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REAL ESTATE, STOCK, AND BOND MARKET NEXUS: AN ARDL BOUNDS TESTING APPROACH

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This paper aims to estimate the long-run and short-run relationships among the Korean real estate, stock and bond markets using the recently developed bounds testing approach. For the entire sample period, our empirical findings are in line with the conventional viewpoints: a positive relation between the stock price and land price; a negative relation between the stock price and bond yield; and an inverse relation between the land price and bond yield.

However, the sub-sample tests generate different relations. First, the negative relationship between stock price and bond yield before the economic crisis has changed into positive one in the second sample period. Second, the relationship between the land and stock prices is in favour of the "credit-price effect" before the Korean economic crisis whereas the "wealth effect" is dominant after the period of the crisis. Third, the positive effect of bond yield on the land price has changed to negative one after the economic crisis. The findings of this paper will be useful to portfolio managers. The finding of a transmission channel from one market to another also gives an important strategic means to the portfolio managers in seeking the maximum profit asset allocation.

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Ⅰ. INTRODUCTION

Korean financial markets have been gradually liberalized from the beginning of

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1990s in accordance with the low barriers to international capital movements and with the deregulations in domestic bond and stock markets. Although some restrictions remained, investments up to 10% of individual stock issues by foreigners were allowed in January 1992, and the stock market was further opened in the process of becoming a member of OECD in 1996. The liberalization of market interest rates was also progressed through the 1980s, and the Korean bond market was further opened in July 1994 because of the big spread between domestic and foreign issues. Finally, the government abolished most of the regulations on investment in listed securities by foreign investors, in accordance to the new scheduling agreements with the IMF in December 1997. This full liberalization in domestic financial markets caused by the outbreak of the Korean economic crisis, *de facto*, has brought an enormous capital inflow for portfolio purposes, and consequently resulted in the changes in market participants as well as characteristics of capital.

On the other hand, the value of domestic real estates was drastically deflated due to the aftermath of economic depression and credit constraints in the capital market right after the Korean economic crisis. A lot of restrictions placed on the real estate markets, which were associated with the prices of newly supplied apartments, the land holdings by foreigners and green belts etc., were deregulated. Moreover, new systems such as ABS (Asset Backed Securities), MBS (Mortgage Backed Securities) and REITs (Real Estate Investment Trusts) were introduced to foster the real estate market after 1999, which help to channel and structure the flow of capital from the financial markets to the real estate markets. Therefore, real estate markets are not likely to be isolated entirely from financial markets any more with advent of these real estate-related systems.

Given the drastic changes in both financial and real estate markets during the last two decades in Korea, the primary focus of this article is to analyze empirically the long-run and short-run relationships among the real estate, stock and bond markets, using a recently developed econometric methodology, 'the bounds tests approach to cointegration.' Particularly, a special focus of the present study is placed on this issue: to what extent did dramatic change in Korean financial markets followed by the economic crisis contributed to the nexus among stock, bond and real estate markets. The implications of findings of this study will be useful to policymakers. For instance, if a stronger nexus among the three markets is found after the Korean economic crisis, this could suggest feasibility in government's interest rate policy to account for the fluctuations in the real estate markets. The structural changes among the three markets could also give important strategic implications to the portfolio managers seeking the maximum profit asset allocation.[1]

A number of researches have empirically performed to investigate the relationships between real estate and financial assets in international markets, whereas only a few studies have focused on the relationships among the three asset markets using Korean data series. The results of previous empirical works are contingent on the methodologies, data series and sample periods employed. For example, using U.S. data with different time periods, Ibbotson and Siegel (1984) and Hartzell (1986) find negative correlations between stocks and real estates, whereas Worzala and Vandell (1993) show a positive correlation between the two variables for the U.K. using quarterly data. Eichholtz and Hartzell (1996) also provide that property and stock indexes are negatively correlated for Canada, U.K. and U.S. More recently, using yearly data from 17 countries over 14 years, Quan and Timan (1999) document a significant positive relation between stock returns and real estate prices when the data are pooled across the countries.

There have also been a number of studies that examined the relationships among real estate, stock and bond markets using more specific econometrics models. The study by Jud and Winkler (2002) reveals that housing price appreciation in 130 metropolitan areas across the U.S. is strongly influenced by stock market appreciation as well as income and interest rates. Based on the augmented Engle-Granger cointegration test, Glascock *et al.* (2000) find that securitized real estate (REITs) behaves more like common stocks and less like bonds in the U.S. market. Chaudhry *et al.* (1999) using the Johansen test of cointegration finds that the stocks tend to have an inverse long-run relationship with real estate, using different regional real estate data in the U.S. They also document that the stock market has a much stronger impact on bonds and T-bills, whereas the effect is rather muted in real estate. Turning to the relationship between land and stock prices, Stone and Ziemba (1990) present strong evidence that stock price returns led land price returns from 1972 to 1987 in Japan. For the U.S. market, the results give less conclusive evidence. Stone and Ziemba (1990, 1992)

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[1] Because this study employed quarterly data rather than daily or monthly data, the short-run relationship between the variables also can be important information to the long-term portfolio strategy.

show no significant relationship between stock and land prices. In contrast, the finding of Gyourko and Keim (1992) suggests that there is a significant relationship between lagged real estate stock returns and real estate returns.

