A STUDY ON FORECASTING THE KOREAN COMPOSITE STOCK PRICE INDEX

By

Seung Woo Ryu

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
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ABSTRACT

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The stock market is one of the hottest issues in Korea recently. And most stock investors have their own tools of analysis for the stock market. This study explores the effective determinants to forecast the trend of KOSPI in a financial time series model, and examines how suitable the model is in forecasting the trend. Using the financial time series model, this study confirms the dominant role of both domestic indicators and foreign indicators as economic factors. Especially, this paper gives analyze on whether the BDI and OECD CLI improves the forecasting ability.

By using the financial time series model with independent variables which are domestic and foreign indicators, this study gives analyze on their use. The results are as follows: first, through the Granger Causality, all the macroeconomic variables used in the analysis have Granger causality with KOSPI. Especially, Baltic Dry Indices (BDI) did Granger-cause KOSPI, and KOSPI did Granger-cause OECD Composite Leading Index (CLI). Second, the coefficient of error correction is found. That is, there is long-term equilibrium between KOSPI and the macro-economic variables. The long-term equilibrium for KOSPI and macroeconomic variables is used along with the co-integration vector. There is five-unit co-integration vector in the co-integration test, and the inclusion of BDI and OECD CLI in the forecasting model is higher adjusted R-squared. Third, as forecasting VECM, we can estimate whether the model including BDI and OECD CLI would be higher than the forecasting ability.

Dedicated to My beloved parents

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I. Introduction

A. Background and purpose of study

Trading in stock market indices has gained unprecedented popularity in major financial markets from every part of the world. The increasing diversity of financial index-related instruments, along with the economic growth in Korea enjoyed in the last few years, has broadened the dimension of stock investment opportunities for both individual and institutional investors. There are two basic reasons for the success of these index trading vehicles. First, they provide an effective means for investors to hedge against potential market risks. Second, they create new profit-making opportunities for market speculators and arbitrageurs. Therefore, being able to accurately forecast a stock market index has profound implications and significance for researchers and practitioners.

Investors have rational decision-making ability on forecasting future information. And the result of the decision-making process appears in a form of balanced price through the deal for the market. If the stock price is a present value of an expected value for future economic situations, the information which is gained will be situational variables for the economy, management performance and financial activities of companies. In other words, the factors which are influenced in the stock market are categorized whole economic factors and each company-specific factor. And whole market factors like economic factors can be used appropriately for evaluating the stock market since each company-specific factor will be offset by the performance of the whole stock market being evaluated. According to this logic, over the last two decades, the theoretical relation between the stock market and macroeconomic-activities has been set, and there were many researches who have proven the relation empirically.

In this study, we will examine the relation between major macroeconomic variables, which provide the information for the overall movement of the stock market and KOSPI by using VECM. Moreover, we will examine the relationship between KOSPI, the unusual variables which are the OECD Composite Leading Indicator[1] and the Baltic Dry Index[2] as good indicators that reflects the Korean economy for better forecasting.

B. Methodology and composition of the study

We checked the theoretical background of the relationship between KOSPI and macroeconomic variables, and then did empirical analysis using VECM preceding previous researches. To avoid the spurious regression for the non-stationary of time series data, this paper will use a unit root test, co-integration test and VECM. This paper is organized as follows:

Chapter one introduces the background, purpose, methodology and composition of this study. Chapter two examines the model to explain the stock return and scrutinizes the theoretical background of stock price and macroeconomic variables. Chapter three reviews preceding studies on the relation between stock price and macroeconomic variables. Chapter four looks into data and the period of analysis, and then goes over the methodology of econometrics which studies the relation between stock prices and macroeconomic variables. Especially, chapter four explains a unit root test, co-integration test, Granger-causality test and the vector error correction model. Chapter five is a part of the empirical analysis. It

[1] One of the most well known(and carefully followed by financial analysts) composite indicators worldwide has been developed by OECD. Published every month, the set of OECD Composite Leading Indicators(CLI) covers not only the OECD member countries, but also the most important non-members(China, Russia, etc.).

[2] The index measures the demand for shipping capacity versus the supply of dry bulk carriers. However, since the demand for shipping varies with the amount of cargo that is being traded in the market (supply and demand) and the supply of ships is much less elastic than the demand for them, the index indirectly measures global supply and demand for the commodities shipped aboard dry bulk carriers, such as cement, coal, iron ore, and grain. Because dry bulk primarily consists of materials that function as raw material inputs to the production of intermediate or finished goods, such as concrete, electricity, steel, and food, the index is also seen as a good economic indicator of future economic growth and production, termed a leading economic indicator because it predicts future economic activity.

analyzes the relation between KOSPI and macroeconomic variables, and forecast KOSPI based on the factor of VECM. Lastly, chapter six summarizes and organizes the result of analysis.

II. Stock Market and Macroeconomic Variables

A. Determination of stock prices and a forecasting possibility

The dividend evaluation model is a typical model which represents the relation between stock prices and macroeconomic variables. According to the model, stock prices are discounted value from the expected value of future cash flow by having stocks. This can be represented in equation I as follow:

$$P=\sum_{i=1}^{\infty}\frac{E(CF)}{(1+R)^{t}} \qquad \text{[Equation-1]}$$

Where P=present value at t, E(CF)= expected cash flow, R= risk adjustment yield from this equation, it is seen that stock price has a positive relation with E(CF), and a negative relation with K. The factors of changing the stock prices are three, as follow:

Firstly, the unexpected variance of expected cash flow; secondly, the expected variance of price from the periodic variance of the yield; lastly, the unexpected variance of the yield.

The first factor, which is an important determining factor of expected cash flow are economic real variables, such as, the real GDP, industrial production, forecasting investment, etc. Kaul(1987) has found that the future growth rate of real activity could explain the yearly stock yield variance over 50%. This means that stock prices are determined to respond to the change in real activities. As a result, stock yield will increase when the economy forecasts a boom in the future; the opposite situation can also occur.

The second factor, the expected yield and varies by time. Fama and French(1989) said that corporate bonds and expected excess return of stock varied simultaneously. So that they used the dividend return rate, bankruptcy spread and maturity spread to forecast the variance of expected return. By looking over the multi-regression of Fama and French(1989), three independent variables we have already mentioned had a positive statistical impact on for every corporate bond and stock return at a significant level. These influences change, depending on the economic situation. From the fact that these three variables can forecast the return of stock and corporate bonds, the variance of expected return appears between many stocks to be in common; we can conclude that the stock price is predictable.

The third factor is an unexpected variance of discount rate. French, Schwert and Stambaugh(1987) did regression analysis for an excess return to research the influence on stock price. As a result, excess stock return had a positive relation with an expected variance of market return. However, it had a negative relation with an unexpected variance.

For the forecast of the stock price, there are varieties of variables which influence the intrinsic value of stock that can be analyzed, case by case, in the financial economic field. And the researches have tended to examine economic factors which influence the whole market movement rather than factors which influence stock price.

