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Full Length Research Paper

Are REITs defensive? Evidence from the U.S.

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Real estate investment trusts (REITs) are regarded as defensive assets with low risk and returns in the real world. The dynamic conditional correlations bivariate threshold GARCH (DCC-TGARCH) model is employed to test for the defensive property of REITs. The data are collected at daily intervals covering the time period from January 3, 2005 to December 31, 2009. Evidence indicates that, the betas work asymmetrically in the up and down markets as well as that the systematic risk of REITs is lower in the down market. In other words, the four types of REITs act as defensive stocks in the time period under discussion in the sense that REITs have lower downside betas when the market declines.

Key words: REITs, defensive, DCC-TGARCH, beta.

INTRODUCTION

Prior research shows that REITs (real estate investment trusts) tend to have low risk, inflation hedging, and defensive characteristics (Howe and Shilling, 1990); Chan et al., 1990; Glascock and Hughes, 1995; Morgan, 2002)]. There are few arguments regarding these characteristics of REITs in current literature, in particular, defensiveness. Glascock (1991) argues that REITs betas shift with market condition: betas are higher during up markets and lower during down markets. Such behaviour may imply that, REITs stock returns would be less affected during periods of significant market decline. Glascock et al. (2004) examine the validity of the standard deviation measure of risk in explaining the returns around the market decline in October 1997 for both REITs and non-REITs stocks. It is found that REITs behaved differently from the overall stock market during the period of high market volatility and that the values of REITs stock declined about one-half as large as the value of non-REITs REITs stocks did. Hence, they suggest that REITs are defensive.

Applying the GJR-GARCH (Glosten Jagannathan Runkle-generalized ARCH) model to the eight listed REITs on the Taiwan Exchange from January 2006 - May 2009, Tsai (2010) examines the defensive property of REITs in the context of asymmetric volatility. The results indicate that five of the eight REITs were defensive in the sense that they demonstrated an anti-leverage effect. It is also found that REITs decreased in value much less than non-REITs stocks did in the down market. It is, moreover, worth noting that they were more defensive than the shares of utility, hotel, and department store industries.

The motivation of this study is two-fold. Firstly, the subprime mortgage crisis and the financial Tsunami in 2008 provide an excellent opportunity to re-examine the defensive property of REITs because all securities were then losing their value disproportionately. Developing the constant conditional correlation bi-variate threshold GARCH (CCC-TGARCH) model, Koutmos and Knif (2002) examine the beta asymmetry by estimating time-varying beta. No literature has been, so far, found to investigate the defensive property of REITs with asymmetric beta. This is the second motivation for us to re-examine the defensive property of REITs with the concept of asymmetric betas. Engle (2002) considers the constant conditional correlation (CCC) assumption to be unrealistic for the financial data and thereby introduces the

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Abbrevations: GJR-GARCH, Glosten Jagannathan Runkle-generalized ARCH; **REITs,** real estate investment trusts.

time-varying correlation into the model. This study, therefore, revisits this issue, utilizing the dynamic conditional correlation bivariate threshold GARCH (DCC-TGARCH) model to estimate varying beta. The rest of the paper proceeds as: description of data and research design is presented in section II, empirical results are provided in Section III while concluding remarks are shown in section IV.

DATA AND RESEARCH DESIGN

The data used in this study are from the National Association of Real Estate Investment Trusts (NAREIT). They are U.S. real estate indices for equity (E-REITs), mortgage (M-REITs), hybrid (H-REITs) and all (A-REITs), covering the period from January 2006 to May 2009 at the daily interval. The NYSE composite is used as the proxy for market portfolios to estimate systematic risk. All data have been retrieved from Datastream. Returns are calculated by taking the logarithmic difference between daily closing indices.

