase

Building Cost increase and Construction Cost Index increase rate has the same trend. In details, when the interest rate is high, the increasing speed of Building Cost also raises. The only difference here is all the changes happen 1 year earlier for Taiwan's Construction Cost Index. In other words, Building Cost has a 1-year lag from Construction Cost Index.

Table 4.7. PSC for Taiwan's IR Increase vs. CCI Increase

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	BCChange & CCIChange	6	.992	.000

Determined by pushing Building Cost happens 1 year earlier, SPSS shows an almost absolute correlation from the two variables (99.2%).

B. Building Cost Vs. Materials Cost Index:

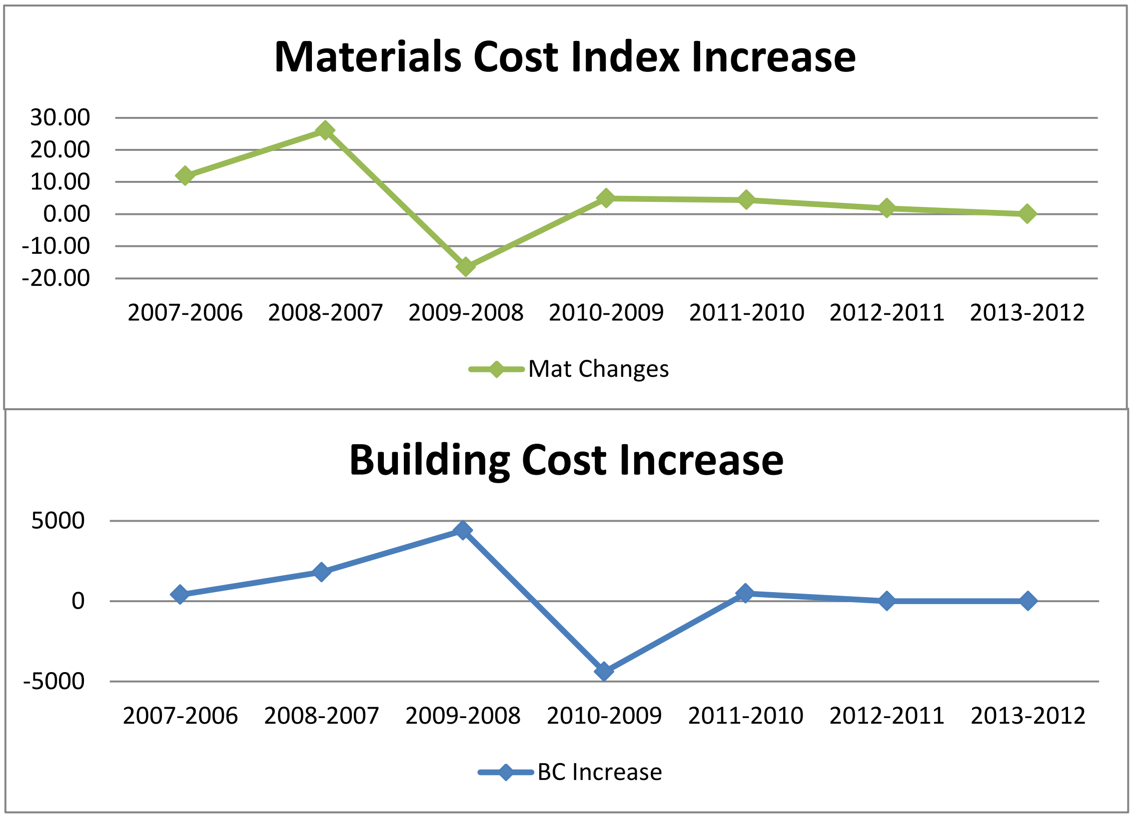

Figure 4.7 Taiwan's BC Increase vs. MCI Increase

Building Cost increase and Materials Cost Index increase rate has the same trend. In details, when the interest rate is high, the increasing speed of Building Cost also raises. The only difference here is all the changes happen 1 year earlier for Taiwan's Materials Cost Index. In other words, Building Cost has a 1-year lag from Materials Cost Index.

Table 4.8. PSC for Taiwan's BC Increase vs. MCI Increase

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	BCChange & MCIChange	6	.996	.000

Determined by pushing Building Cost happens 1 year earlier, SPSS shows an almost absolute correlation from the two variables (99.6%).

