Housing and Stock Market Returns: An Application of GARCH Enhanced VECM

Emmanuel Anoruo and Habtu Braha***

This paper examines the relationship between housing and stock market returns for the United States using the cointegration analysis and the GARCH enhanced VECM. The results suggest that the two series are cointegrated. The results from the GARCH enhanced VECM indicate the presence of spillover effect from the stock market to the housing market but not vice versa. Taken together, the results provide evidence in support of the notion that the two markets are integrated rather than segmented. The findings of cointegration and spillover effect between the two series suggest that investors and portfolio managers cannot achieve risk reduction associated with diversification by jointly holding assets in real estate and stock markets.

Introduction

The relationship between housing and stock returns is important to portfolio managers and investors. Diversification enables portfolio managers and investors to reduce risk by investing in various asset classes including stocks and real estate. If the stock and housing markets were integrated, holding the two assets in the same portfolio will not offer investors the benefit (i.e., risk reduction) associated with diversification. However, if the two markets were segmented, holding both assets in the same portfolio would enable the investors to reduce risk through diversification.

A number of studies have examined the relationship between the stock market and housing market returns and produced mixed results. For instance, Chang *et al*. (2005) using the Johansen and Juselius (1990), the Engle-Granger (1987), and the Geweke and Porter-Hudak (1983) cointegration procedure, conclude that there is no long-run relationship between real estate and stock market in Taiwan. Wilson and Okunev (1999) using fractional integration techniques failed to find evidence in support of cointegration between real estate and stock markets for the United States and the United Kingdom. However, the authors find evidence of fractional integration in the case of Australia. Okunev and Wilson (1997) using non-linear

* Professor of Economics and Finance, Department of Management Science and Economics, Coppin State University, Baltimore, USA. He is the corresponding author. E-mail: eanoruo@coppin.edu

** Professor of Economics, Department of Management Science and Economics, Coppin State University, Baltimore, USA. E-mail: hbraha@coppin.edu

cointegration test examined the long-run relationship between real estate and stock markets in the United States. They find evidence of non-linear relationship between real estate and stock markets. Ansari (2006) using cointegration analysis and the vector error correction model, found negative relationship between real estate and stock markets in the United States. Based on this finding, he concluded that the real estate and stock markets are substitutes.

Liow *et al.* (2005) used the Johansen and Juselius (1990) cointegration tests to examine the long-run relationship between four Asian property stock markets of Japan, Hong Kong, Singapore and Malaysia, and four European property stock markets of UK, France, Germany and Italy. In addition, the authors using the EGARCH procedure examined the volatility spillover among the markets. They found evidence of weak long-run relationships among the property stock markets. Further, the authors failed to find evidence in support of volatility spillovers among the property stock markets. Geltner (1990), Liu *et al.* (1990), and Miles *et al.* (1990), claim that the real estate and stock markets are segmented. However, Ambrose *et al.* (1992), and Gyourko and Kleim (1992) provide evidence in support of integration between the real estate and stock markets.

Unlike the previous studies that mostly applied the fractional integration approach, the present study contributes to the debate by utilizing the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) enhanced Vector Error Correction Model (VECM) to broaden our understanding regarding the relationship between the real estate and stock markets in the United States. In addition, the study implements both the Engle-Granger (1987) and the Johansen and Juselius (1990) cointegration procedures to determine whether the housing and stock markets are integrated or segmented.

Methodology

This study employs cointegration and an enhanced Vector Error Correction Model (VECM) to investigate the long-run relationship between the Housing Market Returns (HMR) and Stock Market Returns (SMR). The time series properties of housing and stock market returns are examined through the modified Dickey-Fuller (Dickey and Fuller, 1981) test proposed by Elliott *et al.* (1996). Elliott *et al.,* have shown that the DF-GLS unit root test has better finite-sample properties than the conventional Augmented Dickey-Fuller (ADF) procedure. In other words, unlike the standard ADF unit root test, the DF-GLS does not suffer from lower power. The study adopts the following equation for the DF-GLS unit root procedure:

$$\Delta y_t^d = \alpha_0 y_{t-1}^d + \sum_{j=1}^{m} \beta_j \Delta y_{t-j}^d + \mu \qquad \text{...(1)}$$

where p is the maximum lag, y_t^d represents locally de-trended series of y_t (i.e., $y_t^d = y_t - z_t\tilde{\beta}$), where $z_t = (1, t)$ and $\tilde{\beta}$ is the regression of $\hat{y}$ on ž). The Modified Akaike Information Criterion (MAIC) (Ng and Perron, 2001) is used to determine the maximum lag lengths. Under the DF-GLS unit root test, the null hypothesis is that $\alpha_0 = 0$, while the alternative hypothesis is $\alpha_0 < 0$. In addition to the DF-GLS, the modified Phillips-Perron unit tests proposed by Ng and Perron (1995 and 2002) are also implemented. The MAIC is used to determine the optimal lag (m) in Equation 1.