Briefly, the stock price is determined by the interaction between expected return and risk factors, and these factors have close relation, with macroeconomic variables, so that the change of economic situation influences stock price. Thus, the forecasting of stock price through macroeconomic variables is possible.

B. Macroeconomic variables

Based on the result of preceding theories and studies, macroeconomic variables are divided into the areas of financial market, foreign market and real economy. We would like choose important macroeconomic variables for representing each market.

1. Money supply and stock price

Some economists who have followed the footsteps of the post-Keynesian school of economics questioned the importance of money in driving stock prices. It is held that movements in money M2 reflect the shift of money from long-term saving deposits to demand deposits, and vice versa as a result of the preceding changes in stock prices. For instance, rise in stock prices provides an incentive to liquidate long-term saving deposits. The received money is then employed in buying stocks and other financial assets. In the process, demand deposits tend to increase, which in turn raises money M2.

It is argued that the trend is reversed when asset and stock prices falls. It means that it is the change in stock prices that actually causes changes in money M2, not the other way around. If money is not a causing factor, but rather is caused by changes in the stock market, obviously it is not a very helpful indicator. In other words, changes in money supply are simply the manifestation of changes that have already taken place in the stock market. Hence, M2 represents money supply.

2. Prices of commodities and stock price

Investors require a higher yield for the decreasing power of purchasing when price of commodities increases. As a result, the risk adjustment yield increases, so it negatively influences the stock returns. And at the same time, corporations increase their cash flow the increase in the price of commodities. In this case, companies' nominal cash flow increases in the same proportion as inflation, stock can provide hedge effect for inflation. In other words, there is no decrease of return for inflation, and stock can use as a hedge for inflation.

In the preceding studies, inflation which is stable and low- level is expected to show a positive relation between stock and inflation. However, Roll and Ross(1986) and

Chen(1991) reported that stocks are not a hedge for inflation, because stock and inflation have a negative relation. In this study, the Consumer Product Index represents prices of commodities.

3. Interest rate and stock price

According to the dividend evaluation model, when the interest rate increases, the stock price decreases due to the increase risk adjustment yield. The process is like this: when the interest rate increases, the expected return of investors increases, and as a result, stock price decreases, and vice versa. Meanwhile, in the case of bull market, companies have a fast turnover because of the fast correction of sales cash, which reacts by increasing money supply and causes decreasing interest and increasing stock price. In contrast, in the case of a bear market, even though the interest rate decreases, a decrease of investment demand causes a decrease of stock price. Thus, in this study, the call rate represents the interest rate.

4. Real economy and stock price

A company's stock prices may go up or down depending on whether investors think its industry is about to expand or shrink. For example, a company may be run well financially, but if the industry is declining, investors might question the company's capability to keep growing. In that case, the company's stock price may fall. Many industries expand and decrease in cycles. For example, house building declines when interest rates rise. The movement of an economy can be analyzed by various economic variables for production and demand, with the representative indicator being the Gross National Product (GNP). However, the GNP can be available only for a year to year or even quarter. Thus, it is difficult to judge the present economic situation or make a future economic prediction only with GNP. Therefore, for a swift grasp of economic trends, we should use variables which are issued monthly to understand the demand trend or production trend.

Korea is a net oil importing country and the amount of imported oil consists of about 20% of the total imports, so we can say that oil price has a great influence on the Korean economy. The OECD issue each member country's composite leading indicator and it is well known as a good indicator of country's economy. As a result, in this paper, the Dubai oil price, industrial production and the OECD composite leading indicator represent the real economic level.

5. International market and stock price

Under an open economy, a national economy has a close relation with the current balance, expert trend and exchange rate. Especially, the international market variables hold a very important role in countries which have large foreign portion of the whole economy such as Korea. Expected cash flow of companies, and as a result, the stock price would decrease, and vice-versa.

For BDI, dry bulk primarily consists of materials that function as raw material inputs to the production of intermediate or finished goods, such as concrete, electricity, steel, and food. The index is also seen as a good economic indicator of future economic growth and production, and is termed a leading economic indicator because it predicts future economic activity. In this paper, the Won per US dollar and BDI represent international market variables.

III. Preceding Studies on the Relation between stock Price and Macroeconomic Variables

A. Overseas studies

Chen, Roll, and Ross (1986)[3] found that the economic state variables which influenced stock market return, and studied the influence for asset price. For this research, using data from 1958 to 1984, it measured the relation between economic news and stock return in an arbitrage price model, using the error term of the vector autoregressive model. They also examined the influence of pricing on exposure to innovations in real per capita consumption. These results were quite disappointing to consumption-based asset pricing theories; the consumption variable was never significant. Finally, they examined the impact of an index of oil price changes on asset pricing and found no overall effect. They concluded that stock returns are exposed to systematic economic news, that they are priced in accordance with their exposures, and that the news can be measured as innovations in state variables whose identification could be accomplished through simple and intuitive financial theory.

Lee(1992)[4] employed a four-variable VAR system real stock returns, real interest rates, growth in industrial production, and rate of inflation with a constant and six lags for the postwar period from 1947 to 1987. His major findings were three. First, stock return appears Granger-causally prior and helps to explain a substantial fraction of the variance in real activity, which responds positively to shocks in stock returns. Second, with interest rates in the VAR system, stock returns explain little variation in inflation; however, interest rates

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[3] Chen, Roll and Ross, "Economic Forces and the stock Market", *Journal of Business*, Vol. 59, No. 3 (1986): 383-403

[4] Bong-Soo Lee, "Causal Relations Among Stock Returns, Interest Rates, Real Activity, and Inflation", *Journal of finance*, Vol. 47, No. 4 (1992): 1591-1603

explain a substantial fraction of the variation in inflation, with inflation responding negatively to shocks in real interest rates. Lastly, inflation explains little variation in real activity, which responded negatively to shocks in inflation for the postwar period. He concluded that there was no causal linkage between stock returns and money supply growth, hence no causal relation between stock returns and inflation. One of the practical implications of his findings was that the negative correlation between stock returns and inflation observed for the post war period may not be a reliable relation for purposes of prediction.

Jones and Kaul (1996)[5] studied the experiences of four countries the United States, Canada, Japan, and the United Kingdom to gauge the effects of oil shocks on different economies. Moreover, they tested whether the reaction of international stock markets to oil shocks can be justified by current and future changes in real cash flow and/or changes in expected returns. They found that in the postwar period, the reaction of United States and Canadian stock prices to oil shocks could be completely accounted for by the impact of these shocks on real cash flows alone. In contrast, in both the United Kingdom and Japan, innovations in oil prices appeared to cause larger changes in stock prices than could be justified by subsequent changes in real cash flows or by changing expected returns. They concluded that the U.S. and Canadian stock markets were rational: the reaction of stock prices to oil shocks could be completely accounted for by their impact on current and expected future real cash flows alone. In contrast, however, the evidence for Japan and the United Kingdom was puzzling. In both countries, they were unable to explain the effects of oil price shocks on stock returns by using changes in future cash flows and/or financial variables that were often used to proxy for changes in expected returns.