C. Bank Interest Rates vs. Construction Cost Index:

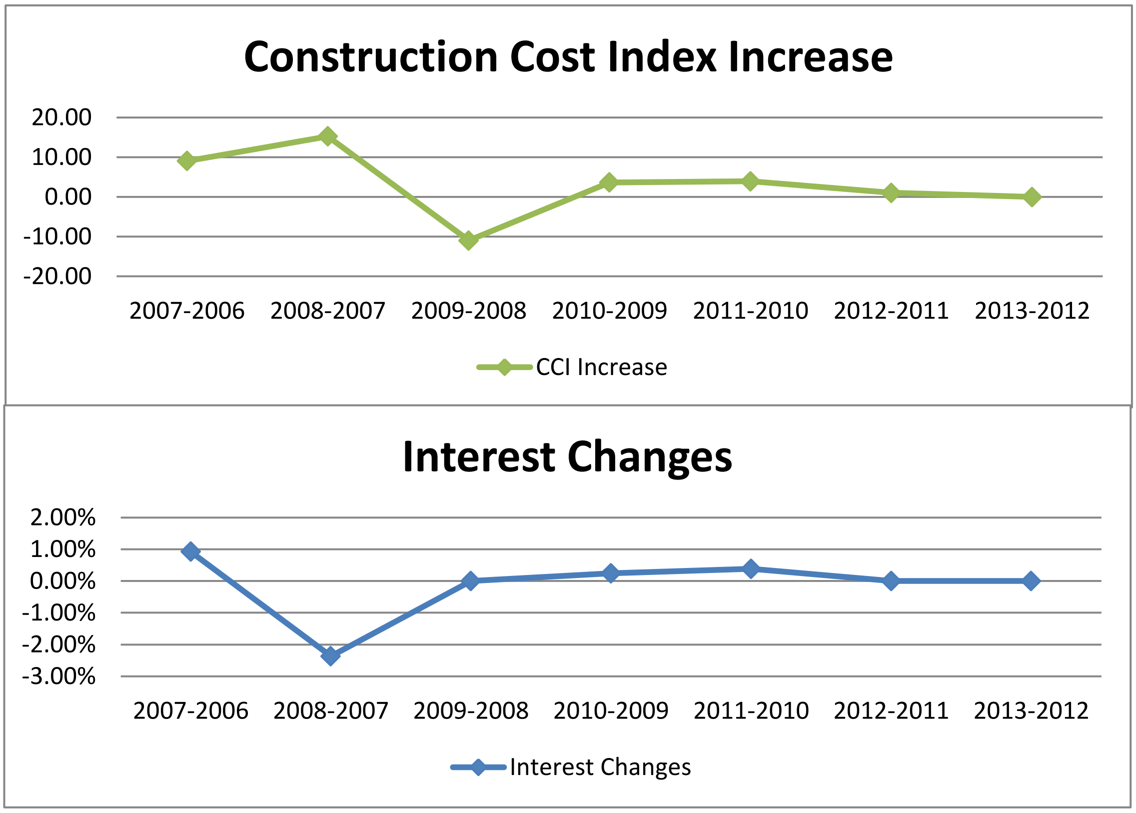

Figure 4.8 Taiwan's BC Increase vs. CCI Increase

Bank interest changes and Construction Cost Index increase rate share the same trend. In details, when the interest rate is high, the increasing speed of Construction Cost Index also raises. However Bank interest rate of Taiwan happened 1 year ahead of Taiwan's Construction Cost Index. In other words, Bank interest rate has a 1-year lag from Construction Cost Index.

Table 4.9. PSC for Taiwan's IR Increase vs. CCI Increase

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	IRChange & CCIChange	6	.894	.016

Determined by pushing Construction Cost Index happens 1 year earlier, SPSS shows a very high correlation value from the two variables (89.4%).