On the other hand, a few studies document the empirical results in relation to the Korean financial and real estate markets. For example, two studies by Seo and Kim (2000) and Park and Park (2001), using a VAR model with quarterly data spanning different time periods, find that stock prices Granger-cause land prices as well as other economic variables such as GDP and interest rates. Meanwhile, based on the Geweke-Meese-Dent exogeneity test, Chi (1998) shows that the real estate market tends to follow the bond market with a half year lag and the stock market with two year lag.

The limitation of simple correlation analyses is that they only consider linear relationships between the variables and ignore potential long-run economic effects. Furthermore, the previous empirical works solve the nonstationarity embedded in the underlying time series in order to avoid the problem of spurious regression before they examine the relationship between the variables. However, the results of unit root test often depend on the methodology adopted and might not be very informative about whether or not there exists a unit root in each series. In addition, ECM, Johansen (1988) and Johansen and Juselius (1990) methods are recently known to be unreliable especially for studies with a small sample size like this study.

In this context, this study employs a new econometric technique for cointegration analysis - bounds test procedure (Pesaran *et al.*, 2001), as an effort to verify the relationship among real estate, stock, and bond markets. The bounds test procedure is a single-equation approach for a cointegration equation and is also a recent test that is based on the estimation of unrestricted error correction model (UECM). This approach has several advantages over the common practice of cointegration analysis (e.g., Engle and Granger, 1987; Johansen, 1988; Johansen and Juselius, 1990) as follows.

First, the bounds test procedure can be applied irrespective of whether the explanatory variables are I(0) or I(1). It is well known that the conventionally used cointegration approaches are applicable only for nonstationary series with the same integrated order, I(1). This approach, however, rules out the uncertainties of stationarity raised when pre-testing the order of integration. To this end, Pesaran and Pesaran (1997: pp. 184) observe that "pre-testing is particularly problematic in the unit-root-cointegration literature where the power of unit root tests are typically low, and there is a switch in the distribution function of the test statistics as one or more roots of the x_t process approach unity". Second, bounds test procedure is robust for cointegration analysis with small sample size. Kremers *et al.* (1992) show that for data with a small sample size, no cointegration relation can be made among variables that are integrated of order one, I(1). Mah (2000) also states that ECM, Johansen (1988) and Johansen and Juselius (1990) methods are not reliable for studies that have a small sample size. As stated by Cheung and Lai (1993), finite-sample analysis can bias the likelihood ratio (LR) test (Johansen, 1988) toward finding cointegration either too often or too infrequently. However, Pesaran and Shin (1999) show that with the ARDL (autoregressive distributive lag) framework, the OLS estimators of the short-run parameters are consistent and the ARDL-based estimators of long-run coefficients are super-consistent in small sample sizes. Third, UECM (Unrestricted Error Correction Model) is likely to have better statistical properties than the two-step Engle-Granger method because unlike the Engle-Granger method the UECM does not push the short-run dynamics into the residual terms. Fourth, it can distinguish dependent and independent variables.

Considering these features of the bounds test approach, this study analyzes the long-run and short-run linkages among real estate, stock and bond markets in Korea. The remainder of this paper is organized as follows. The next section presents a theoretical background on the relationships among real estate, stock and interest rate. A discussion of the econometric model, methodology and data is described in the section Ⅲ. Section Ⅳ explores the empirical results, and the final section presents summary and conclusions.

Ⅱ. THEORETICAL BACKGROUND

Many financial analysts and economists recognize that there exists, ceteris paribus, an inverse relationship between interest rates (bond yields) and stock prices. This relationship is based on the fundamental theory on stock prices. Low interest rates imply that stocks are currently valued using a lower rate to discount future cash flows, which raises their present value and hence stock prices. According to the relationship recently observed, however, stock price is not necessarily negatively related to interest rates. From investors' point of view, considering stocks and bonds as alternative investment assets, a positive relationship can be assumed. Again, bonds tend to be attractive to investors as an alternative investment asset as stock prices decrease, resulting in an increase in bond prices. An increase in bond prices indicates a decrease in interest rate. In portfolio investment, if stocks and bonds are considered as alternative assets focusing on perspectives on movements of capital (liquidity), a positive relationship can be assumed between stock prices and interest rates. In addition, a positive relationship between stock prices and interest rates can also be assumed from a business cycle viewpoint since the outlook for economic recovery raises both stock prices and interest rates. The outlook for economic recovery can also induce an increase of long-term interest rates, consequently raising stock prices.

There exist two theoretical views to explain the positive relationship between stock and real estate prices. The first view, the well-known ‘wealth effect,’ stresses a transmission channel from stock to real estate. Both current income and total wealth have a positive impact on total consumer spending. Since real estate is regarded as consumption goods as well as investment goods whereas financial assets such as stocks do not involve direct consumption,[2] people with unexpected gains in the stock market are likely to distribute their portfolios to favor the real estate market. Put differently, households or firms holding stocks often rebalance their portfolios by selling stocks and investing in other assets such as real estate when stock returns rise. In contrasts, the second view, the so-called ‘credit-price effect,’ focuses a channel from real estate to stock. This view regards a change in real estate value as an important factor in the balance-sheet position of a firm. For example, credit-constrained firms holding a certain amount of real estate or land benefit when real estate prices rise. This is because an increase in the collateral value stemming from a rise in real estate prices reduces the cost of borrowing and gives the firm easier access to financing. The equity (e.g., stocks) values of the firm will then, in turn, rise if the expected profits from the firm’s resulting investments are realized. Therefore, an increase in the real estate prices has a positive impact on stock prices.