Rapach, Wohar and Rangvid (2005)[6] examined the predictability of stock returns

[5] Jones, Charles M. and Cautam Kaul, “Oil and the Stock Market”, *Journal of finance*, Vol. 51, No.2 (1996): 463-491.

[6] David E. Rapach, Mark E. Wohar, Jesper Rangvid, “Macro variables and international stock return predictability”, *International Journal of Forecasting 21*, (2005): 137-166.

using macroeconomic variables in 12 industrialized countries. The macroeconomic variables were interest rate, three-month Treasury bill rate, long-term government bond yield, inflation rate, industrial production growth, unemployment rate and money growth, etc. They considered both in–sample and out-of-sample tests of predictive ability, with the out-of-sample forecast period covering the 1990s for each country using OLS. Among the macro variables they considered, interest rates were the most consistent and reliable predictors of stock returns across countries.

B. Domestic studies

Yu and Park (1997)[7] researched the relation between the Korean stock market and macroeconomic variables, using 24 macro- and micro-economic variables from 1980 to 1996. In this study, they tried to estimate statistics after testing the stationary variables. For the meaning of Granger causality, the won per US dollar, house price, trade balance, current account, composite leading indicator, and sub index for production are leading variables and won per yen and trading volume are lagging variables. However it depends on the period surveyed. For VAR analysis, the stock market return did not have Granger causality with inflation, money supply and interest rate, and only the stock return did Granger-cause consumer production. As a result, they could not verify Fama's proxy hypothesis; in VAR analysis adding won per US dollar, it showed won per US dollar greatly influenced stock price.

Jung and Chung (2002)[8] investigated the long-run equilibrium relationship between stock prices and six macroeconomic variables, using Johansen's co-integration analysis. In

[7] Yu, T. Woo and Park, Y. Man, "Korean Stock Market and Economic Variable: Experience of 1980-1996", *Journal of Korean Security*, (1997), 105-151.

[8] Jung, S. Chang and Chung, S. Young, "Long-Run Relationship of Stock Prices and Macroeconomic Variables with a Structural Break", *The Journal of Korean Financial*, Vol. 15, No. 2, (2002), 205-235.

addition, using Hansen and Johansen (1993)'s recursive likelihood ratio test of the constant co-integration space, this study analyzed the stability of co-integrating vectors, i.e., the structural shift of the relationships between the macroeconomic variables. They found that the Korean market is co-integrated with six macroeconomic forces. However, the regime shift was found some time in 1987. Thus with the dummy variable for the structural changes, this study investigated the long-run relationship between stock prices and macroeconomic variables and showed that the signs of a co-integrating vector were the same as the signs expected by the hypothesis. The stock prices were negatively related with the long-term interest rate, the oil prices and Korean won against the US dollars, and positively related with the inflation, the industrial production, and the money supply.

Hwang and Choi (2006)[9] investigated how economic activities in Korea could explain stock prices by using a co-integration test and variance decomposition methods for a Vector Error Correction Model (VECM). Johansen co-integration tests demonstrated that stock price levels were significantly related to industrial production, the consumer price index, the foreign exchange rate, the interest rate, M2, oil price and trade balance. Also a long-run equilibrium relationship between stock prices and the set of macroeconomic variables existed. Variance decomposition methods supported the strong explanatory power of macroeconomic variables in contributing to the forecast variance for stock price. The results of variance decomposition methods indicated that the foreign exchange rates, the consumer prices index and industrial production were more important than interest rate, oil price and trade balance in the Korean stock market. As a result of dividing the time into two different periods, there was a structural change in the Korean capital market after the financial crisis in 1997.

[9] Hwang, S. Woong and Choi, J. Hyuk, "Empirical Study on Relations between Macroeconomic Variables and the Korean Stock prices: an Application of a Vector Error Correction Model", *The Journal of Financial Management*, Vol. 12, No. 1, (2006), 183-213.

IV. Data and Methodology of Analysis

A. Data

In this paper, we used KOSPI as a monthly data from 2000 to 2007 for analyzing the relation between stock price and macroeconomic variables. We chose nine variables(money supply, inflation, interest rate, industrial production, Won per US dollars, oil price, current account, Baltic Dry Index and OECD composite leading index to consider variables which were used in the Chen, Roll and Ross(1986) study and in previous articles. We used the consumer price index (CPI), which was 100 in 2005, as representing inflation; M2 in billion won as representing money supply; call rate(CR) as representing the interest rate; industrial production(IP), which was 100 in 2000, and OECD CLI(CLI) as representing the real economy; the Dubai oil price(OIL) as representing oil price; Won per US dollars(FX) and the Baltic Dry Index(BDI) as representing the exchange rate, the current balance(CB) in million dollars. Data used in this paper was sourced from homepages for the Economic Statistics System, the Korea Energy Economics Institute, the Korea Maritime Institute and the OECD Business Cycle Analysis Database. All data were converted to log value after seasonal adjustment.

B. The theoretical contemplation for the method of empirical analysis

1. Unit root test[10]

A unit root test tests whether a time series variable is non-stationary using an

[10] Kennedy, Peter. *A GUIDE TO ECONOMETRICS.* 5th ed. (Bodmin: The MIT Press, 2003).

autoregressive model. The most famous test is the Augmented Dickey-Fuller(ADF) test. Another test is the Phillips-Perron test. Both these tests use the existence of a unit root as the null hypothesis. The testing procedure for the ADF test is the same as for the Dickey-Fuller test but it is applied to the model.

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + \varepsilon_t \qquad \text{[Equation-2]}$$

Where α is a constant, β the coefficient on a time trend and *p* the lag order of the autoregressive process. Imposing the constraints α = 0 and β = 0 corresponds to modeling a random walk and using the constraint β = 0 corresponds to modeling a random walk with a drift. By including lags of the order *p* the ADF formulation allows for higher-order autoregressive processes. This means that the lag length *p* has to be determined when applying the test. One possible approach is to test down from high orders and examine the t-values on coefficients. An alternative approach is to examine information criteria such as the Akaike information criterion, Bayesian information criterion or the Hannon Quinn criterion. The unit root test is then carried out under the null hypothesis γ = 0 against the alternative hypothesis of γ < 0. Once a value for the test statistic $DF = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$ is computed it can be compared to the relevant critical value for the Dickey-Fuller Test. If the test statistic is greater (in absolute value) than the critical value, then the null hypothesis of γ = 0 is rejected and no unit root is present.

2. Co-integration test

If the data are shown to be non-stationary, on the basis of an appropriate unit root test, it is tempting to do as Box and Jenkins did, namely purge the non-stationary by differencing and estimate using only differenced variables. But this would mean that valuable information from economic theory concerning the long-run equilibrium properties of the data would be lost, as was stressed by those developing the error-correction model approach. On the other hand, the ECM approach involved mixing data in levels and differences in the same equation, which, if the levels data are I(1), means that the ECM estimating equation could be producing spurious results.