For cointegration, this study first applies the Engle and Granger (1987) two-step cointegration test procedure. The Engle and Granger method is adopted because it avoids the spurious regression problem of the standard ordinary least squares. The procedure requires that one of the non-stationary series be regressed on the other. The residual from the cointegrating equation is recovered and tested for stationarity. If the residual is found to be stationary, the two time series are said to be cointegrated. The regression equation for ADF cointegration tests takes the following form:

$$\Delta \varepsilon_t = \rho \varepsilon_{t-1} + \sum_{i=1}^{n} \beta_i \Delta \varepsilon_{t-1} + \varpi_t \qquad ...(2)$$

where ε_t represents the residual recovered from the cointegrating equation, and ϖ_t is the random error term. In Equation 2, the null hypothesis of no cointegration between the series in the model is rejected if the regression coefficient on ε_{t-1} (i.e., ρ) is negative and statistically significant at the conventional levels.

To complement the results from the Engle-Granger cointegration tests, the study applies the Johansen and Juselius (1990) and Johansen (1991) system based cointegration tests to determine the existence of a long-term relationship between HMR and SMR. The Johansen and Juselius cointegration tests are based on the following VECM:

$$\Delta Y_t = k + \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-1} + z_t \qquad ...(3)$$

where Δ is the difference operator, p denotes the lag-length, Y_t is a vector of endogenous variables (HMR_t and SMR_t), k contains all the deterministic elements, Γ_1, ..., Γ_{p-1} and Π are coefficient matrices, and z_t is a vector of white noise processes. In Equation 3, the optimal lag (p) is selected to make sure that the error terms are independent and identically distributed. The Johansen and Juselius system-based cointegration framework provides two likelihood ratio test statistics including the trace test and the maximum eigenvalue test.

If the eigenvalues indicate the presence of a cointegrating vector, a VECM that describes the systematic disequilibrium adjustment process between housing and stock market returns can be developed. Instead of the conventional VECM, this paper implements the GARCH enhanced VECM. This particular framework controls for long-run restrictions and short-run dynamic relationships between series in the model. It also allows the second moment of the distribution to change through time. The GARCH-in-Mean (GARCH-M) model is applied to simultaneously estimate the mean and variance processes. Under the GARCH procedure, the first moment is generally modeled with a bivariate error correction model. However, the second moment is modeled with a bivariate constant correlation GARCH procedure. The GARCH-M framework is predicated on the notion that the conditional correlations are constant overtime, to ensure that the fluctuations in the conditional covariances are caused by innovations in the two conditional variances. The following system of equations is estimated to obtain the parameters in the model:

$$\Delta HMR_t = \alpha_c + \sum_{i=1}^{k} \beta_i \, \Delta HMR_{t-i} + \sum_{i=1}^{k} \gamma_i \, \Delta SMR_{t-i} + \lambda_{HMR} \, z_{t-1} + \phi_{HMR} \, \Delta h_{HMR,t}^{1/2}$$

$$+ \eta_{SMR} \, \Delta h_{SMR,t}^{1/2} + \varepsilon_{HMR,t} \qquad \text{...(4)}$$

$$\Delta SMR_t = \alpha_f + \sum_{i=1}^{k} \delta_i \, \Delta HMR_{t-i} + \sum_{i=1}^{k} \tau_i \, \Delta SMR_{t-i} + \lambda_{SMR} \, z_{t-1} + \phi_{HMR} \, \Delta h_{HMR,t}^{1/2}$$

$$+ \eta_{SMR} \, \Delta h_{SMR,t}^{1/2} + \varepsilon_{SMR,t} \qquad \text{...(5)}$$