Meanwhile, real estate price can be negatively related to the stock price in terms of substitute relation between the two asset markets. When people believe that the returns on stocks are underestimated compared to those of real estate and thus they expect a high rate of return from investment in stocks, capital will flow into the stock market. This results in a rise in stock prices and a fall

[2] Refer to Jud and Winkler (2002) and Benjamin *et al.* (2004) for more details on the issue of wealth effect of both housing and stock on consumption.

in real estate prices. From the business cycle viewpoint, real estate and stock prices, however, could move in the same direction in the long-run. When the country experiences an economic boom, both real estate and stock markets also show an upward tendency in the prices.[3]

On the other hand, real estate is influenced by the market interest rate through several channels, and the latter is also affected by the former. Financing the purchase of real estate generally involves borrowing on a long-term or short-term basis. Because large amounts are usually borrowed in relation to the prices paid for real estate, financing costs are usually significant and weigh heavily in the decision to buy property. For instance, an increase in interest rates has an impact on the demand for real estate due to an increase in the borrowing cost of purchasing real estate. This decrease in demand for real estate results in a fall of real estate prices. There exists another channel through which interest rate influences the real estate price, in terms of a substitute relation. Interest rate may be seen as reflecting the return from investments, thus affecting the capital flows from a property market into the financial markets. When the market interest rate rises, people are willing to purchase financial assets like bonds at a lower price or willing to place more money on deposit in the banks in order to reduce the opportunity cost of holding real estate, thereby pushing the real estate price down. Conversely, when the interest rate declines, capital will flow into the real estate market and bid up the real estate price until its expected rate of return is equal to that of alternative competing assets.

Given the dynamics of the business cycle, one also might expect to see a positive or negative relationship between real estate prices and interest rates. As interest rates rise the economy and property markets are deflated, implying a negative relationship between interest rates and real estate prices. However, real estate prices and interest rates could move in the same direction given the lagged response of the economy to interest rate changes. Further, a buoyant economy would lead to the up-run in real estate prices and also lead to a rise in interest rates via the transmission channel from real estate prices to the national price level. This suggests that an increase in real estate prices could indirectly raise the interest rates.

In sum, the relationships among real estate prices, stock prices and interest rates may depend on a nation's economic structure and its financial market as

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[3] As a matter of fact, the co-movement in real estate and stock prices has been found in many countries.

well as changes in market situations.

Ⅲ. THE ECONOMETRIC MODEL, METHOD AND DATA

All variables in this study are logged to the advantage of the elasticity properties. The variables used in the model include: the logged land price index, *ln*(Land); the logged stock price index, *ln*(KOSPI); and the logged bond yield, *ln*(Bond). The primary objective of this paper is to evaluate the relationship among real estate, stock, and bond markets using a more robust estimation method. In this study, we use the bounds test proposed by Pesaran *et al.* (2001) which is based on the 'unrestricted error correction model' (UECM).

In this study, the following specification is considered:

$$\ln Y_t = \beta_0 + \beta_1 \ln X_t + \beta_2 \ln Z_t + e_t, \tag{1}$$

where Y is a dependent variable, and X and Z are independent variables at period t, respectively. Since the present study has a small sample size (particularly in sub-period test), the cointegrating relationship among the variables is estimated using the bounds test which is based on the following UECM:

$$\begin{aligned} \Delta \ln Y_t = b_0 &+ \sum_{i=1}^{n} b_{1i} \Delta \ln Y_{t-i} + \sum_{i=0}^{n} b_{2i} \Delta \ln X_{t-i} + \sum_{i=0}^{n} b_{3i} \Delta \ln Z_{t-i} \\ &+ b_4 \ln Y_{t-1} + b_5 \ln X_{t-1} + b_6 \ln Z_{t-1} + b_7 t + e_t, \end{aligned} \tag{2}$$

where Δ is the first difference.

To investigate the existence of a long-run relationship, Pesaran *et al.* (2001) proposed the bounds test based on the Wald test (F-statistic). The asymptotic distribution of the F-statistic is nonstandard under the null hypothesis of no cointegration relationship between the examined variables, irrespective of whether the explanatory variables are purely I(0) or I(1). The test statistics can be derived considering a restricted error-correction model (RECM) by excluding the lagged level variables, $\ln Y_{t-1}$, $\ln Y_{t-1}$ and $\ln Z_{t-1}$ from unrestricted error-correction model (UECM). More formally, we perform a joint significance test (Wald test), where the null and alternative hypotheses are:

$$H_0 : b_4 = b_5 = b_6 = 0$$

$H_1: b_4 \neq b_5 \neq b_6 \neq 0$

The bounds test procedure for cointegration analysis assumes a uniqueness of the cointegrating vector compared to system-based for multivariate vectors as in Johansen approach. The asymtotic critical value bounds for the F-statistic are cited in Pesaran *et al.* (2001, p. 300-301, Table CI(i)-(v)). For some significance level, if the computed F-statistic exceeds the upper critical value, I(1) then reject the null hypothesis. If the computed F-statistic falls below the lower critical value, I(0), the null hypothesis of no cointegration cannot be rejected. When we find that the computed F-statistic falls between the upper and lower bounds, a conclusive inference cannot be made without knowing the order of integration of the regressors.