The two main methods for testing for co-integration are:

a. The Johansen procedure.

b. The Engle-Granger two-step method.

For the Johansen procedure, it has several advantages.[11] First, it deals automatically with the problem of choosing normalization. Second, one guards against inconsistent estimation of the co-integrating relationships by incorporating knowledge that there is more than on co-integrating vector. Third, estimation of the short-run dynamics is undertaken simultaneously, increasing the efficiency of estimation. Forth, the Johansen procedure allows testing of restrictions on the co-integrating vectors. In this paper, we look over the Johansen procedure and use it to take advantages.

a. The Johansen procedure.

Johansen (1988) suggests a maximum likelihood procedure to obtain a and b by decomposing the matrix P of the ECM. Identifying the number of co-integration vectors within the VAR model is the basis for this procedure. To identify the number of co-integration vectors a likelihood ratio test of hypotheses procedure is used. The Johansen

[11] Kennedy, Peter. *A GUIDE TO ECONOMETRICS.* 5th ed. (Bodmin: The MIT Press, 2003).

procedure consists of four steps.[12]

(1) Step 1: Pre-test and lag length test

In step 1, all variables are pre-tested to assess the order of integration. It is easier to detect the possible trends when a series is plotted. The order of integration is important, because variables with different orders of integration pose problems in setting the co-integration relationship. The lag length test is used to find the number of lag values that should be included in the model.

(2) Step 2: Model estimation and determination of the rank of P

The model considered for co-integration can be estimated in several forms based on the specification of the constant and the time trend. If the model has a constant without a time trend, then it can be estimated in two forms: either the constant is inside the co-integrating vector, or it is outside the co-integrating vector. If the model has a time trend, then it is considered either inside or outside the co-integrating vector. Since the endogenous growth model fits the Sri Lankan case better, this study considers the model without time trend. However, because the constant term is insignificant, the model is estimated without the constant term. Selection of the model form depends on the likelihood ratio test statistics, which denote LR_l, based Eigen values. Johansen (1988) indicates that Eigen values are the squared canonical correlation of residuals of R_k and R_0, where R_k is the residual of the regression of X_{t-k} on the lagged differences (k number of lag values), and R_0 is the residual of the regression DX_t on the lagged differences. The null hypothesis for LR_l is as follows:

H_0: restricted model:

$$LR_{\lambda} = T\sum_{i=r+1}^{n}\left\{(\ln(1-\lambda_i^*)) - (1-\hat{\lambda}_i))\right\} \qquad \text{[Equation-3]}$$

where:

[12] Johansen, S., "Statistical Analysis of Co-integrating Vectors," *Journal of Economic Dynamics and Control* 12 (1998): 231-254.

r = number of non-zero Eigen values of unrestricted model;

λ_i^* = Eigen value of the restricted model;

$\hat{\lambda}_i$ = Eigen value of the unrestricted model;

T = number of observations;

n = number of endogenous variables;

Restricted model = time trend or constant inside the co-integrating vector;

Unrestricted model = time trend or constant outside the co-integrating vector.

If $LR_l > c^2$, the critical value for an n-r degree of freedom where n is a number of endogenous variables and r is a number of co-integration relations of unrestricted model, then the null hypothesis is rejected. Johansen (1988) discusses three possibilities:

1. If P=0, the variables are not co-integrated and the model is VAR in first difference.
2. If 0 < rank (P) = r < n, all variables (I(1) endogenous) are co-integrated.
3. If rank (P) = n, the variables are stationary and the model is VAR in levels.

In addition, three tests are available: the Akaike information criterion (AIC), the Schwarz-Bayesian criterion (SBC) and the Hannan-Quinn criterion (HQC).

(3) Step 3: Normalization of co-integrating vector(s) and estimation of the speed of adjustment coefficients If the variables are co-integrated, after selecting the rank, the normalized b vector (setting b_1=1), the speed of adjustment coefficient and the short-run dynamics are estimated.

(4) Step 4: Evaluation of innovation

It is important to evaluate whether the results of the analysis have a sound economic base. The Johansen procedure is preferred to the residual-based approach because it makes it possible to analyze with more complex models.

3. Granger Causality test[13]

A time series X is said to Granger-cause Y if it can be shown, usually through a series of F-tests on lagged values of X (and with lagged values of Y also known), that those X values provide statistically significant information about future values of Y. The test works by first doing a regression of ΔY on lagged values of ΔY. Once the appropriate lag interval for Y is proved significant (t-stat or p-value), subsequent regressions for lagged levels of ΔX are performed and added to the regression provided that they 1) are significant in and of themselves and 2) add explanatory power to the model. More than 1 lag level of a variable can be included in the final regression model, provided it is statistically significant and provides explanatory power. The researcher is often looking for a clear story, such as X granger-causes Y but not the other way around. In the real world, often, difficult results are found such as neither granger-causes the other, or that each granger-causes the other. Furthermore, Granger causality does not imply true causality. If both X and Y are driven by a common third process, but with a different lag, there would be Granger causality. Yet, manipulation of one process would not change the other.

4. Vector Auto Regressive model[14]

When the time series data is unstable after unit root test we can apply two methodologies. First method is to do regression analysis after drawing stable time series through differencing process. In this study, we examine the relation between major macroeconomic variables which provide the information for the overall movement of the stock market and KOSPI. However, since there is no specific theory for this topic, we think

[13] Bent E. Sorensen, "Granger Causality," *Economics* 7395 (2005): 1-4.
[14] Walter Enders, *Applied Econometric Time Series*, (Hoboken: John Wiley & Sons, 2003).

VAR is the most appropriate model. The only problem is that VAR has a limitation which we are not able to draw dynamic stable long term equilibrium, because using differenced time series makes innate potential information of time series lose.

After examining the relation of co-integration, we can use the VECM if there is co-integration as a second method. According to a study of Engle and Granger, when there is co-integration, VAR makes a mistake of setting a model. In this case, we should set a new VAR using error term from co-integration, which is VECM. Thus, we will use VECM if instability of time series and multivariate co-integration are found in the analysis. Since VECM is deeply related with VAR, we will examine VAR first.

Once it has been tested and confirmed that all the variables in question are endogenous I(1) variables, it is possible to proceed to a VAR model. A standard VAR model with stationary and non-stationary variables can be written as follows:

$$Z_t = A_0 + AZ_{t-1} + \cdots + A_p Z_{t-p} + \psi W_t + \delta D_t + v_t, t = 1...T \quad \text{[Equation-4]}$$

where:

Z_t = a vector of I(1) variables (m by 1) in period t;

A_0 = an intercept term;

Z_{t-p} = an (m by 1) vector of the i^{th} lagged value of Z for i =1,2,...., p;

W_t = vector of I(0) variables in period t;

D_t = dummies in period t.