D. Bank Interest Rates vs. Materials Cost Index

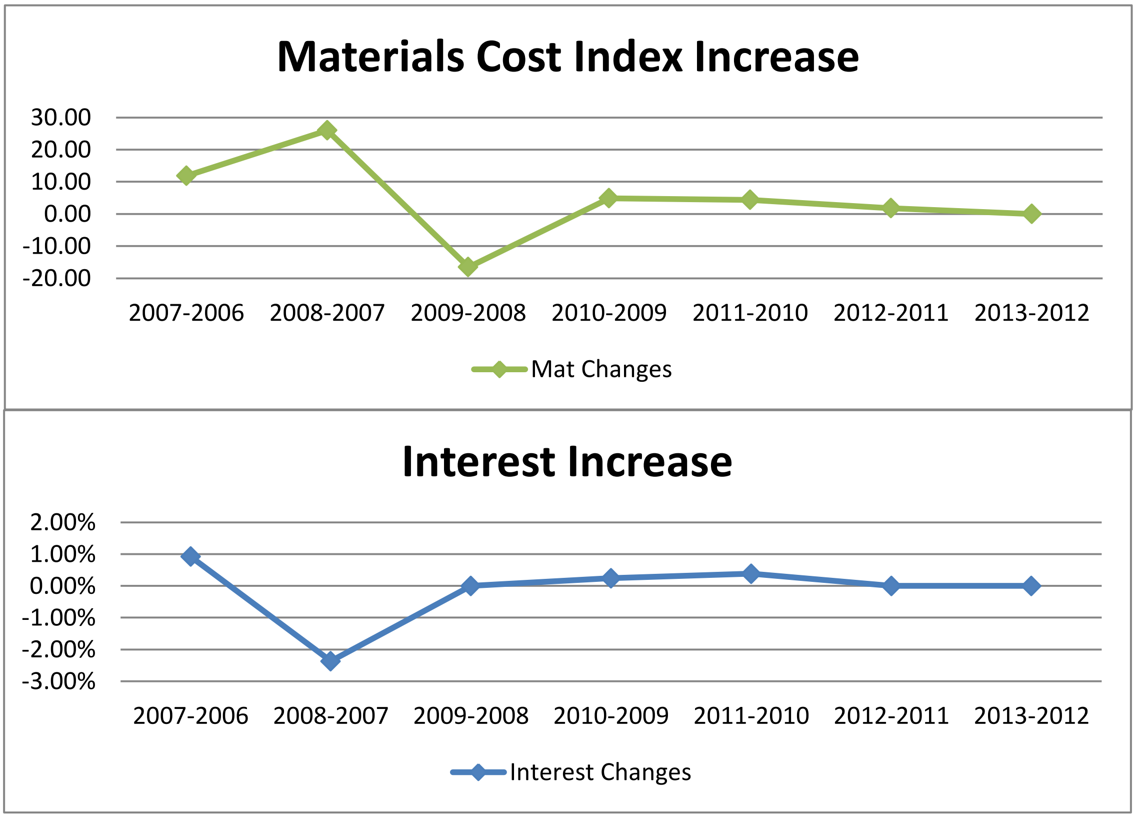

Figure 4.9 Taiwan's IR Increase vs. MCI Increase

Bank interest changes and Materials Cost Index increase rate share the same trend. In details, when the interest rate is high, the increasing speed of Materials Cost

Index also raises. However Bank interest rate of Taiwan happened 1 year ahead of Taiwan's Materials Cost Index. In other words, Bank interest rate has a 1-year lag from Materials Cost Index.

Table 4.10. PSC for Taiwan's IR Increase vs. MCI Increase

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	IRChange & MCIChange	6	.869	.024

Determined by pushing Materials Cost Index happens 1 year earlier, SPSS shows an almost absolute correlation from the two variables.