$$h_{HMR,t} = \theta_{HMR} + \mu_{HMR} \, \varepsilon_{HMR,t-1}^{2} + \psi_{HMR} \, h_{HMR,t-1} + \varsigma_{HMR,t} \qquad \text{...(6)}$$

$$h_{SMR,t} = \theta_{SMR} + \mu_{SMR} \, \varepsilon_{SMR,t-1}^{2} + \psi_{SMR} \, h_{SMR,t-1} + \varsigma_{SMR,t} \qquad \text{...(7)}$$

$$\rho = h_{HMR,SMR,t} \, (h_{HMR,t} \, h_{SMR,t})^{-1/2} \qquad \text{...(8)}$$

where z_{t-1} is the error correction term which imposes the long-run restrictions, $h^{1/2}_{HMR,\ t}$ is the conditional standard deviation of HMR at time *t*, $h^{1/2}_{\mathrm{SMR},\ t}$ is the conditional standard deviation of SMR at time *t*, $h_{SMR,\ HMR,\ t}$ is the conditional covariance at time *t*, ε_{HMR} and ε_{SMR} are the error terms, and *k* is the optimal lag-length (determined to be one in this study) that is obtained by minimizing the AIC (Akaike 1973). The parameters are obtained by implementing a quasi (normal)-maximum likelihood estimation procedure. Engle and Bollerslev (1986) indicate that the starting values for the conditional variance process (i.e., h_t) should be equal to the unconditional variance.

The use of the VECM enables the researcher to detect important feedback relationships that may exist between HMR and SMR. Most importantly, the VECM allows causality to emerge from two different channels including the sum of the regression coefficients on the lagged variables and the lagged error correction term. The utilization of the GARCH-M methodology enhances the validity of the results, since the GARCH term in this model controls for potential confounding effects by accounting for the impact of immediate changes in volatility on the dependent variable. The application of the GARCH enhanced VECM is important in determining volatility spillover between the HMR and SMR series. Volatility spillover effects are incorporated by introducing $h^{1/2}{}_{HMR,\ t}$ and $h^{1/2}{}_{SMR,\ t}$ terms in the conditional mean equations.

Data and Summary Statistics

The data on house price index used in this study were collected from the Office of Housing Enterprise Oversight website http://www.ofheo.gov. The stock market data were obtained via http://www.financeyahoo.com. The data consist of quarterly observations on housing and the S&P 500 indexes for the United States, covering the period, 1975:1 to 2005:4. The conditional volatility measures for housing and stock markets were obtained through the

GARCH process. The conditional standard deviations from the GARCH process for housing and stock markets are recovered and used as volatility indicators. The volatility measures obtained through the GARCH process have been shown to perform better than those obtained from other procedures such as, the standard deviation of the series.

Table 1 furnishes the summary statistics for housing and stock market returns (calculated as percentage changes). The mean values for housing and stock market returns are approximately 1.507 and 2.407. The housing returns varied from a minimum of –0.953% to a maximum of 4.544% in the period under consideration. The stock market returns fluctuated from a maximum of 18.087% to a minimum of –26.373%. The standard deviations for SMR and HMR—6.494% and 1.026% respectively—reveal that the stock market return series fluctuated more from the mean than the housing market returns, during the study period. The data reveal that the housing returns are positively skewed, while the stock market returns are negatively skewed.

Table 1: Summary Statistics

	HMR	SMR
Mean	1.507	2.407
Maximum	4.544	18.087
Minimum	–0.953	–26.373
Std. Dev.	1.026	6.494
Skewness	0.468	–0.531
Kurtosis	3.300	5.441
Jarque-Bera	4.942	36.329
Probability	0.085	0
Observations	123	123

Note: HMR = Housing Market Returns; and SMR = Stock Market Returns.

Empirical Results

The empirical aspect of the study consists of first testing for unit root using the DF-GLS to determine the time series properties of housing and stock market returns. Second, testing for long-run relationship between the housing and stock market series using the Engle-Granger two-step procedure and the Johansen and Juselius (1990) cointegration framework. Third, the short-run and long-run dynamics between the time series are examined through modified VECM. Table 2 presents the unit root test results obtained from DF-GLS method. The maximum lags were determined by application of MAIC (Ng and Perron, 2002). A constant and time trend were included in the equation for the DF-GLS unit root procedure. The results indicate that housing and stock market returns are not stationary in their levels. However, they are stationary at 5% level of significance after first differencing. In all, the unit root tests indicate the order of integration to be one for both housing and stock market returns.