One of the important features of the VAR model is that there is no specific dependent variable. Owing to this feature, analysis of the VAR model with I(1) variables would be biased because it would yield higher R^2 values and larger t-values with very low level Durbin-Watson statistics (Darnell, 1994). The co-integration concept led to the development of an estimation procedure for the VAR model containing non-stationary variables, i.e. integrated variables. However to employ the co-integration technique, the presence of co-integration in the model is a necessary condition.

Lag length test[15]

AIC and SBC are used to determine the appropriate lag length. Statistics of AIC and SBC are based on the following formulas:

$$AIC_p = \frac{-nm}{2}(1+\log 2\pi) - \frac{n}{2}\log\left|\tilde{\Sigma}_p\right| - ms \qquad \text{[Equation -5]}$$

$$SBC_p = \frac{-nm}{2}(1+\log 2\pi) - \frac{n}{2}\log\left|\tilde{\Sigma}_p\right| - \frac{ms}{2}\log(n) \qquad \text{[Equation -6]}$$

where:

s = $mp + q + 2$;

m = jointly determined dependent variables (endogenous variables);

q = deterministic or exogenous variables;

p = lag length;

$\tilde{\Sigma}_p$ = residual sum of the square of the VAR model.

[15] Xiaojun W., *NUTRITION INTAKE AND ECONOMIC GROWTH.,* Kiyoshi T., (Rome: Food and Agriculture Organization of the United Nations, 2008).

Empirically, SBC never selects lag values that are larger than AIC, while AIC selects relatively higher lag values.

5. Vector Error Correction model[16]

It is quite possible for random walks to be related to each other so that a regression of one random walk on the other has a stationary error term. For example let $\Delta x_t = \varepsilon \quad \Delta y_t = u$ and let $y_t + x_t$ be stationary. The simplest example is that $y_t = -x_t + v$. That is, let one random walk be the negative of the other – allowing for some error. Then the sum is simply a random error with no unit root or autocorrelation. If the combination of unit root variables is not unit root then there must be some relationship between them. This is if and only if statement. If you find co-integration then a relationship exists, if not it does not. Therefore if you are interested in establishing that a relationship exists between unit root variables, this is equivalent to establishing co-integration. That relationship is called the co-integrating vector, which for our example is since the sum is stationary. There is a way to write a system that captures all the relationships and avoids unit roots. Consider:

$$\Delta x_t = \alpha_1(\beta_1 y_{t-1} + \beta_2 x_{t-1}) + \varepsilon_t + v_t \qquad \text{[Equation -7]}$$

$$\Delta y_t = \alpha_2(\beta_1 y_{t-1} + \beta_2 x_{t-1}) + u_t + v_t \qquad \text{[Equation -8]}$$

This is called a vector error correction model. The error correction comes from the co-integrating relationship. The betas contain the co-integrating equation and the alphas the speeds of adjustment. If y and x are far from their equilibrium relationship, either y or x or both must change, the alphas let the data choose.

[16] Kim M. and Chang K., *Financial Econometrics*, (Seoul: Kyung Moon Sa, 2002).

IV. The empirical analysis for KOSPI

A. Basic Data analysis

1. Basic Statistics

According to the basic statistics for 1st differencing variables, KOSPI was increased by 6.53% for one year. FX decreased by -2.68% for one year. The call rate was increased by 0.3% on average, industrial production was increased by 10.63% on average and the Consumer Product Index was increased by 2.39% on average. M2 was increased by 7.75% for one year. The Dubai oil price was increased by 13.73% for one year. The Baltic Dry Index was increased by 33.90% for one year, while the OECD Composite Leading Indicator was increased by 5.88% for one year. Except for the basic statistic analysis, we used log value for all data, which would be a level variable in this paper. The basic statistics of variables used in this paper are as follows.

Table 1 The basic statistics for raw data

	KOSPI	FX	CR	PI	CPI	M2	CB	OIL	BDI	CLI
Mean	963.860	1116.350	4.250	91.638	95.285	917665.597	959.589	39.090	3040.771	123.126
Maximum	2063.140	1328.000	5.390	128.400	106.300	1269522.500	3554.400	86.850	10581.000	162.455
Minimum	500.640	902.300	3.250	66.500	83.847	676961.300	-1168.200	17.690	853.000	88.198
Std. Dev.	383.751	128.757	0.616	15.492	6.649	161586.198	926.406	17.812	2077.496	21.802
Skewness	1.039	-0.096	0.093	0.411	-0.106	0.291	0.487	0.839	1.499	0.182
Kurtosis	0.303	-1.239	-1.011	-0.898	-1.234	-0.817	0.709	-0.508	2.596	-1.087

KOSPI=The Korea Composite Stock Price Index, FX= Won per US dollars, CR=Call Rate, PI=Industrial Product, CPI=Consumer Price Index, M2=Money Supply, CB=Current Balance, OIL=Dubai Oil Price, CLI=OECD Composite Leading Indicator.

Table 2 The basic statistics for 1st differencing variables

	KOSPI	FX	CR	PI	CPI	M2	CB	OIL	BDI	CLI
Mean	6.801	0.484	1.436	4.504	4.554	13.714	5.192	3.571	7.813	4.798
Maximum	7.632	0.495	1.685	4.855	4.666	14.054	8.176	4.464	9.267	5.090
Minimum	6.216	0.471	1.179	4.197	4.429	13.425	-7.063	2.873	6.749	4.480
Std. Dev.	0.369	0.007	0.146	0.167	0.070	0.176	4.266	0.430	0.643	0.178
Skewness	0.451	-0.242	-0.128	0.191	-0.187	0.015	-2.156	0.423	0.196	-0.054
Kurtosis	-0.748	-1.248	-0.959	-1.107	-1.204	-0.977	3.055	-1.194	-0.870	-1.114

KOSPI=The Korea Composite Stock Price Index, FX= Won per US dollars, CR=Call Rate, PI=Industrial Product, CPI=Consumer Price Index, M2=Money Supply, CB=Current Balance, OIL=Dubai Oil Price, CLI=OECD Composite Leading Indicator.

2. Correlation Analysis

By the relation between KOSPI and the exchange rate, Won per United States Dollar has a negative correlation for KOSPI. For Korea, correlation of exchange rate and KOPSI has a negative correlation, which shows the Korean economy is highly dependent on exports. The call rate is known as having a negative correlation; it has a weak negative correlation with KOSPI, so its influence is not significant. CPI and PI have a strong positive correlation with KOSPI, which shows KOSPI can be a hedge role for inflation. KOSPI has also a strong positive correlation with M2. The BDI has a weak negative relation with KOSPI. OECD CLI has a strong positive correlation with KOSPI, which indicates that CLI acts as a leading indicator. The correlation coefficient of variables is as follows

Table 3 Correlation Coefficient

	KOSPI	FX	CR	PI	CPI	M2	CB	OIL	BDI	CLI
KOSPI	1	-0.198	-0.020	0.050	0.058	0.298	-0.187	0.182	-0.008	0.088
FX		1	-0.019	0.005	0.143	0.017	0.162	-0.149	0.021	-0.138
CR			1	0.049	0.000	-0.061	0.133	0.054	0.055	-0.012
PI				1	-0.010	0.055	0.100	0.008	0.300	0.201
CPI					1	-0.024	-0.126	0.249	-0.015	-0.026
M2						1	-0.038	0.047	0.101	0.055
CB							1	-0.090	0.032	0.008
OIL								1	-0.091	-0.098
BDI									1	0.114
CLI										1

KOSPI=The Korea Composite Stock Price Index, FX= Won per US dollars, CR=Call Rate, PI=Industrial

Product, CPI=Consumer Price Index, M2=Money Supply, CB=Current Balance, OIL=Dubai Oil Price, CLI=OECD Composite Leading Indicator.

