

Consumer Sentiment and REIT Returns: Testing for Causality in-Mean and in-Variance

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This study uses the BEKK-GARCH (1,1) framework to test for causality in-mean and in-variance between REIT returns and changes in consumer sentiment. The results provide evidence supportive of causality in-mean running from All, Equity, and Mortgage REIT returns to changes in consumer sentiment for the full sample period and the first sub-period but not vice versa. In the second sub-period, there was no evidence of causality in-mean between changes in consumer sentiment and the various REIT returns. The results further show evidence of bidirectional causality in-variance between changes in consumer sentiment and the three REIT returns in the full sample period and the first sub-period. For the second sub-period, causality in-variance runs from changes in consumer sentiment to All and Equity REIT returns. However, evidence of bidirectional causality in-variance is indicated between changes in consumer sentiment and Mortgage REIT returns for the second sub-period. Taken together, the results suggest that innovations in consumer sentiment are informational in predicting future movements in REIT returns and vice versa.

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1. Introduction

The relationship between asset returns and consumer sentiment has gained increased attention among policymakers, financial economists and analysts, given its importance in the field of behavioral finance. The behavioral hypothesis suggests that consumer sentiment is an important determinant of household consumption expenditures. Simply put, consumers tend to spend more when they are optimistic about future economic outlook. However, consumers spend less when they are pessimistic about the future prospects of the economy. A limited number of studies including Lin *et al.* (2009) and Almudhaf (2010) have investigated the relationship between the real estate investment trusts (REIT) returns and consumer sentiment. Lin *et al.* (2009) examined the relationship between investor sentiment and REIT returns. They find that REIT returns tend to increase when investors are optimistic and decrease when they are pessimistic about the economy. Almudhaf (2010) examined the relationship between consumer sentiment and REIT returns using data from January 1978 through September 2008. Almudhaf (2010) employed the standard vector autoregressive (VAR) model to explore causal relationship between consumer sentiment and REIT returns. He finds that consumer sentiment has significant impact on REIT returns. However, the results from the Granger-causality test reveal that causality runs from REIT returns to changes in consumer sentiment

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but not vice versa. He therefore concluded that REIT returns could be used to predict future movements in consumer sentiment.

Other studies on the impact of sentiment on asset returns focused on the relationship between investor sentiment and stock market returns. For instance, Glascock et al. (2000) argue that REITs tend to behave more like common stocks following the enactment of the 1993 Revenue Reconciliation Act. Yu and Yuan (2011) find that investor sentiment is an important determinant of both expected return and volatility of the U.S. stock market. Matsusaka and Sbordone (1995) maintain that consumer sentiment accounts for between 13 and 26 percent of the variations in the postwar US GNP. In addition, they reject the null hypothesis that consumer sentiment does not Granger GNP. Asgary and Gu (2005) using data for France, the United Kingdom and the US find statistically significant relationship between stock market and consumer sentiment.

Baek, et al (2005) examined the factors that determine asset prices. They find that investor sentiment explains movements in asset prices better than the other factors considered by their study. Clarke and Statman (1998) explored the relationship between investor sentiment and equity returns. They used Investor Intelligence newsletter as a measure of investor sentiment. They find that the sentiment of newsletter writers has no implications for equity returns. Fisher and Statman (2000) using the American Association of Investors measure of sentiment, find that the effect of investor sentiment on equity returns is negative and statistically significant. Honcoop and Lehnert (2007) examined the relationship between investor sentiment and stock market returns. They find that investor sentiment has significant effect on equity returns. Fisher and Statman (2003) maintain that consumer sentiment has statistically negative effect on stock market returns. DeLong, et al. (1990) finds that investor sentiment is a significant determinant of small stock price.