Table 2: Modified Dickey-Fuller (DF-GLS) Unit Root Test Results

Series	Level	Lag(s)	Difference	Lag(s)
HMR	–2.11	2	-3.89^{**}	1
SMR	–2.74	4	-3.76^{**}	2

Note: ** implies rejection of the null hypothesis of unit root at 5% level. The 5% critical value is –3.01. The MAIC was used to determine the lag lengths. HMR – Housing Market Returns, and SMR – Stock Market Returns.

Since the housing and stock market return series both have one order of integration, the study next applies the standard Engle-Granger cointegration procedure to determine the long-run relationship between housing and stock market returns. As postulated by Engle and Granger (1987), Equation 2 is implemented in both direct and reverse orders to ensure completeness. Table 3 presents the Engle-Granger cointegration test results. The result obtained from the direct regression is presented in Panel A of Table 3. The test statistic of –1.75 is less than the critical value of –3.398 at 5% level. In contrast, the result from the reverse regression displayed in Panel B, suggests that the housing and stock market returns are cointegrated at the 5% level. The computed value (–4.72) is greater than the critical value (–3.398) at 5% level.

Table 3: Engle-Granger Two-Step Cointegration Test Results

	t-Stat.	Lags
Panel A: Direct Regression: Dependent Variable *HMR*	−1.75	5
Panel B: Reverse Regression: Dependent Variable *SMR*	−4.72**	5

Note: ** indicates rejection of the null hypothesis of no cointegration at 5% level. The 5% critical value is −3.398 taken from the MacKinnon (1991). HMR – Housing Market Returns, and SMR – Stock Market Returns.

Given the mixed results provided by the Engle-Granger two-step cointegration procedure, the study next implements the Johansen and Juselius (1990) and Johansen (1991) cointegration frameworks. Table 4 presents results from the Johansen and Juselius cointegration tests. As can be seen from Table 4, the trace and maximum eigenvalue cointegration test results reject the null hypothesis of no cointegration (i.e., $r = 0$) between housing and stock market returns. The computed test statistics of the trace and maximum eigenvalue 27.47 and 25.05, respectively are greater than the critical values 20.26 and 15.89 at 5% level of significance. These results support the result obtained from the reverse regression of the Engle-Granger procedure. We subsume from the results obtained from the two different procedures that housing and stock market returns are integrated rather than segmented. This result implies that risk reduction cannot be achieved by holding both assets in the same portfolio. This finding is consistent with Ambrose *et al.* (1992) and Gyourko and Kleim (1992) who maintain that the real estate and stock markets are integrated.

Table 4: Johansen Bivariate Cointegration Test Results

Null Hypothesis	**Trace Test**		**Maximum Eigenvalue Test**		
	Test Statistic	**Critical Value**	**Null Hypothesis**	**Test Statistic**	**Critical Value**
$r = 0$	27.47**	20.26	$r = 0$	25.05**	15.89
$r \geq 1$	2.42	9.16	$r \geq 1$	2.42	9.16

Note: ** indicates rejection of the null hypothesis of no cointegration at 5% level. The critical values are obtained from the EVIEWS 5.0 program. VAR lag order is 4, as determined by the MAIC.

The study next implements the modified VECM to ascertain the dynamic interactions between housing and stock market returns, since the two series are cointegrated.

Table 5 displays the results obtained from GARCH enhanced VECM. Column 2 of Table 5 presents the results obtained from Equation 6, whereas Column 3 presents the results obtained from Equation 7. The results in Column 2 reveal that the housing market has negative lagged effect on itself. The error correction term (z_{t-1}) and stock market returns have no implications for the housing market, as the regression coefficients on these variables are not statistically significant. However, it is interesting to observe that the measure of volatility for the stock market ($h^{1/2}_{SMR}$) has significant effect on housing market returns. The regression coefficient on $h^{1/2}_{SMR}$ is statistically significant at 5% level. This finding further supports the notion that the housing market is not immune from disturbances in the stock market. Above all, it strengthens the finding of cointegration between housing and stock returns.