B. The empirical analysis

1. Unit Root Test

As the result of the ADF unit root test for variables, the null hypothesis which unit root exists was not rejected for the raw data. After 1st differencing, the null hypothesis which unit root exists was rejected, so we can say that variables are stationary. Therefore the variables in this paper flow in an I(1) process except M2. The result of the unit root test for variables in this empirical analysis is shown as follows.

Table 4 The result of ADF unit root test for raw data and 1st differencing data

		KOSPI	CPI	FX	PI	CR	M2	OIL	CB	BDI	CLI
Critical Value	1%	-2.588	-2.588	-2.588	-2.588	-2.588	-2.588	-2.588	-2.588	-2.588	-2.588
	5%	-1.9436	-1.9436	-1.9436	-1.9436	-1.9436	-1.9436	-1.9436	-1.9436	-1.9436	-1.9436
Level		0.930341	5.116128	-0.949231	1.486927	-0.315442	4.667682	1.80703	-1.876296	1.177548	2.118892
1st Difference		*-4.543137	*-4.528706	*-4.653928	*-8.892747	*-3.772899	-1.558223	*-5.693242	*-6.938514	*-4.923755	*-3.682601
2nd Difference							*-8.246455				

KOSPI=The Korea Composite Stock Price Index, FX= Won per US dollars, CR=Call Rate, PI=Industrial Product, CPI=Consumer Price Index, M2=Money Supply, CB=Current Balance, OIL=Dubai Oil Price, CLI=OECD Composite Leading Indicator. (*), (**), (***) are statistically significant at 1%, 5%, 10% each. Lag=3.

2. Granger Causality

For the result of the Granger causality test, all variables have Granger causality with KOSPI. Especially, CPI and BDI do Granger-cause KOSPI and KOSPI does Granger-cause OECD CLI. This result shows the possibility that BDI and OECD CLI would be good variables for VECM. In Yu and Park (1997) study, the stock market return did not have Granger causality with inflation, money supply and interest rate, so we can interpret that the relation between Korean stock market and macroeconomic variables are strongly changed.

Table 5 The result of Granger Causality test for raw data

	KOSPI	FX	CR	PI	CPI	M2	CB	OIL	BDI	CLI
KOSPI	-	↔	↔	↔	←	↔	↔	↔	←	→
FX		-	-	↔	-	-	←	→	←	↔
CR			-	-	←	↔	↔	↔	↔	↔
PI				-	↔	←	-	↔	←	→
CPI					-	↔	↔	-	→	←
M2						-	↔	→	→	←
CB							-	←	←	↔
OIL								-	-	→
BDI									-	→
CLI										-

KOSPI=The Korea Composite Stock Price Index, FX= Won per US dollars, CR=Call Rate, PI=Industrial Product, CPI=Consumer Price Index, M2=Money Supply, CB=Current Balance, OIL=Dubai Oil Price, CLI=OECD Composite Leading Indicator.

3. Co-integration test

We can know that the variables used in this paper were I(1) series through a unit root test for all variables in this empirical analysis. In many previous researches, after Unit root test, VECM was estimated by converting a stable series for an unstable time series. However, this method overlooks the equilibrium relation which is long- term dynamic and stable between series. In other words, even though time series variables are not stable, co-integration exists between two variables if the linear relation is stable. If variables are differenced because they are unstable before verifying the existence of co-integration, in this process, long-term information may be lost. If there is no co-integration between variables, VAR analysis should be done; otherwise VAR, including the long-term equilibrium section, is estimated through VECM.

The test has an effect on verification of the theoretical relation between variables and whether variables are done by co-integration. If the linear combination of variables is stable, we can expect that the variables are going to fluctuate to keep a constant relation in the long term. Based on this fact, we look into the long-term relation between KOSPI and the economic variables. The distribution and estimation of test statistics depends on the hypothesis for the existence of a linear trend; it is very important to choose the existence of a linear trend. First, there is a constant in the co-integration relation, but there is no determinant time trend in the variable itself (Case I). Second, there are determinant time trends in both the co-integration relation and variable (Case II). Variables in this paper have significant time trends in themselves, so we estimated for Case II.

AIC of lag 3 is the biggest among test the values, so we used lag 3 for all statistic tests. To determine the appropriate lag length, we used the statistics of AIC. The result of AIC is as follows.

Table 6 The result of AIC

	Lag 1	lag 2	lag 3	lag 4	lag 5	lag 6	lag 7
AIC	-41.0614	-41.1337	-40.9243	-41.1173	-42.3199	-44.4251	-50.3178

Looking over the estimation result below, we can know that a 5 co-integration relation exists between variables. Through the existence of co-integration, we can deduce the long-term equilibrium relation between variables. If there is more than one co-integration vector that is exists, the vector which has the biggest Eigen value is the most helpful for deducing the long-term relation. Using the normalized co-integration vector, we compared usefulness of including the BDI and CLI in this model.

[Table 7] shows that there are 5 co-integration relations at 1% significant level at least. It also means that there is long term relation between KOSPI and macroeconomic variables. The result of the Johansen test for variables from February 2000 to December 2007 is as follows:

Table 7 The result of co-integration test

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.647431	406.1814	244.15	257.68	None **
0.542941	310.2706	202.9	215.4	At most 1 **
0.512714	238.2399	165.58	177.2	At most 2 **
0.432789	172.1007	131.7	143.09	At most 3 **
0.347693	119.9345	102.14	111.01	At most 4 **
0.26535	80.62836	76.07	84.45	At most 5 *
0.190304	52.2592	53.12	60.16	At most 6
0.153761	32.8383	34.91	41.07	At most 7
0.129249	17.47864	19.96	24.6	At most 8
0.050278	4.745889	9.24	12.97	At most 9

*(**) denotes rejection of the hypothesis at 5%(1%) significance level, Lag=3

In the unrestricted model, KOSPI and Won per US dollar exchange rate have a negative long-term relation. The coefficient is -128.35. This shows that if the Won per US dollar exchange rate is increased, KOSPI will be decreased because foreign investors tend to withdraw their money from KOSPI.