From the estimated UECM, the long-run elasticities are the coefficient of the one lagged explanatory variables (multiplied by a negative sign) divided by the coefficient of the one lagged dependent variable (Bardsen, 1989). Thus, the long-run elasticities are $-(b_5/b_4)$ and $-(b_6/b_4)$ (Y's elasticity on X and Y's elasticity on Z, respectively). The short-run effects are captured by the coefficients of the first differenced variables in equation (2).

All data are quarterly and span from 1986Q4 to 2005Q2.[4] The land price series is obtained from the Korea Land Corporation and is seasonally adjusted. For the stock prices, Korea Stock Exchange (KSE)'s index, called as KOSPI (Korea Composite Stock Price Index), is employed. KOSPI is a price-weighted index based on an aggregate market value using a base date of January 4, 1980 and a base index of 100. The yield rates of 3 year maturity corporate bond are used for interest rates. Stock prices and bond yields are borrowed from the database reported by the Bank of Korea.

Ⅳ. EMPIRICAL RESULTS

4.1 Unit Root Test

Before testing whether the three time series are cointegrated, we investigate the order of integration of each series using four alternative testing procedures. In addition to traditional unit root tests such as ADF and PP tests, Zivot and

[4] The land price series is available only from the fourth quarter of 1986.

Andrews (1992) and Harvey *et al.* (2001) unit root tests (which consider structural breaks) are performed. In Table 1, the results of the unit root test depend on the methodology adopted, even though both ADF and PP tests generate similar results for all data series. While the stock price index (ln KOSPI) in level is stationary only at the 10% significant level based on the results of ADF, PP and Zivot and Andrews tests, the series is not stationary according to the Harvey *et al.*' unit root test. Moreover, there is an inconsistency among traditional tests (ADF and PP tests), Zivot and Andrews test, and Harvey *et al.* unit root test. The traditional tests do not support stationarity in the bond yield series, whereas the latter tests produce the weak stationarity result in the series. For the land price series, all four tests show consistent results of I(1). In addition to this informative result on the unit root tests, the fact that our empirical study relies on a small sample size also supports the bounds testing approach in order to verify the long-run relationship among the variables.[5] On the other hand, the results of the unit root test, considering structural break, show that most of the structural breaks in the time-series data occurs around the time of the Korean economic crisis. This finding corroborates the fact that there exist considerable structural changes in both the real estate and financial markets in Korea due to the aftermath of the economic crisis.

[Table 1] Unit root test

	Without structural break		With structural break			
	ADF	PP	Zivot and Andrew		Harvey, Leybourne, and Newbold	
ln KOSPI	-3.427*	-3.280*	-4.954*	(1997Q3)	-3.727	(2000Q1)
ln Bond yield	-2.626	-1.735	-4.911*	(1997Q3)	-4.876**	(1997Q2)
ln Land price	-2.967	-2.536	-4.257	(2002Q2)	-3.850	(1998Q1)
Δ ln KOSPI	-6.189 ***	-6.272***	-6.968***	(1998Q3)	-6.340***	(1990Q4)
Δ ln Bond yield	-6.638 ***	-6.199***	-7.044***	(1998Q1)	-6.638***	(1993Q3)
Δ ln Land price	-3.535 **	-3.582**	-6.115***	(1991Q3)	-5.836***	(1994Q1)

Note: The standard unit root test is based on $(1-L)y_t = \alpha + \beta t + (\rho - 1)y_{t-1} + \Sigma_{i=1}^{m}\gamma_i(1-L)y_{t-i} + \varepsilon_t$. The unit root test which consider structural break is based on $y_i = \mu + \theta DU(\lambda) + \beta t + \gamma DT(\lambda) + \alpha y_{t-1} + \Sigma_{i=1}^{m} c_i(1-L)y_{t-i} + \varepsilon_t$. The (yyyy/qq) refers to break points. The appropriate lag lengths were determined by the Schwarz Info Criterion. *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level. Critical Value: -5.57(1%), -5.08(5%), -4.82(10%) for Zivot and Andrews; -4.99(1%), -4.50(5%), -4.22(10%) for Harvey, Leybourne, and Newbold.

[5] The advantages of bounds test minimize the problems.

4.2 Regression Analysis

In selecting an approximate lag length (n) for the unrestricted error correction model (UECM) estimate, a set of UECMs was estimated with lag length of four. However, for sub-period tests, a higher order of lag structure was not feasible given that the period after the foreign exchange crisis had only 26 quarterly observations. As a result, suitable lag-length selections are required, which minimize the Akaike information criterion (AIC) and the Schwartz criterion (SC). A parsimonious UECM is desirable to ascertain the explanatory variable to be included in the model. The general UECM was tested downwards sequentially to arrive at a parsimonious equation. In selecting a specific model, all the first differenced variables with a relatively small absolute t-value (less than one) were dropped sequentially. A parsimonious UECM is estimated and reported in Table 2 through Table 4.

Most models passed a battery of diagnostic tests. However, for whole period data, when land price is the dependent variable the residuals follow autoregressive conditional heteroskedasticity (ARCH). The magnitude of the residuals appears to be related to the magnitude of recent residuals. However, ARCH in itself does not invalidate standard least square (LS) inference. Only, ignoring ARCH effects may result in loss of efficiency. One problem with time series regression models is that the estimated parameters may change over time. Unstable parameters can result in model misspecification and, if left undetected, have the potential to bias the results. To account for this, here, we examine whether the estimated coefficients are stable over time or not. To do this we apply the cumulative sum of recursive residuals of square (CUSUMSQ). Figure 1 shows the plots of CUSUMSQ tests. The results for most models show that the estimated coefficients are stable over each sample period. An exception is when bond yield is the dependent variable with whole period data (i.e., graph (g) in Figure 1). This result may suggest that the sub-period test is more useful, particularly when bond yield is the dependent variable.