E. Construction Cost Index vs. Materials Cost Index

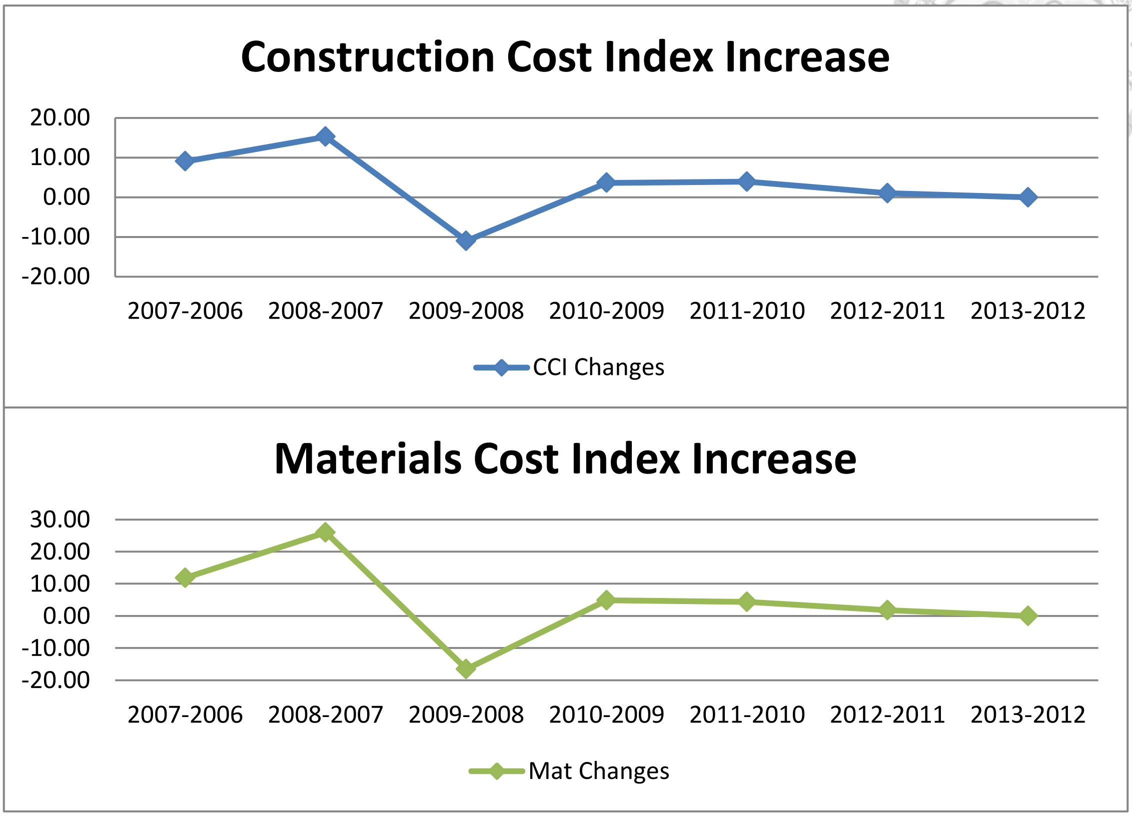

Figure 4.10 Taiwan's CCI Increase vs. MCI Increase

These two Indexes share the same increase or decrease trend over time. In the same period of time, when the Construction Cost Index increasing (or decreasing) speed is high, the same happens to the Materials Cost Index's increasing (or decreasing) speed.

Table 4.11. PSC for Taiwan's CCI Increase vs. MCI Increase

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	CCIChange & MCIChange	7	.993	.000

As shown in the SPSS result, they have an almost absolute value of correlation for the two variables (99.3%).