Lemmon and Portiniaguina (2006) examined the relationship between investor sentiment and size premium. They find that investor sentiment is not informational relative to momentum and value premiums. They further find that consumer confidence is highly correlated with small stock market returns. Jansen and Nahuis (2003) investigated the relationship between changes in consumer sentiment and stock market returns for a sample of nine European countries. They find that changes in consumer sentiment and stock market returns are highly positively correlated for the sample countries. They further find that stock market returns have causal implications for consumer confidence for the countries under study. Chung, *et al.* (2012) examined the asymmetric predictive power of investor sentiment on stock market returns using a multivariate Markov switching model. They find that investor sentiment has predictive power on stock market returns in the expansion state but not in the recession state. They also obtained similar results using the consumer confidence index as a measure of investor sentiment.

From the preceding studies it can be inferred that the relationship between consumer sentiment and REIT returns has not gained adequate attention in the literature. Unlike most of the previous studies, the present study uses the BEKK (Baba, Engle, Kraft and Kroner, 1990) specification of the multivariate Generalized Autoregressive Conditional Heteroscedasticity) GARCH model [here after, BEKK-GARCH] to test for causality in-mean and in-variance between changes in consumer sentiment and REIT returns. The multivariate BEKK-GARCH model has better power than the residual cross-correlation function (CCF) procedure which most studies in the literature applied. The framework is also robust to model misspecification. To the best knowledge of the author, this study is the first to apply the multivariate BEKK-GARCH model in testing for causality in-mean and in-variance between changes in consumer

sentiment and REIT returns. In addition, this paper uses longer time series running from February 1978 through September 2012.

The remainder of the paper is structured as follows. Section 2 furnishes the econometric techniques of the study. Section 3 discusses the data and the descriptive statistics. Section 4 details the empirical results. Section 5 presents the conclusions and implications of the study.

2. Methodology

The empirical analysis of the study begins with the application of the modified Dickey-Fuller (Elliot et al., 1996) and the Phillips-Perron (Phillips-Perron, 1988) unit root procedures to ascertain the time series properties of changes in consumer sentiment and the REIT returns. To conserve space, these unit root procedures will not be discussed as they have been extensively applied in the extant literature. The study adopts the BEKK-GARCH(1,1) framework to test for causality in-mean and in-variance between changes in consumer sentiment and REIT returns. The conditional mean takes the form of a vector autoregressive (VAR) model given by:

$$\chi_t = \lambda_t + \sum_{i=1}^p \theta_i \chi_{t-i} + \nu_t \tag{1}$$

where $\chi_t = (x_{1t}, x_{2t})$, x_1 and x_2 represent changes in consumer sentiment and REIT returns, respectively. The parameter vector of the mean equation (1) is given by $\lambda = (\lambda_1, \lambda_2)$ and the autoregressive term θ_i . The residual vector is given by $\nu_t = (\nu_1, \nu_2)$. The residual vector is bivariate and normally distributed with conditional variance-covariance matrix as follows:

$$H_t = \begin{bmatrix} h_{11t} & h_{12t} \\ h_{21t} & h_{22t} \end{bmatrix} \tag{2}$$

$$H_t = C_0' C_0 + \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1} \varepsilon_{2,t-1} \\ \varepsilon_{1,t-1} \varepsilon_{2,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} H_{t-1} = \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} \tag{3}$$

Equation (2) models the dynamic process of H_t as a linear function of its own past values H_{t-1} , in addition to the past values of the squared innovations $(\nu_{1,t-1}^2, \nu_{2,t-1}^2)$ and thus allowing for influences from both changes in consumer sentiment and the REIT returns on the conditional variance. This framework allows the conditional variances and covariances of the two series to influence each other. This allows the researcher to test the null hypothesis of spillover effect in one or both directions. The use of BEKK models ensures that the variance-covariance matrix is positive definite.

Under the assumption that the error terms are normally distributed, the parameters of the multivariate GARCH model can be estimated by maximizing the log likelihood function as follows:

$$L_{norm} = -\frac{1}{2} [m \log(2\pi) + \log(|H_t|) \varepsilon_t' H_t^{-1} \varepsilon_t] \tag{4}$$

In equation (4), m represents the number of conditional mean equations while ε_t stands for m vector of mean equation residuals.