Call rate and KOSPI have a positive long-term relation. This is a different result from the previous empirical research on the US economy which found that a lower call rate increases stock price. Consumer Price Index and KOSPI have a positive long-term relation. CPI is related to commodity price; generally commodity price has a negative long-term relation. This means that if commodity price is increased, and investors required a higher rate to compensate for the purchasing power, then this causes an increase of the risk adjustment rate; as a result, the stock price falls. In this empirical analysis, a stock can be a hedge for inflation. Production Index and KOSPI have a positive long-term relation. The coefficient is 10.66. It corresponds with many previous researches in which corporate production activity and stock price have a positive relation. M2 and KOSPI have a positive long-term relation. The coefficient is 5.03. The increase of M2 links with money liquidity; plenty of money liquidity boosts the stock market. However it does not correspond with a general long-term relation. Many researches show that the increase of M2 causes an increase in interest rate and inflation; then the stock price falls. On the other hand, there is a research that shows the influence of M2 on the stock market depends on the economic cycle. In other words, in an economic boom, the increase of M2 makes the scale of the economy bigger; as a result, stock price rises as this empirical research shows. In an economic recession, the increase of M2 only reflects the inflation, so that the stock price falls. For oil price and KOSPI, the coefficient is -2.09. The increase in the international oil price is the reason for the increase in raw materials, companies' costs are increased then it ends up with a stock price fall. The Baltic Dry Index and KOSPI have a negative long-term relation. The coefficient is -0.99. If BDI is increased, global supply and demand could be increased. Korea's economy depends on the world economy to a great extent; however, this empirical result can not prove the relation between KOSPI and BDI. The OCED Composite Leading Indicator and KOSPI have a negative long-term relation. The coefficient is -4.09. OECD CLI is well known as good tool of economic forecasting and has a positive relation with KOSPI. In Granger Causality, KOSPI preceded OECD CLI, so this is reasonable. Comparing the unrestricted model and the restricted model, we found that the unrestricted model would be better than the restricted model because the adjusted R-squared shows that BDI and CLI is a good variable to be included in the forecasting model. The long-term equilibrium relation of using normalized co-integration vector is as follows.

Table 8 Long-term equilibrium relation

	Long term equribrium relation	Adjusted R-squared
Unrestricted model	KOSPI=-128.35FX+0.31CR+10.66PI+64.02CPI+5.03M2+0.06CB-2.09OIL-0.99BDI-4.09CLI-0.21	0.518
Restricted model	KOSPI=-36.06FX-0.42CR+30.57PI+85.72CPI-141.30M2+0.09CB-1.11OIL-0.37	0.448

Restricted model=except BDI and CLI

4. The estimation of VECM

As we have seen in the unit root test, because VECM is more appropriate than VAR. This is why we analyze the relation between KOSPI and macroeconomic variables. The error correction model, shows the equilibrium between variables. When a gap is generated from long-term equilibrium at a certain point, this equilibrium error is based on the concept which will be corrected as time passes. In this study, we have proved the long-term equilibrium between variables, so we will proceed to study the long-term equilibrium relation and short-term movement of dynamic variables.

$$\begin{bmatrix} \Delta(KOSPI_t) \\ \Delta(FX_t) \\ \Delta(CR_t) \\ \Delta(PI_t) \\ \Delta(CPI_t) \\ \Delta(M2_t) \\ \Delta(CB_t) \\ \Delta(OIL_t) \\ \Delta(BDI_t) \\ \Delta(CLI_t) \end{bmatrix} = \sum_{i=1}^{k-1} [\Gamma i] \begin{bmatrix} \Delta(KOSPI_t) \\ \Delta(FX_t) \\ \Delta(CR_t) \\ \Delta(PI_t) \\ \Delta(CPI_t) \\ \Delta(M2_t) \\ \Delta(CB_t) \\ \Delta(OIL_t) \\ \Delta(BDI_t) \\ \Delta(CLI_t) \end{bmatrix} + [\Pi] \begin{bmatrix} \Delta(KOSPI_{t-3}) \\ \Delta(FX_{t-3}) \\ \Delta(CR_{t-3}) \\ \Delta(PI_{t-3}) \\ \Delta(CPI_{t-3}) \\ \Delta(M2_{t-3}) \\ \Delta(CB_{t-3}) \\ \Delta(OIL_{t-3}) \\ \Delta(BDI_{t-3}) \\ \Delta(CLI_{t-3}) \end{bmatrix} + \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \\ \mu_6 \\ \mu_7 \\ \mu_8 \\ \mu_9 \\ \mu_{10} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \\ \varepsilon_8 \\ \varepsilon_9 \\ \varepsilon_{10} \end{bmatrix} \quad \text{[Equation 4-1]}$$

In the above equation, Δ represent the 1st differencing, the μ vector is (10×1) a constant vector, k is the lag structure, and ε_t is the Gaussian White noise vector. Γ_t is a (10×10) matrix and represents a short-run adjustment matrix of 15 variables at i lag. Through this matrix, we can figure out the short dynamic movement between variables. Moreover, matrix Π has the information for long-term equilibrium between 15 variables. The number of co-integration vectors is determined by Π rank at co-integration test. The long-term equilibrium section was deduced already; based on that, the short-term section was estimated. For considering the usefulness of BDI and CLI, we compared both the adjusted R-squared of BDI and CLI.

Unrestricted model has higher adjusted R-squared than restricted model, so including

BDI and CLI is reasonable for good forecasting. The estimated result for 1st differencing data in VECM is as follows.

Table 9 Estimated result for 1st differencing data in VECM

Error Correction	Unrestricted D(DKOSPI)	Restricted D(DKOSPI)
R-squared	0.679	0.597
Adj. R-squared	0.518	0.448

Restricted model=except BDI and CLI

6. Impulse response functions and forecasting error variance decomposition

Variance decomposition provides a different method of depicting the system dynamics. Variance decomposition decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VECM. The variance decomposition gives information about the relative importance of each random innovation to the variables in the VECM.

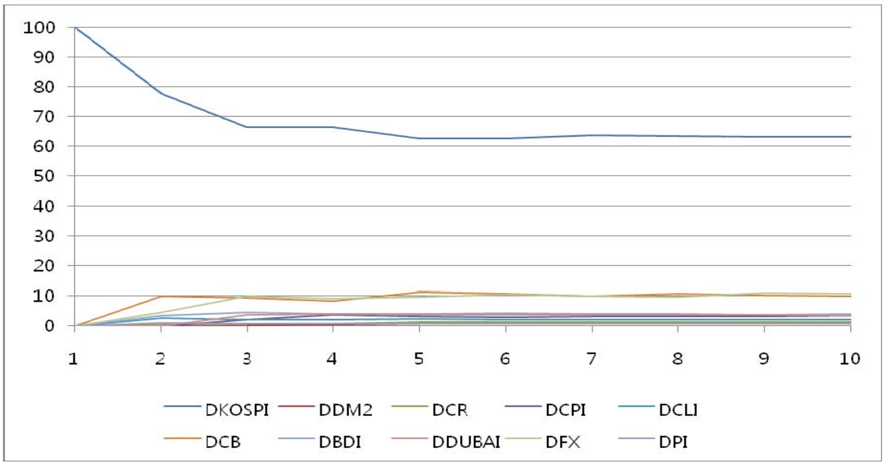
When a certain variable has a power of influence, the portion is big or becoming increased; in contrast, when certain variables do not have a power of influence, the portion is small or becoming decreased. [Figure 1] represents the variance portion of KOSPI forecasting error for each variable in VECM. After 10 periods, KOSPI explains 63% of its own variance, Won per US dollar (FX) explains 10.8% of the KOSPI variance; current balance (CB) explains 10% of KOSPI variance, then other variables have a very small influence on KOSPI. This result is different from a study of Hwang and Choi (2006), that is, the importance of macroeconomic variables are changed from foreign exchange rates, the consumer prices index and industrial production to foreign exchange rates, interest rate, oil price. We can know that the relation between Korean stock market and macroeconomic variables are not fixed but changing.