To verify the presence of a long-run equilibrium relationship among land prices, stock prices and bond yields, a joint significance test (Wald test) for $H_0: b_4 = b_5 = b_6 = 0$ was performed. We first analyze the results of the bounds test for the whole period (1986Q4-2005Q2), which are presented in the second columns of Table 2 through Table 4. When land price is the dependent variable as shown in Table 2, the calculated F-statistic, 8.55, is higher than the upper bound critical value of 4.85 at the 5% significant level. This suggests that the null hypothesis of no cointegration cannot be accepted and that there exists a cointegration relationship among land prices, stock prices and interest rates over whole sample period. Table 2 also shows that the land price series is positively adjusted by the stock price in the long-run. In addition, the estimated long-run elasticity of stock price is 0.489 and is statistically significant at the 1% level. The cointegration relations, however, are not found when the stock price and interest rate are the dependent variables as in the second columns of Table 3 and 4. Meanwhile, the land and stock prices have a significant positive relation with each other in the short-run during the whole period as shown in Table 2 and 3.

[Table 2] Estimated preferred UECM (dependent variable: Land price)

	Whole period (1986Q4-2005Q2)	Period I (1986Q4-1997Q3)	Period II (1999Q1-2005Q2)
Constant	0.082 (1.358)	0.062 (0.595)	0.438 (1.255)
Δ ln Land $_{t-1}$	0.533 (6.303)***	0.255 (1.724) *	0.537 (2.902) ***
Δ ln Land $_{t-3}$	---	0.274 (2.010) **	---
Δ ln KOSPI $_{t}$	0.048 (3.003) ***	0.030 (0.965)	0.022 (1.718) *
Δ ln KOSPI $_{t-1}$	-0.037 (-2.410) **	---	---
Δ ln Bond $_{t}$	---	0.005 (-0.123)	-0.027 (-1.285)
Δ ln Bond $_{t-1}$	-0.040 (-1.981) **	---	---
ln Land $_{t-1}$	-0.061 (-5.049) ***	-0.063 (-3.653) ***	-0.111 (-1.412)
ln KOSPI $_{t-1}$	0.030 (3.041) ***	0.023 (1.712) *	0.018 (1.658)
ln Bond $_{t-1}$	-0.001 (-0.126)	0.026 (0.993)	-0.027 (-0.390)
(Diagnostic tests)			
R^2	0.748	0.820	0.488
Adjusted R^2	0.721	0.783	0.327
Durbin-Watson	2.361	2.360	1.894
$\chi^2_{Auto}(2)$	4.152	1.073	1.252
$\chi^2_{ARCH}(1)$	4.553**	0.485	0.247
$\chi^2_{RESET}(2)$	4.651	1.624	0.182
Computed F-statistic	8.555	5.424	1.018
($H_0: b_4 = b_5 = b_6 = 0$)	(cointegrated)	(cointegrated)	(not cointegrated)
Long-run Elasticities			
KOSPI	0.489 (3.668) ***	0.371 (2.050) **	---
Bond	-0.100 (-0.126)	0.416 (1.153)	---

Note: Critical value bounds at 5% level - Lower: 3.79 and Upper: 4.85 (two regressors and no trends in the model) from Pesaran *et al.* (2001, p.300), Table C1(iii) Case (III). The critical values for $\chi^2(1) = 3.84$ and $\chi^2(2) = 5.99$ at 5% significance level. *** indicates significant at 1% level; ** indicates significant at 5% level; * indicates significant at 10% level. The numbers in parenthesis refer to t-statistics.

[Table 3] Estimated preferred UECM (dependent variable: KOSPI)

	Whole period (1986Q4-2005Q2)	Period I (1986Q4-1997Q3)	Period II (1999Q1-2005Q2)
Constant	1.052 (2.672) ***	1.448(3.526) ***	3.645 (0.619)
Δ ln KOSPI $_{t-1}$	0.185 (1.611)	---	0.159 (0.744)
Δ ln KOSPI $_{t-2}$	---	0.251 (1.758) *	---
Δ ln KOSPI $_{t-3}$	---	0.362 (2.369) **	---
Δ ln KOSPI $_{t-4}$	---	0.294 (1.947) *	---
Δ ln Land $_{t}$	2.561 (3.278) ***	1.484 (1.712) **	1.421 (0.486)
Δ ln Land $_{t-1}$	-1.319 (1.856) *	0.943 (1.151)	---
Δ ln Bond $_{t}$	---	-0.585 (-2.872) ***	0.612 (1.870) *
Δ ln Bond $_{t-1}$	---	---	---
Δ ln Bond $_{t-2}$	-0.295 (-1.982) **	---	---
Δ ln Bond $_{t-3}$	-0.271 (-1.806) *	---	---
ln KOSPI $_{t-1}$	-0.192 (-2.944) ***	-0.320 (-3.531) ***	-0.253 (-1.237)
ln Land $_{t-1}$	0.046 (0.475)	0.358 (2.138) **	-0.341 (-0.244)
ln Bond $_{t-1}$	-0.005 (-0.143)	-0.364 (-2.838) ***	-0.229 (-0.668)
(Diagnostic tests)			
R^2	0.460	0.574	0.572
Adjusted R^2	0.393	0.454	0.421
Durbin-Watson	2.114	1.699	2.521
$\chi^2_{Auto}(2)$	0.319	2.277	3.101
$\chi^2_{ARCH}(1)$	1.711	0.905	0.825
$\chi^2_{RESET}(2)$	0.028	0.077	0.205
Computed F-statistic	4.065	5.915	1.645
($H_0: b_4 = b_5 = b_6 = 0$)	(inconclusive)	(cointegrated)	(not cointegrated)
Long-run Elasticities			
Land	0.240 (0.524)	1.117 (3.683) ***	---
Bond	-0.025 (-0.143)	-1.138 (-3.587) ***	---