2.2. Causality-in-Variance Tests

Most of the earlier studies on causality in-variance and in-mean applied the residual cross-correlation function (CCF) procedure developed by Cheung and Ng (1996) and extended by Hong (2001). The CCF consists of two steps. In the first step, univariate GARCH models are estimated and both the standardized and squared residuals are recovered. In the second step, causality in-mean is tested by using the cross-correlation coefficients between the standardized residuals. On the other hand, causality in-variance is tested by using the cross-correlation coefficients between the squared standardized residuals. Dijk et al. (2005) suggest that the CCF procedure has the tendency to yield unreliable results especially in the presence of structural changes relative to the existence of causality in-variance.

To mitigate the problem associated with the CCF procedure, Caporale et al. (2002) proposed an alternative framework which involves the estimation of a multivariate GARCH framework and then testing for the relevant zero restrictions on the conditional variance parameters. Caporale et al. (2002) suggest that causality can emerge in either direction by sequentially constraining the matrices A_{11} or B_{11} to be upper triangular and lower triangular. Hafner and Herwartz (2004) maintain that unlike the CCF procedure, the multivariate GARCH framework proposed by Caporale et al. (2002) has better power properties and is also robust to model misspecification. The multivariate GARCH framework allows the researcher to simultaneously test the null hypotheses of no causality-in-variance from x_{1t} to x_{2t} (i.e. $H_0: A_{12} = B_{12} = 0$) and no causality-in-variance from x_{2t} to x_{1t} , (i.e. $H_0: A_{21} = B_{21} = 0$). Pantelidis and Pittis (2004) argue that tests for causality-in-variance are likely to suffer from size distortions when causality-in-mean effects are not taken into consideration. To this effect, the study uses the VAR specification of equation (1) to test for causality in-mean.

3. Data and Description Statistics

The study employs monthly data on returns for All REITs, Equity and Mortgage REITs. The data were obtained from the website of National Association of Real Estate Investment Trusts, Inc. (NAREIT) at <http://www.reit.com/DataAndResearch/IndexData/FNUS-Historical-Data/Monthly-Index-Data.aspx>. The data span the time period February 1978 through September 2012. To assess the impact of the 1993 Revenue Reconciliation Act on the relationship between changes in consumer sentiment and REIT returns, the sample period is divided into two. The first sub-period runs from February 1972 through December 1992. The second sub-period runs from January 1993 through June 2008. The data on consumer sentiment are obtained from the *Surveys of Consumer Attitudes and Behavior* administered monthly by the *Survey Research Center* (SRC) of the University of Michigan.

Table 1 displays the summary statistics for REIT returns and changes in consumer sentiment. The mean values for All, Equity and Mortgage REIT returns are 1.01, 0.54 and -0.33 percent, respectively. The mean value for changes in consumer sentiment is 0.13. From the minimum and maximum statistics, it can be seen that both the return series and changes in consumer sentiment have fluctuated greatly for the time period under study. For instance, the returns for All REITs ranged from a minimum of -30.23 to a maximum of 27.97 percent. The standard deviations reveal that the returns for Mortgage REIT exhibited the greatest variability (5.42%) from the mean. In contrast, All REIT returns with a standard deviation of 4.90 percent posted the least deviation from the mean. The standard deviation for changes in consumer sentiment stood at 5.10. The statistics presented in Table 1 reveal that all of the three REIT return series are negatively skewed, while changes in consumer sentiment are positively skewed.

Table 1: Summary Statistics (February 1978 – September 2012)

Statistics	ALR	CS	EQR	MOR
Mean	1.01	0.13	0.54	-0.33
Maximum	27.97	24.57	30.50	15.73
Minimum	-30.23	-18.07	-31.91	-25.73
Standard. Deviation.	4.90	5.10	5.04	5.42
Skewness	-0.88	0.10	-0.75	-0.91
Kurtosis	10.64	4.90	11.78	6.11
Jarque-Bera	1067.14***	63.41***	1379.62***	226.14***
Probability	0.00	0.00	0.00	0.00
Observations	417	417	417	417

*** Indicates significance at the 1% level. ALR = All REIT returns, CS = changes in consumer sentiment, EQR = Equity REIT returns, MOR = Mortgage REIT returns.