4.2.3 Comparisons of variables between Vietnam and Taiwan:

A. Building Costs:

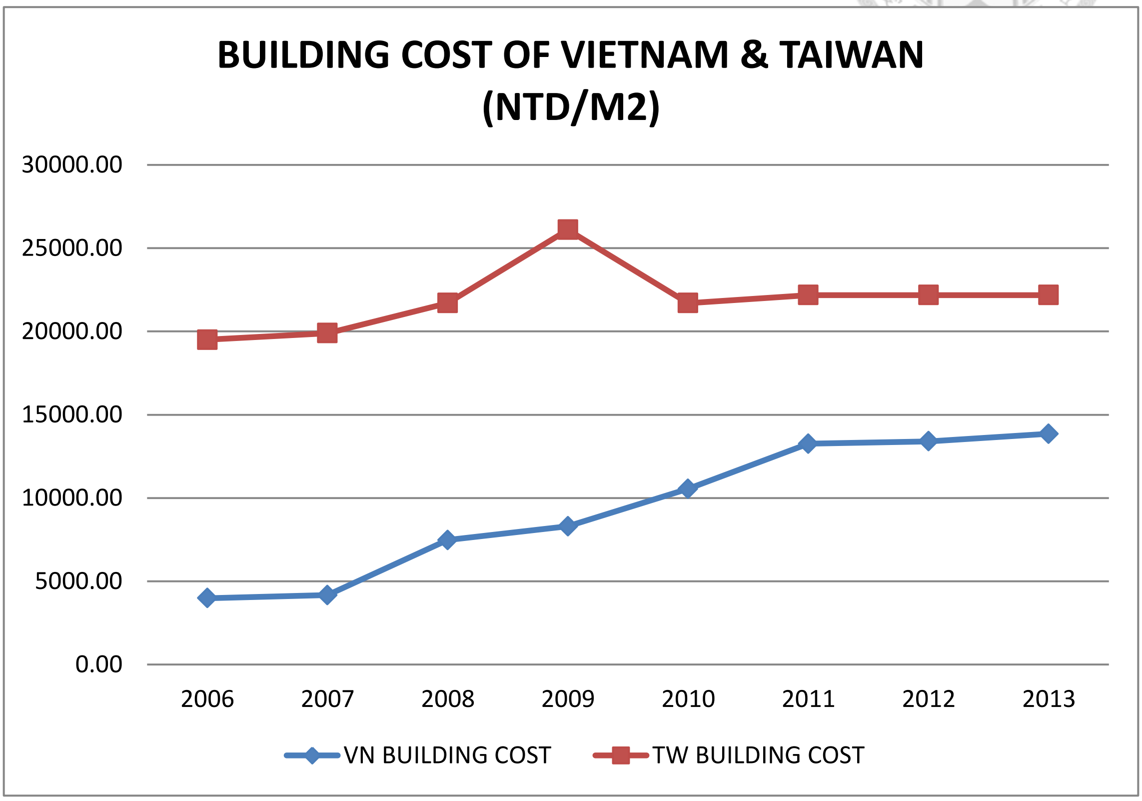

Figure 4.11 Vietnam and Taiwan's Building Costs

As shown in the graph above, Vietnam has a higher Building Cost increase speed than in Taiwan (347% over 113.7% in 7 years). In terms of USD the speed is 263% over 112%. In 2006 Taiwan's Building Cost was about 5 times of Vietnam's Building Cost but after 7 years it is only about 2 times in the year 2013.

B. Building Costs:

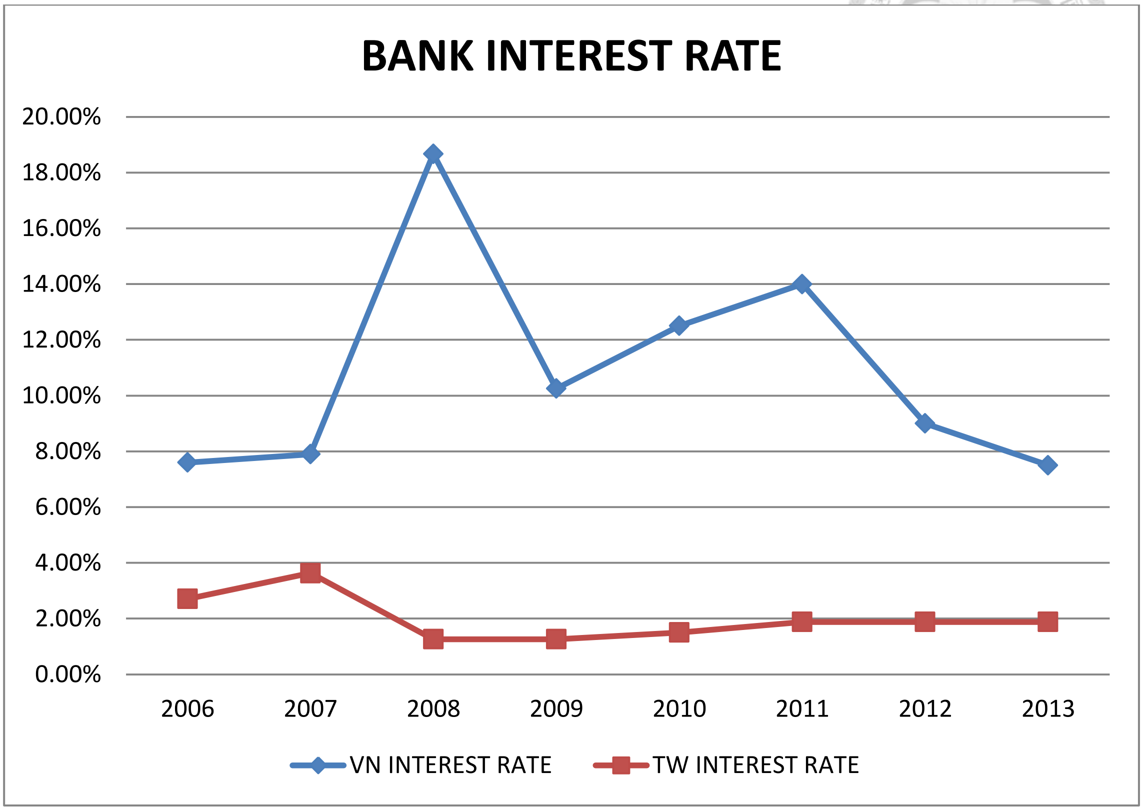

Figure 4.12 Vietnam and Taiwan's Interest Rates

Vietnam has a very high interest rate with high fluctuation rate. On the contrary, Taiwan's interest rate is very stable. It never grew past 3.9% while Vietnam's maximum has reached almost 20%.