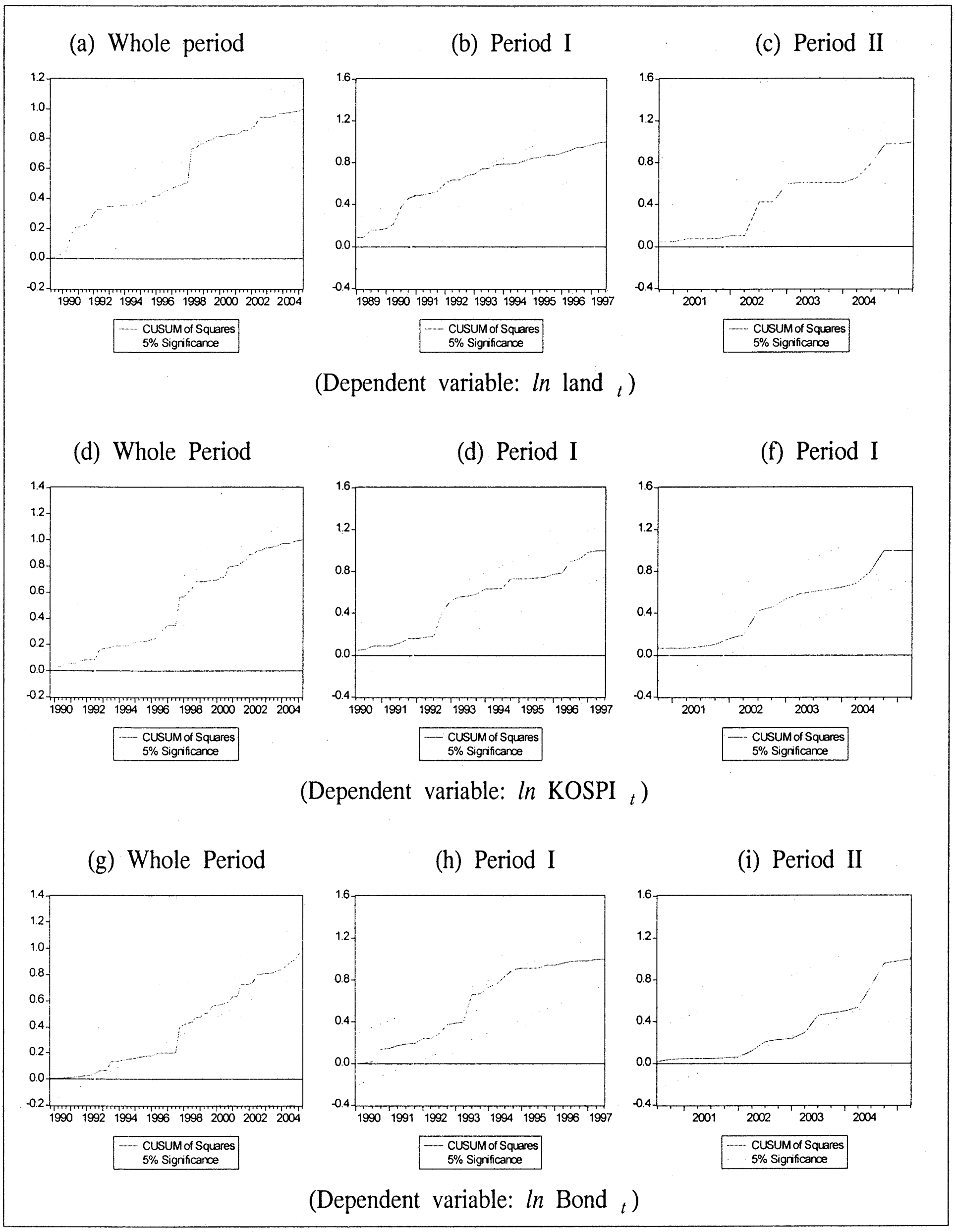
Note: Critical value bounds at 5% level - Lower: 3.79 and Upper: 4.85 (two regressors and no trends in the model) from Pesaran *et al.* (2001, p.300), Table C1(iii) Case (III). The critical values for $\chi^2(1) = 3.84$ and $\chi^2(2) = 5.99$ at 5% significance level. *** indicates significant at 1% level; ** indicates significant at 5% level; * indicates significant at 10% level. The numbers in parenthesis refer to t-statistics.