The dynamic conditional correlation bivariate threshold GARCH (DCC-TGARCH) model, introduced by Engle (2002) is used to estimate the time-varying beta in this study. It is specified as follows:

$$r_{i,t} = \mu_{i,t} + \varepsilon_{i,t} \tag{1}$$

$$r_{m,t} = \mu_{m,t} + \varepsilon_{m,t} \tag{2}$$

$$\sigma^2_{i,t} = \alpha_{i,0} + \alpha_{i,1}\varepsilon^2_{i,t-1} + \alpha_{i,2}\sigma^2_{i,t-1} + \delta_i S_{i,t-1}\varepsilon^2_{i,t-1} \tag{3}$$

$$\sigma^2_{m,t} = \alpha_{m,0} + \alpha_{m,1}\varepsilon^2_{m,t-1} + \alpha_{m,2}\sigma^2_{m,t-1} + \delta_m S_{m,t-1}\varepsilon^2_{m,t-1} \tag{4}$$

$$\sigma_{im,t} = \rho_{im,t}\sigma_{i,t}\sigma_{m,t} \tag{5}$$

Where, the subscripts *i* and *m* are REITs *i* and the market portfolio, respectively. $r_{i,t}$ and $r_{m,t}$ refer to continuously compounded returns at time *t.* $\mu_{i,t}$ and $\mu_{m,t}$ are conditional means. $\varepsilon_{i,t}$ and $\varepsilon_{m,t}$ denote new shocks at time *t.* $S_{k,t-1}$ is a dummy variable with a value of unity if $\varepsilon_{k,t-1} < 0$ and zero otherwise for *k*=*i*, *m*. Equation (3) and (4) describe the way how the conditional variance responds asymmetrically to a rise and a fall in the asset price. Specifically, $\alpha_{k,1}$ is the impact of positive return shocks on the conditional variance, while $\alpha_{k,1} + \delta_k$ is the impact of negative return shocks. Positive δ_k indicates a leverage effect embodied in the conditional variance. Equation (5) describes the process of time-varying covariance. Moreover, $\rho_{im,t}$, the dynamic conditional correlation between REITs and market returns, is calculated by using Equation (6) and Equation (7) developed by Engle (2002).

$$\rho_{im,t} = \frac{q_{im,t}}{\sqrt{q_{ii,t}q_{mm,t}}} \tag{6}$$

$$q_{im,t} = \bar{\rho}_{im} + \gamma(z_{i,t-1}z_{m,t-1} - \bar{\rho}_{im}) + \varphi(q_{im,t-1} - \bar{\rho}_{im}) \tag{7}$$

Where, $\bar{\rho}_{im}$ is the constant unconditional correlation between REITs and market returns and $z_{i,t-1} = \varepsilon_{i,t-1}/\sigma_{i,t-1}$ and $z_{m,t-1} = \varepsilon_{m,t-1}/\sigma_{m,t-1}$ are the standardized residuals of REITs and market returns, respectively.

Equation (7) shows the dynamic process of the conditional correlation. γ and φ capture the effects of previous shocks and previous conditional correlation on the current conditional correlation. If $\gamma + \varphi < 1$, the correlation between the financial assets will revert to the long-run unconditional level after a shock. With estimation of the model comprising Equations (1) ~ (7), the time-varying betas for all REITs types are calculated using the following formula:

$$\beta_{i,t} = (\sigma_{i,m,t}/\sigma^2_{m,t}) = (\rho_{im,t}\sigma_{i,t})/\sigma_{m,t} \tag{8}$$

In order to further investigate whether the REITs asset is defensive or not, the following regression is specified as follows:

$$\beta_{i,t} = c_i + \pi_1\beta_{i,t-1} + \pi_2 S_{m,t-1} + v_{i,t} \tag{9}$$

Equation (9) shows that positive return shocks have an impact of c_i on the betas, while negative return shocks have an impact of $c_i + \pi_2$ on the betas. The REITs are defensive assets if $\pi_2 < 0$, which implies that their betas would become smaller in the down market.

EMPIRICAL RESULTS

First of all, the Ljung-Box test for model specification is performed on standardized residuals, squared standardized residuals and the cross-product of standardized residuals. The results, documented in the last five rows of Table 1, indicate that the DCC-TGARCH specification is appropriate for the data set in the time period. The results from estimation of the DCC-TGARCH model are reported in the rest of Table 1. For simplicity, the conditional mean is assumed to be fixed, that is, $\mu_{i,t} = \mu_i$ and $\mu_{m,t} = \mu_m$. μ_i is larger than μ_m for A-REITs and E-REITs, indicating that these two REITs performed better in the time period. H-REITs and M-REITs, nevertheless, performed worse.