Year 2008 witnessed an interest rate reported to be the highest in Vietnam's history of banking (18.67% Deposit rate). It is the year when Vietnam's stock market bubble was popped. Therefore a lot of people rushed to find a new way to invest. Vietnamese people soon learned that stock exchange could become paper in a blink of an eye, so they changed to another "safer" way which is real estate properties. However this has caused another bubble to start, and later was popped at the end of 2010/start of year 2011.

C. Construction Cost Index

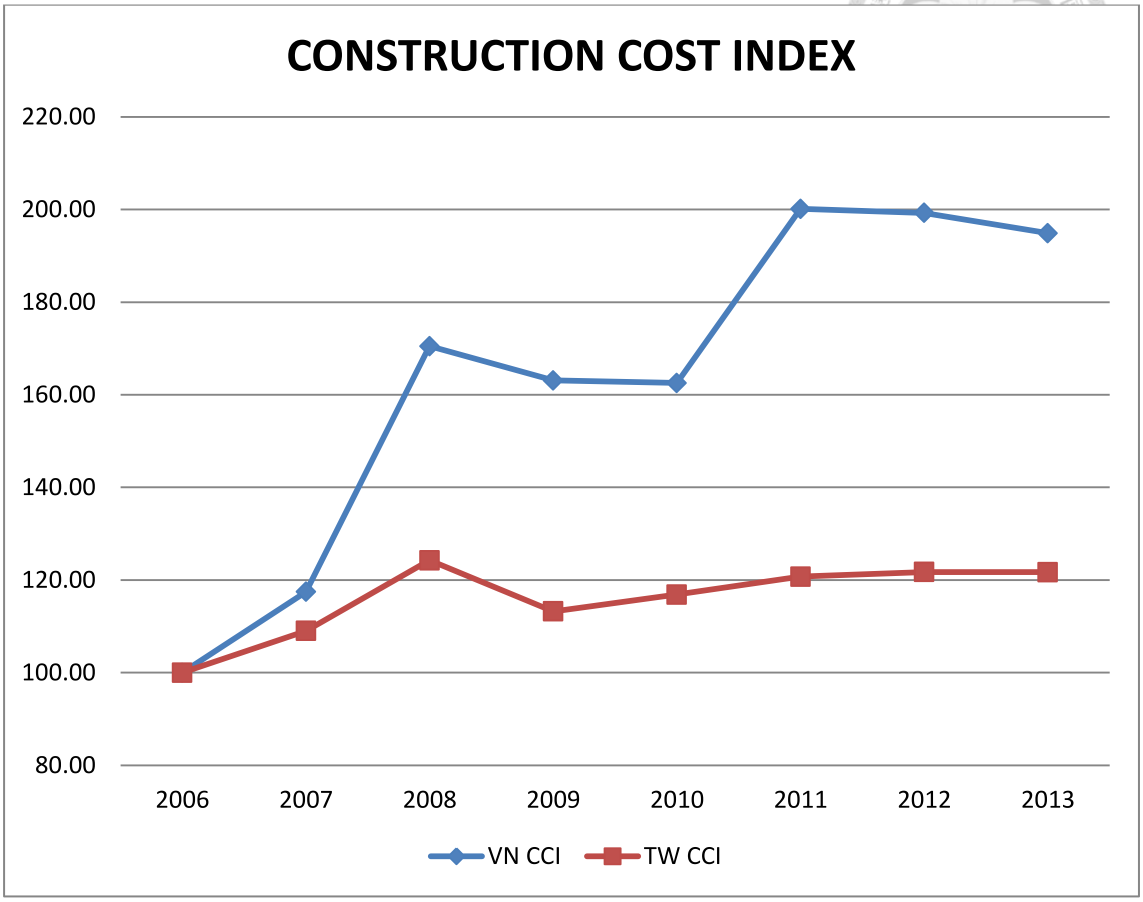

Figure 4.13 Vietnam and Taiwan's Construction Cost Index

While Vietnam's Construction Cost Index has increased to almost 200% over 7 years, Taiwan's Construction Cost Index only increased to 121.7%. (Vietnam's CCI is almost 2 times faster than Taiwan's CCI in terms of increasing speed). Both variables are similar in terms of trend. However, the fluctuation rate of Vietnam's Construction Cost Index is much higher.