The finding of spillover effect from the stock market to the housing market is inconsistent with Liow *et al.* (2005) who failed to find evidence of significant cross-volatility spillovers among the Asian and European property markets. This contradiction could be attributed to the methodologies applied by the two studies and the quality of data. The results from the variance equation suggest that the ARCH and GARCH variables have significant influence on the housing market, as their regression coefficients (i.e., 0.206 and 0.306) are statistically significant at 5% and 1% level, respectively.

Table 5: Results from the GARCH Enhanced VECM

Series/Equation	ΔHMR_t	ΔSMR_t
Mean Equation		
Constant	0.011 (0.20)	–0.510 (–0.95)
ΔHMR_{t-1}	–0.319 (–4.07)	0.051 (0.10)
ΔSMR_{t-1}	–0.001 (–0.04)	0.014 (0.15)
z_{t-1}	–0.003 (–0.31)	–0.917 (–6.35)
$\Delta h^{1/2}_{HMR,t}$	2.897 (–7.37)	4.089 (1.32)
$\Delta h^{1/2}_{SMR,t}$	–0.018 (–2.09)	–0.228 (–1.77)
Variance Equation		
Constant	0.088 (1.42)	7.523 (1.71)
ARCH	0.206 (2.08)	0.163 (1.20)
GARCH	0.360 (3.88)	0.660 (4.71)
Diagnostic Tests		
R-squared	0.482	0.251
Adjusted R-squared	0.444	0.197
Akaike Info. Criterion	6.617	2.223
Schwarz Criterion	6.827	2.433
F-statistic	12.783	4.608
Prob. (*F*-statistic)	0	0
Durbin-Watson Stat.	1.961	

Note: The MAIC was used to determine the lag lengths. HMR = Housing Market Return, SMR = Stock Market Return.

Turning next to the results obtained from the stock market equation, as presented in Column 3 of Table 5, it can be seen that housing market returns have significant effect on stock market returns. This finding is consistent with the conventional wisdom, which maintains that investors shift funds from the stock market to the bond market when the interest rates are high and vice versa. The error correction term (z_{t-1}) relative to the stock market equation is negative and statistically significant at 1% level. This result indicates that the stock market adjusts to restore equilibrium between the two markets in the event of disturbances. The housing market volatility measure ($h^{1/2}_{SMR,t}$) is statistically insignificant at the conventional levels. From the variance equation, it can be seen that *GARCH* variable is statistically significant at 1% level, while the *ARCH* variable is statistically insignificant.

The diagnostic tests reported in Table 5 suggest that Equations 6 and 7 possess the attributes of good models. In both cases, the *Durbin-Watson* statistic rejects the null hypothesis of serial correlation in the data. Similarly, the *F*-statistic indicates that the models are well-specified. Figures 1 and 2 display the conditional standard deviation of housing and stock market returns obtained from Equations 6 and 7 respectively. From Figure 1, it can be seen that fluctuations in the housing market were more pronounced between the late 1970s and mid-1980s. Similar observation can be made for the period between 2004 and 2005. The period between the late 1970s and mid-1980s was associated with double-digit inflation and high interest rates. The period 2004-2005, marks the beginning of the housing bubble in the United States. From Figure 2, it can be seen that fluctuations in the stock market were more pronounced between 1986 and 1990. This period includes the 1987 stock market crash in the United States. The fluctuations in the stock market once again pronounced following the terrorist attacks in 2001.