Table 10 Variance Decomposition of KOSPI

Period	KOSPI	FX	CR	PI	CPI	M2	CB	DUBAI	BDI	CLI
1	100	0	0	0	0	0	0	0	0	0
2	77.832	4.434	0.426	0.937	0.063	0.017	10.064	0.025	3.584	2.618
3	66.380	9.989	0.861	0.707	2.244	0.178	9.372	3.728	4.513	2.029
4	66.493	9.011	0.810	0.765	3.712	0.531	8.334	4.048	4.100	2.197
5	62.821	9.784	1.337	0.709	3.289	0.755	11.189	3.991	3.779	2.347
6	62.743	10.583	1.381	0.769	2.981	0.694	10.688	4.180	3.829	2.153
7	63.649	9.877	1.306	0.794	3.236	1.073	9.904	4.140	3.839	2.182
8	63.547	9.777	1.202	0.732	3.168	1.032	10.611	3.915	3.761	2.256
9	63.118	10.875	1.328	0.686	3.216	1.004	10.259	3.708	3.715	2.090
10	63.294	10.807	1.302	0.649	3.354	0.951	10.020	3.563	3.891	2.169

KOSPI=The Korea Composite Stock Price Index, FX= Won per US dollars, CR=Call Rate, PI=Industrial Product, CPI=Consumer Price Index, M2=Money Supply, CB=Current Balance, OIL=Dubai Oil Price, CLI=OECD Composite Leading Indicator. Lag=3.

Figure 1 Variance Decomposition of KOSPI

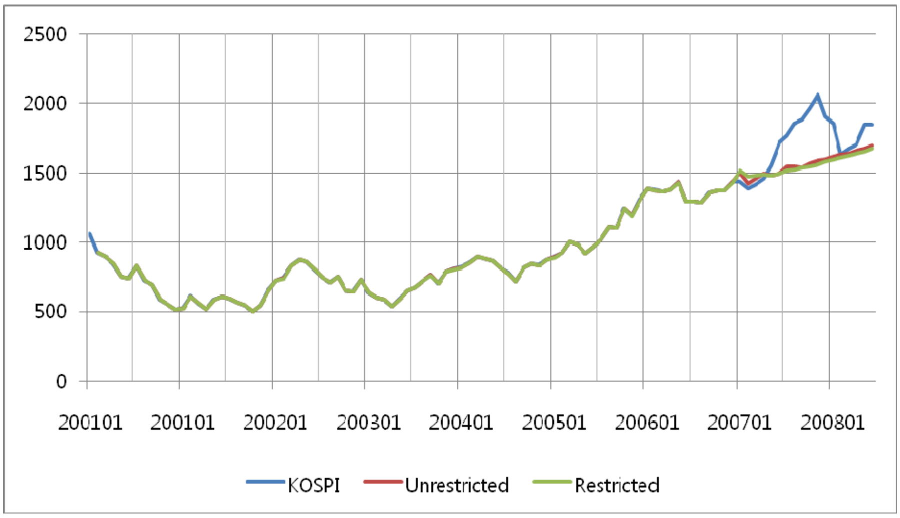


7. Forecasting

So far, we have analyzed the relation between KOSPI and macroeconomic variables through VECM that are considered long-term equilibrium. In this chapter, we will analyze estimated models. The model will be divided into two; one is an unrestricted model which includes all variables, and the other is a restricted model which does not include BDI and CLI.

We can hardly evaluate in advance how correct the forecasting is. So we deducted the ex-post forecast, then examined through comparing the real value and fitness of the estimated model. Thus, we set the forecasting period from January 2007 to June 2008 for the whole test period. The graph below represents the result of forecasting and the real value. The forecasting based on VECM is different from the real value, and it cannot show the change of the KOSPI direction. In variance decomposition, we saw that variables used in this study explained only about 80% of the KOSPI variation. If we can find more variables which are related to variations of KOSPI, we can achieve a higher power of the forecasting. Hopely there may be much difference between the unrestricted model and the restricted model. However, as we can see, there is not much difference between them for the power of the forecasting.

Figure 2 Forecasting for VECM



V. Conclusion

The purpose of this study is to figure out the econometric relation between KOSPI and macroeconomic variables. Moreover, it is to set the foundation for estimating the model of KOSPI and macroeconomic variables to enable the construction of the investment strategy. We examined the correlation and causality between KOSPI and macro-economic variables. Moreover, we analyzed long-term equilibrium and short-term movement, using co-integration and VECM for examining dynamic and endogenous movement. Through this empirical test , we found the fitness of BDI and OECD CLI for our model. Lastly, based on VECM, we examined the forecasting of KOSPI, using equations through the VECM divided unrestricted model and the restricted model.

Based on the results of this empirical study, we can conclude as follows: First, by the long-term equilibrium for KOSPI and macroeconomic variables using a co-integration vector we can know that KOSPI has a negative relation with the Won per US dollar, a positive relation with the call rate, a positive relation with the Consumer Product Index and Product Index, a negative relation with M2, a positive relation with Current Balance, and a negative relation with oil prices, Baltic Dry Index, and the OECD Composite Leading Indicator.

Second, through Granger Causality, all macroeconomic variables used in this paper have Granger causality with KOSPI. Especially, the Consumer Product Index and Baltic Dry Index do Granger-cause KOSPI and KOSPI does Granger-cause OECD CLI. Compared to preceding studies, the relation between Korean market and macroeconomic variable is stronger than before.

Third, we could get the coefficient of error correction. So we found out that there was long-term equilibrium between KOSPI and macroeconomic variables used in this study.

Fourth, in forecasting the VECM, through this paper we hoped that BDI and OECD

CLI would improve the power of the forecasting. But as a result, it did not work. However this does not mean that BDI and OECD CLI do not relate to KOSPI. There are many macroeconomic variables which are related to KOSPI. Thus, we left the finding that the more macroeconomic variables which are related to KOSPI, then the more precise the forecasting, for further study.

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