[Table 4] Estimated preferred UECM (dependent variable: Bond yield)

	Whole period (1986Q4-2005Q2)	Period I (1986Q4-1997Q3)	Period II (1999Q1-2005Q2)
Constant	-0.261 (-0.818)	0.408 (1.160)	8.622 (2.632) **
Δ ln Bond $_{t-1}$	0.358 (3.011) ***	0.456 (2.868) ***	-0.056 (-0.327)
Δ ln KOSPI $_{t}$	---	-0.330 (-3.114) ***	0.208 (1.761) *
Δ ln KOSPI $_{t-1}$	---	0.114 (1.121)	---
Δ ln KOSPI $_{t-4}$	-0.173 (-1.924) **	---	---
Δ ln Land $_{t}$	---	0.882 (1.547)	-2.111 (-1.061)
Δ ln Land $_{t-1}$	0.257 (0.483)	---	---
ln Bond $_{t-1}$	-0.146 (-2.208) **	-0.439 (-3.579) ***	-0.513 (-2.848) ***
ln KOSPI $_{t-1}$	0.093 (1.583)	-0.033(-0.585)	0.359 (3.393) ***
ln Land $_{t-1}$	0.030 (0.325)	0.251 (2.291) **	-2.231 (-3.158) ***
t	-0.003(-2.159) **	0.005(2.695) **	
(Diagnostic tests)			
R^2	0.331	0.488	0.540
Adjusted R^2	0.259	0.364	0.465
Durbin-Watson	1.956	2.265	1.893
$\chi^2_{Auto}(2)$	0.107	0.894	1.491
$\chi^2_{ARCH}(1)$	2.196	1.055	0.015
$\chi^2_{RESET}(2)$	3.958	0.061	1.564
Computed F-statistic	3.375	4.659	5.018
($H_0: b_4 = b_5 = b_6 = 0$)	(not cointegrated)	(not cointegrated)	(cointegrated)
Long-run Elasticities			
KOSPI	---	---	0.699(2.656) ***
Bond	---	---	-4.351(-9.417) ***

Note: Critical value bounds at 5% level - Lower: 3.79 and Upper: 4.85 (two regressors and no trends in the model), and Lower: 4.87 and Upper: 5.85 (two regressors and trends in the model) from Pesaran et al. (2001, p. 300), Table C1(iii)-C1(v). The critical values for $\chi^2(1)=3.84$ and $\chi^2(2)=5.99$ at 5% significance level. *** indicates significant at 1% level; ** indicates significant at 5% level; * indicates significant at 10% level. The numbers in parenthesis refer to t-statistics.

[Figure 1] Plots of the CUSUM of squares



There exist short-run negative relationships between the stock price and bond yield as in the second columns of Table 3 and 4. The second column of Table 2 also reveals that the land price is negatively related to the bond yield in the short-run, but not vice versa as in the second column of Table 4. As stated previously, these results generally appear to be in line with the traditional financial theory in explaining the relationships among the variables. Namely, the empirical findings during the whole sample period can be summarized as follows: a positive relationship between the stock price and land price; a negative relationship between the stock price and bond yield; and an inverse relation between the land price and bond yield. According to the conventional viewpoints, interest rate reflects the borrowing costs of firms or individuals for financing. Therefore, an increase in financing costs stemming from a rise in the interest rate has a negative impact on valuing the stocks by investors, which could lower the stock price itself. An increased financial cost also reduces the investment (i.e., demand) on real estates and leads to a decrease in the real estate prices.

The outbreak of the Korean economic crisis in 1997 had enormous impacts on all economic sectors. The economic crisis has brought about structural changes especially in both the financial and real estate markets in step with financial liberalization and the deregulation associated with real estates since 1998. In this regard, it would be meaningful to examine the direct contribution of the Korean economic crisis to the relationships among the financial variables. To this end, we analyze the empirical findings of the present study by giving attention to the structural changes in the financial and real estate markets before and after the periods of the economic crisis.

As shown in Table 2, the land price is positively adjusted, in the long-run, by the changes in the stock price before the Korean economic crisis whilst this positive long-run relation does not hold during the second sub-sample period. Instead, the only short-run positive relation is found during the second sub-sample period. Both the short-term and long-term explanatory powers of bond yields on land price are not statistically significant in the two sub-periods. Regardless of the insignificant effect of bond yields on land prices, the relationship between land prices and bond yields has changed from positive to negative after the economic crisis in both the short-run and long-run (i.e., Period I and II in Table 2). This seems to reflect, to some degree, the capital flow into the real estate market due to the record-low interest rate during the recent few years in Korea.

On the other hand, the effects of both land prices and bond yields on stock prices are found in Table 3. Before the Korean economic crisis, there exists a significant positive relationship between the stock and land prices in the short-run as well as in the long-run. Land prices, however, have no more explanatory power on the stock prices in both short-run and long-run in the second sample period, which contrasts with the finding of significant positive effect of stock prices on land prices after the economic crisis as shown in Table 2. This change in explanatory power of land prices on stock prices implies the globalization in the Korean stock market after the economic crisis. Thus, other economic factors, rather than real estate, are more likely to affect the movement of stock prices. In short, the relationship between land and stock prices is in favour of the "credit-price effect" before the economic crisis whilst the "wealth effect" is dominant after the period of the crisis. Meanwhile, the stock price was negatively influenced by the bond yield in the short-run as well as in the long-run before the economic crisis. In contrast, the stock price was positively affected by the bond yield in the short-run in the second sample period, suggesting that the effect of alternative investment assets between stocks and bonds was found after the economic crisis. This result is consistent with the findings of Chang (2005).