The conditional variance equation describes the way how volatility responds asymmetrically to a rise and a fall in the asset price. The estimates of δ_i and δ_m are statistically significantly positive at the 5% level for all types of REITs and the NYSE index, suggesting that the shocks from bad news cause more volatility than those from good news. Hadsell- (2006) indicates that volatility moves halfway back to its mean following a given deviation, which is defined as $\alpha_{i,1} + 0.5\delta_i + \alpha_{i,2}$ in the TGARCH model. If $\alpha_{i,1} + 0.5\delta_i + \alpha_{i,2} < 1$, we have see the

Table 1. Maximum Likelihood estimates of DCC-TGARCH model comprising Equations (1) - (7).

	A-REITs	E-REITs	H-REITs	M-REITs
μ_i	0.0359	0.0479	-0.0239	-0.0666*
	(0.0391)	(0.0397)	(0.0388)	(0.0269)
μ_m	0.0229	0.0227	0.0137	0.0175
	(0.0271)	(0.0272)	(0.0256)	(0.0248)
$\alpha_{i,0}$	0.0517**	0.0535**	0.0254**	0.0418**
	(0.0084)	(0.0086)	(0.0030)	(0.0083)
$\alpha_{i,1}$	0.0643**	0.0681**	0.0267**	0.1084**
	(0.0140)	(0.0145)	(0.0076)	(0.0186)
$\alpha_{i,2}$	0.8845**	0.8841**	0.9291**	0.8208**
	(0.0117)	(0.0122)	(0.0043)	(0.0160)
δ_i	0.0758**	0.0689**	0.0813**	0.1245**
	(0.0211)	(0.0209)	(0.0136)	(0.0240)
$\alpha_{m,0}$	0.0254**	0.0258**	0.0187**	0.01552**
	(0.0035)	(0.0036)	(0.0029)	(0.0024)
$\alpha_{m,1}$	0.0079	0.0064	0.0053	-0.0085
	(0.0127)	(0.0126)	(0.0142)	(0.0125)
$\alpha_{m,2}$	0.9117**	0.9121**	0.9182**	0.9230**
	(0.0108)	(0.0109)	(0.0115)	(0.0103)
δ_m	0.1142**	0.1159**	0.1224**	0.1424**
	(0.0189)	(0.0191)	(0.0196)	(0.0200)
γ	0.0549**	0.0631**	0.0439**	0.0291**
	(0.0161)	(0.0173)	(0.0134)	(0.0116)
φ	0.1635	0.1422	0.9287**	0.9567**
	(0.3723)	(0.3394)	(0.0252)	(0.0222)
Log L	-3943	-3988	-4288	-3885
$\alpha_{i,1}+0.5\delta_i+\alpha_{i,2}$	0.987	0.987	0.996	0.991
$\gamma+\varphi$	0.218	0.205	0.973	0.986
$Q_i(4)$	5.325	5.054	4.039	2.303
$Q_m(4)$	7.777	7.848	6.924	6.654
$Q_i^2(4)$	6.444	6.127	3.539	4.981
$Q_m^2(4)$	5.78	5.776	5.355	4.926
$Q_{i,m}(4)$	7.225	7.057	7.928	2.271

Note: * and ** denote significance at the 5 and 1% levels, respectively. Standard errors are in parentheses, $Q_k(4)$ and $Q_k^2(4)$ are the Ljung-Box test statistics detecting autocorrelation in the standardized residuals and standardized squared residuals of the DCC-GARCH model up to the fourth lags for *k=i, m*. $Q_{i,m}(4)$ is the Ljung-Box statistics detecting the cross-product of standardized residuals for asset i and the market m up to the fourth lag.

mean-reverting conditional volatility and shocks are transitory in nature. The estimates of $\alpha_{i,1}+0.5\delta_i+\alpha_{i,2}$ range from 0.987 (E-REITs) - 0.996 (H-REITs), this implies that, shocks are transitory. The effect of mean reversion to the permanent component of the unconditional correlation $\bar{\rho}_{im}$ is represented by γ and φ. γ is found to be statistically significantly positive at the 5% level for all types of REITs. φ is significantly positive for H-REITs and M-REITs and though it is insignificantly positive for A-REITs and E-REITs. The sum of γ and φ lies between 0.205 (E-REITs) and 0.973 (H-REITs). The condition of $\gamma+\varphi<1$ is observed for each type of REITs, which implies that, the dynamic conditional correlation moves around a long-run constant level and displays a mean-reverting dynamic process.