Figure 1: Conditional Standard Deviation for Housing Market Returns

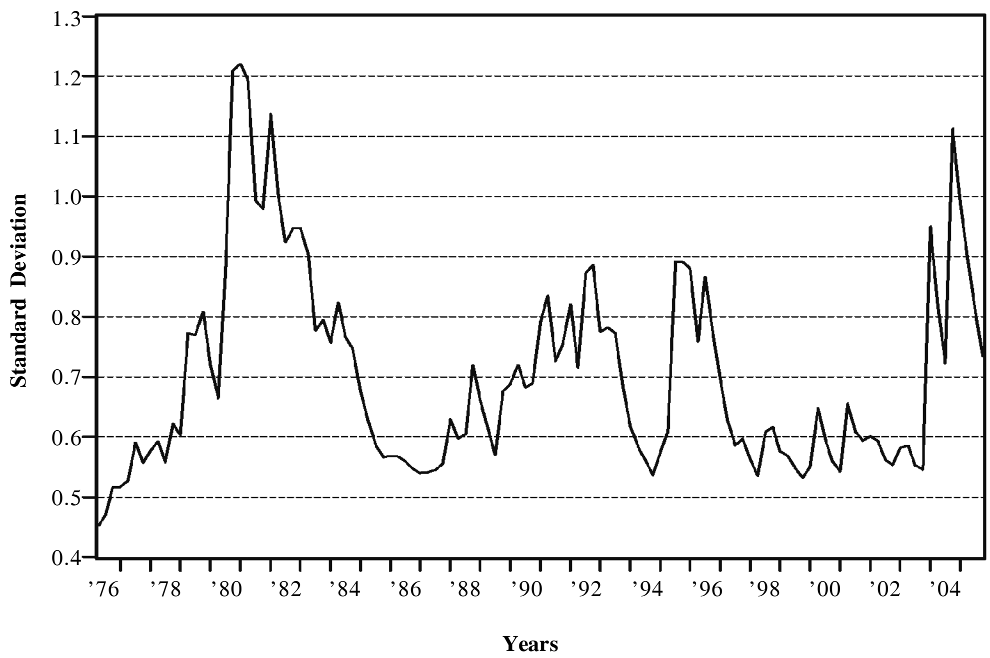
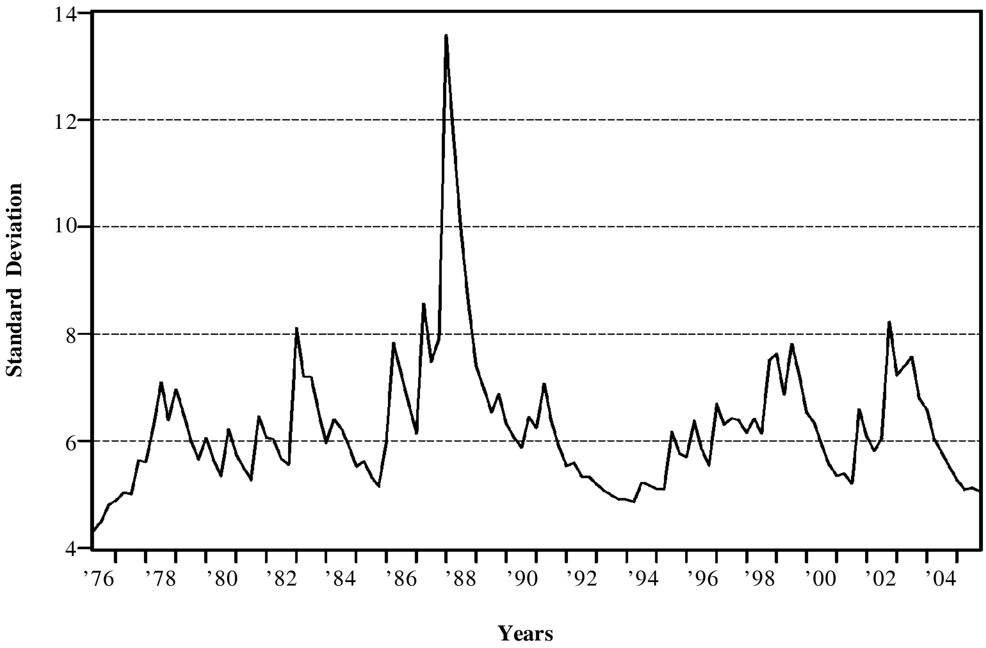


Figure 2: Conditional Standard Deviation for Stock Market Returns



Conclusion

This paper has used cointegration analysis and the GARCH enhanced VECM to examine the long-run relationship and the dynamics between the housing and stock markets for United States for period spanning from 1975:1 to 2005:4. In particular, the study applied the modified DF-GLS unit root procedure to determine the time series properties of long-term interest rates, housing and stock market returns. The modified VECM was not only used to examine the dynamics between the housing and stock market returns, but also to explore the possibility of spillover effects among the markets.

The results from the DF-GLS unit root procedures suggest that housing and stock market returns are stationary at first difference. The results obtained from the Johansen and Juselius cointegration tests suggest that housing and stock markets are cointegrated. The results reveal that risk reduction through diversification cannot be achieved by holding assets in both housing as well as stock market. The results from the GARCH enhanced VECM suggest that housing market returns affect the stock market returns through the statistically significant error correction term. The results further reveal the existence of spillover effect from the stock market to the housing market but not vice versa.