The three REIT return series and changes in consumer sentiment display excess kurtosis. However, the excess kurtosis for changes in consumer sentiment is less pronounced than those for the three REIT return series. Based on the Jarque-Bera statistics the null hypothesis that the return series and changes in consumer sentiment are normally distributed is rejected at the 1 percent significance level in all of the cases.

Table 2: Spearman's Correlation Coefficients between the REIT Returns (February 1978 – September 2012)

Statistics	ALR	CS	EQR	MOR
ALR	1.00			
CS	.291***	1.000		
EQR	.963***	.292***	1.000	
MOR	.603***	.205***	0.491***	1.000
ALR	1.00			
CS	.291***	1.000		
EQR	.963***	.292***	1.000	

*** Correlation is significant at the 1% level (2-tailed). ALR = All REIT returns, CS = changes in consumer sentiment, EQR = Equity REIT returns, MOR = Mortgage REIT returns.

Table 2 presents the Spearman's correlation coefficients between REIT returns and changes in consumer sentiment. The results indicate that the relationships between the four series are positive and statistically significant at the 1 percent level. The highest correlation coefficient is recorded between All REIT and Equity REIT returns. However, the least correlation coefficient is recorded between changes in consumer sentiment and Mortgage REIT returns.

4. Empirical Results

The empirical results of the study are discussed in this section. Prior to testing for causality in-mean and in-variance, the study applies the modified ADF (DF-GLS) and the Phillips-Perron unit root tests to ascertain the time series properties of REIT returns and changes in consumer sentiment. Panels A and B of Table 3 present the unit root test results from the DF-GLS and the Phillips-Perron, respectively. The optimal lags were determined through the modified Akaike Information Criterion (MAIC). The results from the DF-GLS presented in Panel A indicate that the REIT return series and changes in consumer sentiment have zero order of integration. The test statistics reject the null hypothesis of a unit root in all of the cases at the 1 percent level of significance. For instance, the test statistic for All REIT returns under the DF-GLS unit root procedure is -7.86 while the critical value at the 1 percent level is -3.98. The results from the Phillips-Perron unit root test procedure presented in Panel B of Table 3 are similar to those obtained from the DF-GLS. The null hypothesis of a unit root is rejected at the 1 percent level in all of the cases indicating that the four series are level stationary.

Table 3: Unit Root Test Results (January 1978 – September 2012)

Series	t-stat	Lag(s)	1%CV
Panel A: Modified ADF (DF-GLS)			
ALR	-7.86 ^{***}	4	-3.98
EQR	-8.74 ^{***}	3	-3.98
MOR	-4.59 ^{***}	11	-3.98
Panel B: Phillips-Perron			
ALR	-18.40 ^{***}	8	-3.98
EQR	-18.64 ^{***}	7	-3.98
MOR	-18.74 ^{***}	8	-3.98

^{***} indicates significance at the 1% level. ALR = All REIT returns, CS = changes in consumer sentiment, EQR = Equity REIT returns, MOR = Mortgage REIT returns.

Having ascertained that all of the three REIT return series and changes in consumer sentiment have zero order of integration, the study next implements the GARCH models in order to test for causality in-mean and in-variance. Based on the Akaike Information Criterion, a GRACH(1,1)-BEKK was selected for both the mean and conditional variance equations. Table 4A presents the BEKK-GARCH(1,1) estimates between consumer sentiment and All REIT returns for the three sample periods. From Panel A of Table 4A, it can be seen that changes in consumer sentiment are significantly affected by their second lagged value at least at the 10 percent level, in all of the three sample periods. The first (ALR_{t-1}) and second (ALR_{t-2}) lagged values of All REIT returns have significant effects on the mean of changes in consumer sentiment for the full sample period and first sub-period but not in the second sub-period. These results indicate the existence of spillover in mean from All REIT returns to changes in consumer sentiment for the full sample period and the first sub-period.