The descriptive statistics for daily time-varying betas for each type of REITs are listed in Table 2. The mean beta shows that M-REITs have relatively lower systematic risk than any other types of REITs. The augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used to examine whether the time-varying betas are stationary. Both tests reject the null hypothesis of non-stationarity at the 1 and 5% significance levels in all cases, indicating that the systematic risk associated with the four types of REITs is stationary.

Table 3 illustrates estimates of the asymmetric time-varying beta. Evidence shows that the beta works asymmetrically in the up and down markets since the asymmetric parameter π_2 is negative and statistically significant. The negative sign reveals that the REITs' systematic risk is lower in the down market than in the up market. The REITs assets, therefore, have lower downside betas, which has implications for investment strategies. A portfolio would perform better in the down market if more assets with lower downside betas are contained in the portfolio. For instance, the beta coefficient of A-REITs was 1.0288 (= 0.0778 + 0.9510) in the up market while it turned to be 0.0513 (= 0.0778 - 0.0265) in the down market. It implies that, a 1.0288% rise in the A-REITs return would be associated with a 1% rise in the market return, while a 0.0513% fall in the A-REITs return would be associated with a 1% fall in the market return. It is thus advised that, in order to be defensive in the down market, more REITs stocks will be included in the portfolio. Moreover, the half-life of an innovation ranges from 6 days in M-REITs to 26 days in H-REITs.

Conclusions

Using the daily data covering the period from January 3, 2005 - December 31, 2009 period, this study empirically tests whether the REITs assets in the U.S are defensive. The method utilized in this study is the dynamic conditional correlations bivariate threshold GARCH (DCC-TGARCH) model. Evidence indicates that, the negative return shocks from bad news cause more volatility than those from good news. The shocks are transitory in nature and the dynamic conditional correlation moves around a long-run constant level. Thus, the dynamic

Table 2. The descriptive statistics of the time-varying beta.

	A-REITs	E-REITs	H-REITs	M-REITs
Mean	1.3277	1.3495	1.3003	0.5753
Standard deviation	0.3270	0.3582	0.4213	0.1908
Maximum	2.7955	3.0497	3.5877	1.7221
Minimum	0.5567	0.4977	0.5863	0.1972
ADF	-3.5286**	-3.3605*	-3.3581*	-6.1163**
PP	-5.3333**	-5.1320**	-4.2794**	-8.5960**

Notes: * and ** denote significance at the 5 and 1% levels, respectively. ADF and PP are abbreviations for the augmented Dickey-Fuller and Phillips-Perron unit root tests. The critical values of ADF and PP at the 5 and 1% levels are -2.86 and -3.43, respectively.

Table 3. OLS estimates of asymmetric time-varying beta.

	A-REITs	E-REITs	H-REITs	M-REITs
c_i	0.0778**	0.0799**	0.0525**	0.0709**
	(0.0120)	(0.0122)	(0.0091)	(0.0080)
π_1	0.9510**	0.9515**	0.9736**	0.8910**
	(0.0085)	(0.0085)	(0.0064)	(0.0127)
π_2	-0.0265**	-0.0303**	-0.0376**	-0.0170**
	(0.0056)	(0.0061)	(0.0054)	(0.0048)
$\overline{R}^2$	0.9055	0.9069	0.9465	0.7918
HL	13.7964	13.9423	25.9075	6.0059

Notes: * and ** denote significance at the 5 and 1% levels, respectively. Standard errors are in parentheses. The half life (HL) of a shock, calculated as ln(0.5)/ln(π_1), measures the degree of persistence.

process displays a mean-reverting one. Moreover, the mean beta shows that E-REITs have the lowest systematic risk among all types of REITs. The half-life of an innovation ranges from 6 days in M-REITs to 26 days in H-REITs.

It is found that the four types of REITs, that is, All-REITs, Equity-REITs, Mortgage-REITs and Hydird-REITs act as the defensive stocks during the time period from January 3, 2005 - December 31, 2009. This finding is consistent with those in Glascock (1991), Glascock et al. (2004) and Tsai (2010). It has implications for individual and institutional investors in the sense that they could increase profitability by raising the holdings of REITs in their portfolios when the market declines.

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