In 2008 two countries' indexes decreased after suffering the effect of the global economy crisis. This shows the same reaction is reported from two countries' construction industry when they face the same problem, despite many differences exist between them.

D. Materials Cost Index

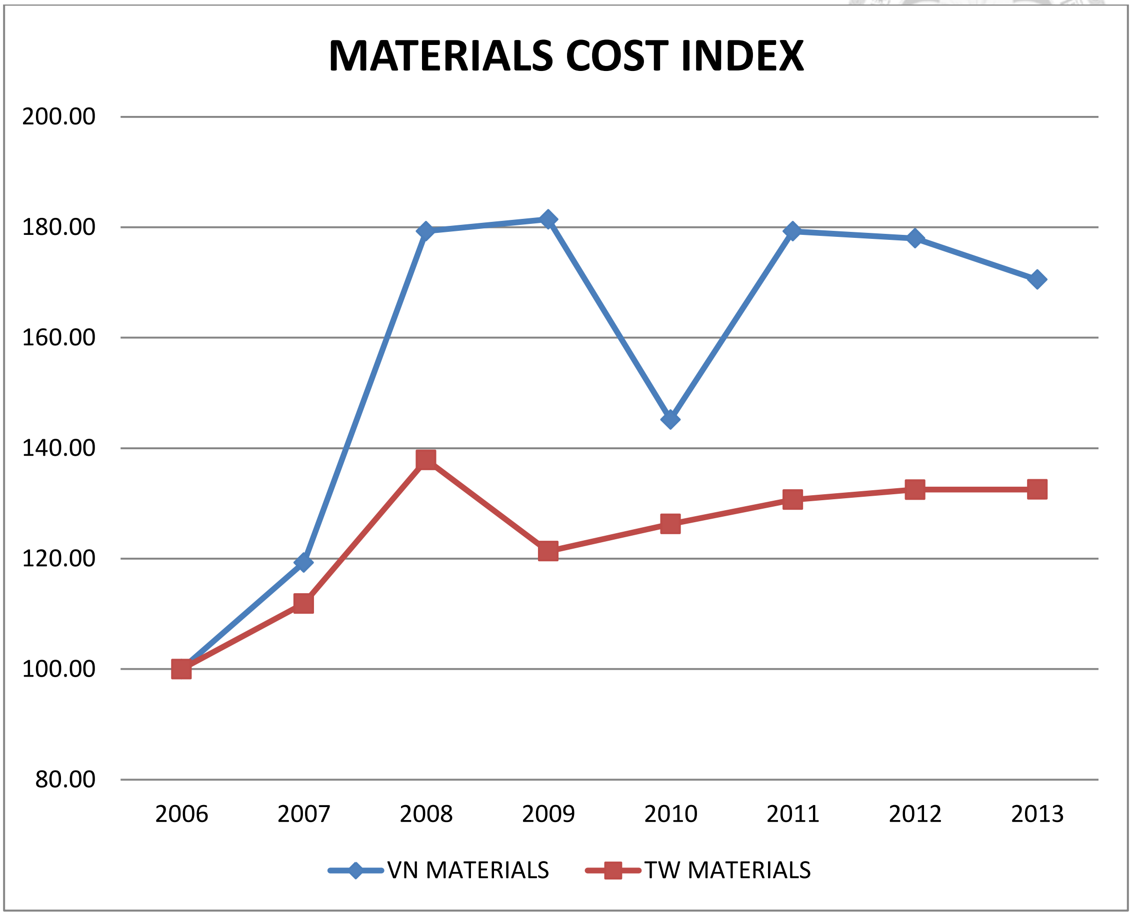

Figure 4.14 Vietnam and Taiwan's Materials Cost Index

Both variables are similar in terms of trend. However, the fluctuation rate of Vietnam's Materials Cost Index is higher. In the year 2008, during the world economic crisis, while Taiwan's materials industry reacted to the crisis, Vietnam's materials industry did not act the same way. The reason for this is that when the stock market collapsed, people changed their investment to real estate properties. Therefore a lot of houses and apartments were built to meet people's demand. Hence, the materials' price even raised a bit in 2008. However, in 2010 the demand started to drop intensively. A high number of construction sites were stalled. As a result, the price of materials dropped quite low over just one year.