The results from the variance equation are presented in Panel B of Table 4A. The coefficients A(1,2) and B(1,2) represent the spillover effect from changes in consumer sentiment to All REIT returns. On the other hand, the coefficients A(2,1) and B(2,1) represent the spillover effect from All REIT returns to changes in consumer sentiment. From the results, it can be inferred that changes in consumer sentiment respond to their own shocks and conditional volatility given that the coefficients A(1,1) and B(1,1) are statistically significant at the 1 percent level in the full sample and both sub-periods. Similarly, the results show that All REIT returns respond to their own shocks and conditional volatility in all of the sample periods as the coefficients A(2,2) and B(2,2) are statistically significant at the 1 percent level. There is evidence of spillover effect from changes in consumer sentiment to All REIT returns in all of the sample periods as the coefficients A(1,2) and B(1,2) are statistically significant at least at the 5 percent level. However, spillover effect from All REIT returns to changes in consumer sentiment is observed only for the full sample and the first sub-period, given that the coefficients A(2,1) and B(2,1) are statistically significant.

Panel B of Table 4B presents the BEKK-GARCH(1,1) estimates for the relationship between changes in consumer sentiment and Equity REIT returns for all sample periods. The results show that changes in consumer sentiment respond to their own shocks and conditional volatility since either the coefficients A(1,1) or B(1,1) or both are statistically significant. The results also show that Equity REIT returns respond to their own shocks and conditional volatility as evidenced by the significance of the coefficients A(2,2) and B(2,2) at the 1 percent level. The coefficients A(1,2) and B(1,2) are statistically significance at least at the 10 percent level, indicating the presence of spillover effect from changes in consumer sentiment to Equity REIT returns for all of the sample periods. However, the results show evidence of spillover effect from Equity REIT returns to changes in consumer sentiment in

the full sample and the first sub-period as the coefficients B(2,1) and A(2,1), respectively are statistically significant at the 1 percent level.

Table 4A: BEKK-GARCH (1,1) Estimates (Consumer Sentiment versus ALL REIT Returns)

Series	Feb. 1978 – Sept.2012		Feb. 1978-Dec. 1992		Jan. 1993-Oct. 2012	
	Parameter	t-Statistic	Parameter	t-Statistic	Parameter	t-Statistic
Panel A: Mean Equation						
Constant	-0.061	-0.307	-0.194	-0.724	0.174	0.679
CS _{t-1}	-0.037	-0.907	-0.104	-1.368	-0.069	-1.113
CS _{t-2}	-0.156***	-3.776	-0.144*	-1.741	-0.182***	-3.197
ALR _{t-1}	0.155***	3.227	0.380***	3.569	0.067	1.186
ALR _{t-2}	0.098**	2.246	0.168*	1.646	0.007	0.118
Constant	0.890***	4.848	0.834***	3.564	1.068***	3.825
CS _{t-1}	-0.010	-0.236	-0.083*	-1.710	0.025	0.379
CS _{t-2}	-0.001	-0.012	-0.037	-0.721	-0.001	-0.022
ALR _{t-1}	0.125**	2.556	0.307***	4.495	0.032	0.499
ALR _{t-2}	-0.057	-1.208	-0.119*	-1.817	-0.027	-0.415
Panel B: Variance Equation						
C(1,1)	0.397	1.206	1.664***	4.809	0.320**	2.770
C(2,1)	0.739	0.398	1.887***	3.646	0.501	0.474
C(2,2)	1.667**	2.098	0.000	0.000	1.019**	2.165
A(1,1)	0.142***	4.029	0.411***	3.149	0.214***	18.096
A(1,2)	0.284***	5.871	0.199**	2.638	0.329***	8.892
A(2,1)	-0.013	-0.234	0.917***	4.040	-0.058	-1.347
A(2,2)	0.296***	5.884	0.408**	2.730	0.245***	4.190
B(1,1)	0.962**	87.955	0.621***	3.837	0.976***	203.257
B(1,2)	0.061**	-2.506	-0.225***	-5.041	-0.037***	-3.177
B(2,1)	0.088***	4.471	-0.238**	-2.184	0.009	0.393
B(2,2)	0.800***	18.176	0.796***	5.718	0.877***	38.111