The major finding of this study is that the housing and stock markets are integrated rather than segmented. From the perspective of investment, risk reduction cannot be achieved by holding assets from both the markets in the same portfolio. ❖

References

1. Akaike H (1973), *Information Theory and an Extension of the Maximum Likelihood Principle*, Petrov B N and Craki F (Eds.), Proc. 2nd International Symposium on Information Theory, Akademiai Kiado, Budapest.

2. Ambrose B W, Ancel E and Griffiths M D (1992) "The Fractal Structure of Real Estate Investment Trust Returns: The Search for Evidence of Market Segmentation and Nonlinear Dependency", *Journal of the American Real Estate and Urban Economics Association*, Vol. 20, No. 1, pp. 25-54.

3. Ansari M (2006), "The US Housing Boom and the Stock Market Decline: Searching for a Causal Nexus", *Finance India*, Vol. XX, No. 2, pp. 213-530.

4. Chang T, Huang C, Chia F and Wei C (2005), "Are Real Estate and Stock Markets Related? The Case of Taiwan", *The Business Review*, Vol. 3, No. 2, pp. 125-130, Cambridge.

5. Dickey D and Fuller W (1981), "The Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrica*, Vol. 49, pp. 1057-1072.

6. Elliott G, Rothenberg T J and Stock J H (1996), "Efficient Test for an Autoregressive Unit Root", *Econometrica*, Vol. 64, pp. 813-836.

7. Engle R F and Bollerslev T (1986), "Modeling the Persistence of Conditional Variances", *Econometric Reviews*, Vol. 5, pp. 1-50.

8. Engle R F and Granger C W J (1987), "Cointegration and Error Correction: Representation, Estimation and Testing", *Econometrica*, Vol. 55, pp. 251-276.

9. Geltner D (1990), "Return Risk and Cash Flow with Long-Term Riskless Leases in Commercial Real Estate", *Journal of the American Real Estate and Urban Economics Association*, Vol. 18, pp. 377-402.

10. Geweke J and Porter-Hudak S (1983), "The Estimation and Application of Long Memory Time Series Model", *Journal of Time Series Analysis,* Vol. 4, No. 4, pp. 221-238.

11. Gyourko J and Kleim D (1992), "What Does the Stock Market Tell Us about Real Estate Returns?", *Journal of the American Real Estate Finance and Urban Economics Association*, Vol. 20, No. 3, pp. 457-485.

12. Johansen S (1991), "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, Vol. 59, pp. 1551-1580.

13. Johansen S and Juselius K (1990), "Maximum Likelihood Estimation and Inferences on Cointegration with Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, Vol. 69, pp. 675-684.

14. Liow K H, Ooi J and Gong Y (2005), "Cross-Market Dynamics in Property Stock Markets: Some International Evidence", *Journal of Property Investment and Finance*, Vol. 23, No. 1, pp. 55-75.

15. Liu C H, Hartzell D, Greig D W and Grissom T V (1990), "The Integration of the Real Estate Market and the Stock Market: Some Preliminary Evidence", *Journal of Real Estate Finance and Economics,* Vol. 3, No. 3, pp. 261-282.

16. Miles M, Cole R and Guilkey D (1990), "A Different Look at Commercial Real Estate Returns", *Journal of American Real Estate and Urban Economics Association*, Vol. 18, No. 4, pp. 403-430.

17. Ng S and Perron P (1995), "Unit Root Tests in ARMA Models with Data-Dependent Methods for the Selection of the Truncation Lag", *Journal of the American Statistical Association*, Vol. 90, pp. 268-281.

18. Ng S and Perron P (2001), "Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power", *Econometrica*, Vol. 69, pp. 1519-1554.

19. Ng S and Perron P (2002), "PPP May not Hold After All: A Further Investigation", *Annals of Economics and Finance*, Vol. 3, pp. 41-19.

20. Okunev J and Wilson J (1997), "Using Nonlinear Tests to Examine Integration Between Real Estate and Stock Markets", *Real Estate Economics*, Vol. 25, No. 3, pp. 487-505.

21. Wilson P and Okunev J (1999), "Long-Term Dependencies and Long Run Non-Periodic Co-Cycles: Real Estate and Stock Markets", *The Journal of Real Estate Research*, Vol. 18, No. 2, pp. 257-278.

Reference # 42J-2008-06-02-01