Table 4 shows the long-run and short-run effects of both land and stock prices on the bond yields. Only short-run negative effect of stock prices is found in Period I, whereas there is evidence of positive long-run as well as short-run effects of stock prices on the bond yields in Period II. This result indicates the relationship between the stock prices and the bond yields has changed from negative to positive about the time of the Korean economic crisis.

Meanwhile, the results of cointegration relationships among the three markets are mixed in two sub-sample periods. When the land and stock prices are dependent variables, the three markets are cointegrated only in the first sample period whereas there exists a unique cointegration relation in the second sample period when the bond yield is the dependent variable.

We found an interesting feature in the stock price and the bond yield equations (i.e., Period I and II in both Table 3 and 4). In both cases, the negative relationship between the two variables has changed to positive one. As stated earlier in this paper, the positive relationships between the stock price and bond yield have been recently observed in the international markets. This would reflect the fact that stocks and bonds have been alternatively invested more than they did before the crisis as financial capital has been increasingly floating due to globalization of the international financial markets. Bearing in mind the caveat that bonds tend to be more attractive to investors as an alternative investment asset as stock prices decrease, the positive relationship between stock prices and bond yields could be valid. This feature seems to apply to the Korean financial markets because international capital has been allowed to inflow much more freely and thus mutual-fund markets (including equity type, bond type, and hybrid type) have been remarkably activated after the Korean economic crisis.

Another interesting feature is found in the relationship between the stock and land markets. For the whole sample period, land prices are more affected by stock prices, compared to the effect of land prices on stock prices. However, considering the periods before and after the economic crisis, the results generate different relations between the two assets. Before the economic crisis, the finding of a significant positive channel from the land to stock prices in both short-run and long-run implies that the two asset markets was predominated by the "credit-price effect". On the other hand, after the economic crisis, the land price is influenced by the stock price in the short-run but no more effect of land price on the stock price is found. Consequently, this converse channel from the stock to land prices supports that the "wealth effect" is prevailing in the two asset markets. This short-run impact of stock prices on land prices could be understood by the transmission channel of portfolio diversification from stock to real estate markets. Namely, when a nation's economy is in the recovery phase, the capital usually flows into the financial markets like stock market, and then into the real estate markets.

Ⅴ. CONCLUSION

During the last two decades, there have been drastic changes in both the financial and real estate markets in Korea, due to the liberalization of the markets and the impact of the economic crisis on the markets. Considering these features, this paper uses a recently developed cointegration technique - the bounds testing approach - to test for long-run and short-run relationships among the real estate, stock and bond markets. We also examined the contribution of the Korean economic crisis to the changes in nexus among the three markets. Overall, the results point to several conclusions as follows.

For the entire sample period, our findings generally appear to be in line with the conventional viewpoints and with the previous researches in explaining the relationships among the variables on the following grounds: a positive relation between the stock price and land price; a negative relation between the stock price and bond yield; and an inverse relation between the land price and bond yield. According to the traditional finance theory, interest rate reflects the borrowing costs of firms or individuals for financing. Therefore, an increase in the financing costs stemming from a rise in the interest rate has a negative impact on valuing the stocks by investors, which could lower the stock price itself. An increased financial cost also reduces the investment on real estates and leads to a decrease in the real estate prices.

However, when we analyze the empirical findings based on the sub-sample tests, different relations among the three asset markets are found as follows. First, the negative relationship between stock price and bond yield before the economic crisis has changed into a positive one in the second sample period. This implies that stocks and bonds have been alternatively invested more than they did before period of the crisis as international financial capital has been increasingly flowing into the domestic financial markets. A positive relationship between stock prices and bond yields would be clarified as stock and bond perform well a role of an alternative asset, and as investors' money is actively moved across the two markets. For instance, a drop in interest rate could be the result of increased risk or/and precautionary saving as investors substitute away from risky assets (e.g., stocks) into less risky assets (e.g., bonds or real estates).

Second, during the first sample period, the land price is an important determinant of stock price, while the land price has no more explanatory power on the stock price in both long-run and short-run after the period of the Korean economic crisis. In contrast, land price is influenced by the stock price after the economic crisis. Put differently, the relationship between the land and stock prices is in favour of the "credit-price effect" before the economic crisis whereas the "wealth effect" is dominant after the period of the crisis. This finding seems to reflect the fact that there exists a transmission channel of the short-run portfolio diversification from stock to real estate markets during the second sample period.

Third, the relationship between land prices and bond yields has changed from positive to negative after the economic crisis in both the long-run and short-run although the effects of the bond yields on land prices are not significant. To some degree, this seems to reflect the capital flow into the real estate market due to the record-low interest rate during the recent few years in Korea. In fact, the recent low interest rate led to more investment in real estates by increasing the leverage ratio.

The findings of this study will be useful to policy makers and portfolio managers. Especially, under the rapidly changing markets' circumstances caused by financial liberalization and deregulation, scrutiny into the altered nexus among stocks, bonds, and real estates could be helpful in deliberating appropriate measures in terms of government policy and portfolio strategy. For instance, the finding of positive relationship between stocks and bond yields suggests that the two assets can be combined in a portfolio to hedge the otherwise potential risky investment. Finding that a boom in stock market is transmitted to a boom in real estate market also gives an important strategic means to the portfolio managers seeking maximum profit asset allocation.

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