***, **, and * indicate significance at the 1%, 5% and 10% level, respectively

Table 4B: BEKK-GARCH (1,1) Estimates (Consumer Sentiment versus Equity REIT Returns)

Series	Feb. 1978 – Sept.2012		Feb. 1978-Dec. 1992		Jan. 1993-Sept. 2012	
	Parameter	t-Statistic	Parameter	t-Statistic	Parameter	t-Statistic
Panel A: Mean Equation						
Constant	0.092	0.462	-0.142	-0.464	0.182	0.695
CS _{t-1}	-0.055	-1.297	-0.121*	-1.708	-0.078	-1.407
CS _{t-2}	-0.146***	-3.752	-0.187**	-2.474	-0.169	-3.156***
EQR _{t-1}	0.142***	3.160	0.312***	3.333	0.064	1.022
EQR _{t-2}	0.077*	1.793	0.219**	2.435	0.012	0.212
Constant	0.473**	2.357	0.748***	3.570	0.547	1.967**
CS _{t-1}	0.000	0.007	0.051	1.038	0.011	0.169
CS _{t-2}	0.007	0.173	-0.031	-0.640	0.017	0.250
EQR _{t-1}	0.082*	1.676	0.062	0.779	0.017	0.263
EQR _{t-2}	-0.032	-0.636	-0.029	-0.423	-0.026	-0.350
Panel B: Variance Equation						
C(1,1)	0.587**	2.452	0.061	0.550	-0.324**	-2.649
C(2,1)	0.622	0.850	-1.223***	-4.601	-0.626**	-2.460
C(2,2)	1.701***	8.002	0.001	0.000	0.950***	6.341
A(1,1)	0.185***	4.440	0.070	1.189	0.219***	10.904
A(1,2)	0.267***	12.201	-0.101**	-1.980	0.341***	17.662
A(2,1)	-0.017	-0.356	0.354***	21.163	-0.055	-1.395
A(2,2)	0.285***	8.392	0.431***	4.239	0.225***	6.997
B(1,1)	0.958***	83.312	0.954***	130.500	0.975***	184.993
B(1,2)	-0.064***	-4.076	-0.036*	-1.696	-0.046**	-4.452
B(2,1)	0.065***	3.806	0.003	0.145	0.009	0.829
B(2,2)	0.820***	58.668	0.873***	17.909	0.886***	97.760

***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Panel B of Table 4C presents the BEKK-GARCH(1,1) estimates for the relationship between changes in consumer sentiment and Mortgage REIT returns for all sample periods. The results show that changes in consumer sentiment respond to their own shocks and conditional volatility as the coefficients A(1,1) and B(1,1) are statistically significant. Similar results are indicated for Mortgage REIT returns given that the coefficients A(2,2) and B(2,2) are statistically significant at the 1 percent level in all of the sample periods. Shocks to changes in consumer sentiment have spillover effect on Mortgage REIT returns as the coefficient A(1,2) is statistically significant at the 1 percent level in the full sample period and the two sub-periods. There is however evidence of spillover effect from Mortgage REIT returns to changes in consumer sentiment in the full sample and the second sub-period.

Table 4C: BEKK-GARCH (1,1) Estimates (Consumer Sentiment versus Mortgage REIT Returns)