E. Labor Cost Index

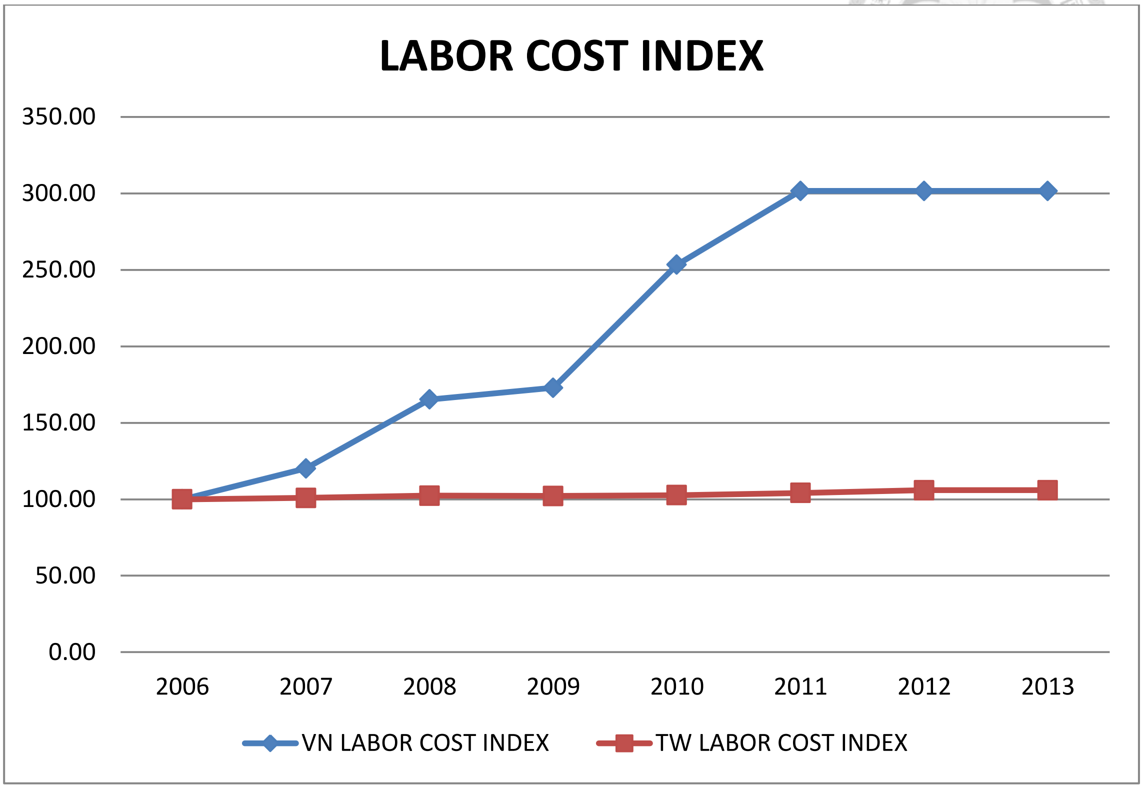

Figure 4.15 Vietnam and Taiwan's Labor Cost Index

Taiwan's Labor Cost Index was able to maintain at a very stable rate. It only increased to 105.88% over 7 years. On the other hand, Vietnam's labor cost has raised to a massive rate of 3 times (301%)

Compared to the increase rate of Vietnam's Building Cost (347%), this is a relatively appropriate increase for Vietnam's labor cost. However Taiwan's labor cost only increased to 105.88% compared to 113.7% from Building Cost and 121.7% from Construction Cost Index, this might not reflect the right amount that the Taiwan's labor deserve to get.

CHAPTER 5: CONCLUSION

This research has presented a basic approach when it comes to comparing the similarities and differences between two countries' indexes related to the construction industry. The usefulness of it is that it not only helps readers to see how different (or similar) in the mentioned variables in the countries, it also helps them to have a short-term prediction using this method when the data is available.

There are many methods to either compare or predict the upcoming trend of indexes in the construction industry. Results have demonstrated that the trend prediction of the method is accurate in terms of short-term prediction. However, long-term forecasting of Construction Cost Index and other indexes using this method may be hinder due to the high uncertainty of the economy and the politic risks.

It is shown that while Taiwan's stable indicators have shown that its construction industry has now been into the stable period, Vietnam's fluctuating indicators prove the unstable industry of a developing country. Moreover, the suffering from 2010's real estate bubble is fading and the Building price is starting to increase again. The labor cost have stayed stable for 3 years and is predicted to continue the same trend or increase just a little in the next few years. Therefore this is a good chance for the overseas construction companies to invest in the public building construction market in Vietnam.

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