Series	Feb. 1978 – Sept.2012		Jan. 1978-Dec. 1992		Feb. 1993-Sept. 2012	
	Parameter	<i>t</i> -Statistic	Parameter	<i>t</i> -Statistic	Parameter	<i>t</i> -Statistic
Panel A: Mean Equation						
Constant	0.256	1.250	0.519*	1.670	0.284	1.009
CS _{t-1}	-0.010	-0.227	-0.022	-0.332	-0.024	-0.445
CS _{t-2}	-0.142***	-3.425	-0.172**	-2.574	-0.165***	-2.709
MOR _{t-1}	0.097**	2.448	0.201**	2.762	0.047	1.089
MOR _{t-2}	0.062	1.518	0.244***	3.205	-0.023	-0.451
Constant	-0.190	-0.890	-0.386	-1.290	0.142	0.452
CS _{t-1}	-0.008	-0.160	-0.052	-0.729	0.000	-0.002
CS _{t-2}	-0.034	-0.691	-0.094	-1.595	-0.050	-0.580
MOR _{t-1}	0.146**	2.885	0.227**	2.954	0.127*	1.875
MOR _{t-2}	-0.009	-0.188	0.022	0.357	-0.034	-0.431
Panel B: Variance Equation						
C(1,1)	-0.167	-0.584	0.556	0.971	0.327	1.463
C(2,1)	2.744***	7.200	2.752***	4.990	-2.665***	-4.959
C(2,2)	0.000	0.000	0.000	0.000	0.000	0.000
A(1,1)	0.150***	3.429	0.251***	3.090	0.090***	9.998
A(1,2)	0.284***	3.828	0.349***	4.320	0.379***	3.764
A(2,1)	0.000	-0.009	0.167	1.467	0.000	0.009
A(2,2)	0.423***	7.402	0.306***	3.031	0.447***	5.631
B(1,1)	0.959***	69.451	0.943***	49.967	0.973***	199.956
B(1,2)	-0.037	-1.019	-0.104	-1.563	0.014	0.346
B(2,1)	0.099**	2.338	0.013	0.110	0.059***	19.504
B(2,2)	0.688***	9.098	0.536***	2.584	0.712***	7.783

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

4.1. Causality in-Mean Test Results

Table 5 displays the Granger causality-in-mean test results between changes in consumer sentiment and the REIT returns for the three sample periods. Panel A presents the causality-in-mean test results. The results show evidence of mean spillover from All REIT returns to changes in consumer sentiment in the full sample period and the first sub-period. However, in the second sub-period, there was no evidence of causality in-mean from All REIT returns to changes in consumer sentiment.

Similarly, the results presented in Panel B reveal that causality -in-mean runs from Equity REIT returns to changes in consumer sentiment but not vice versa in the full sample period

and in the first sub-period. Nevertheless, there is no evidence of mean spillover from Equity REIT returns in the second sub-period. According to the test results, there is no evidence of causality-in-mean from changes in consumer sentiment to Equity REIT returns in all of the sample periods. The test results in Panel C show evidence of causality-in-mean from Mortgage REIT returns to changes in consumer sentiment for the full sample period and the first sub-period. The results further reveal that there was no evidence of causality-in-mean from Mortgage REIT returns to changes in consumer sentiment. The results failed to provide evidence of causality-in-mean from changes in consumer sentiment to Mortgage REIT returns in all of the sample periods. Taken together, the test results presented in Table 5 provide evidence of mean spillover effect from the three REIT returns to changes in consumer sentiment but not vice versa, in the full sample period and in the first sub-period. However, the causality-in-mean observed in the full sample period and in the first sub-period dissipated in the second sub-period. These results suggest that the 1993 Revenue Reconciliation Act weakened the relationship between changes in consumer sentiment and REIT market returns.

Table 5: Granger Causality-in-Mean Test Results

Hypothesis	Feb. 1978-Sept.2012		Feb. 1978-Dec. 992		Feb. 1993-Sept. 2012	
	<i>Chi-Square Stat</i>	<i>P-Value</i>	<i>Chi-Square Stat</i>	<i>P-Value</i>	<i>Chi-Square Stat</i>	<i>P-Value</i>
Panel A: Consumer Sentiment versus All REIT Returns						
Causality from All REIT Returns to Consumer Sentiment [$H_0: ALR_{t-1} = ALR_{t-2} = 0$]	16.71***	0.00	19.43***	0.00	1.43	0.49
Causality from Consumer Sentiment to All REIT Returns [$H_0: CS_{t-1} = CS_{t-2} = 0$]	0.06	0.97	3.34	0.19	0.14	0.93
Panel B: Consumer Sentiment versus Equity REIT Returns						
Causality from Equity REIT Returns to Consumer Sentiment [$H_0: EQR_{t-1} = EQR_{t-2} = 0$]	13.38***	0.00	22.56***	0.00	0.79	0.67
Causality from Consumer Sentiment to Equity REIT Returns ($H_0: CS_{t-1} = CS_{t-2} = 0$)	0.03	0.99	0.96	0.62	0.06	0.97
Panel C: Consumer Sentiment versus Mortgage REIT Returns						
Causality from Mortgage REIT Returns to Consumer Sentiment [$H_0: MOR_{t-1} = MOR_{t-2} = 0$]	9.40***	0.01	19.44***	0.00	1.31	0.52
Causality from Consumer Sentiment to Mortgage REIT Returns [$H_0: CS_{t-1} = CS_{t-2} = 0$]	0.51	0.77	3.11	0.21	0.34	0.84

*** indicates rejection of the null hypothesis at the 1% significance level. ALR = All REIT returns, CS = Consumer Sentiment, EQR = Equity REIT returns and MOR = Mortgage REIT returns.

4.2. Causality in-Variance Test Results

The study next conducts the causality-in-variance tests for the various variance equations by constraining the matrices A11 and B11 to be upper triangular or lower triangular, and hence permitting causality to emerge in one direction at a time. Table 6 reports the LR statistics and their associated p-values for causality in variance tests. Panel A of Table 6 reports the causality-in-variance test results. From Panel A, it can be observed that the null hypothesis of unidirectional causality in-variance from All REIT returns to changes in consumer sentiment should be rejected at the 1 percent level of significance in both the full sample and the first sub-period. Similarly, the null hypothesis of unidirectional causality in-variance from

changes in consumer sentiment to All REIT returns is rejected at the 1 percent level of significance in both the full sample period and in the first sub-period. These results provide evidence of bidirectional causality-in-variance between changes in consumer sentiment and All REIT returns for the full sample period and the first sub-period. For the second sub-period, the results reveal that causality-in-variance runs from changes in consumer sentiment to All REIT returns but not vice versa.

Table 6: Granger Causality-in-Variance Test Results

Hypothesis	Feb.1978-Sept.2012		Feb.1978-Dec.1992		Feb. 1993-Sept. 2012	
	Chi-Square Stat	P-Value	Chi-Square Stat	P-Value	Chi-Square Stat	P-Value
Panel A: Consumer Sentiment versus All REIT Returns						
Causality from All REIT Returns to Consumer Sentiment [$H_0: A(2,1) = B(2,1) = 0$]	25.11***	0.00	47.36***	0.00	2.82	0.24
Causality from Consumer Sentiment to All REIT Returns [$H_0: A(1,2) = B(1,2) = 0$]	34.54***	0.00	27.08***	0.00	83.49***	0.00
Panel B: Consumer Sentiment versus Equity REIT Returns						
Causality from Equity REIT Returns to Consumer Sentiment [$H_0: A(2,1) = B(2,1) = 0$]	18.26***	0.00	109.57***	0.00	1.74	0.42
Causality from Consumer Sentiment to Equity REIT Returns [$H_0: A(1,2) = B(1,2) = 0$]	157.94***	0.00	32.14***	0.00	37.80***	0.00
Panel C: Consumer Sentiment versus Mortgage REIT Returns						
Causality from Mortgage REIT Returns to Consumer Sentiment [$H_0: A(2,1) = B(2,1) = 0$]	11.99***	0.00	5.43***	0.00	5.28***	0.00
Causality from Consumer Sentiment to Mortgage REIT Returns [$H_0: A(1,2) = B(1,2) = 0$]	16.31***	0.00	18.82***	0.00	14.18***	0.00

***, **, and * indicate rejection of the null hypothesis at the 1%, 5% and 10% significance level, respectively. ALR = All REIT returns, CS = changes in consumer Sentiment, EQR = Equity REIT returns, and MOR = Mortgage REIT returns.

Panel B of Table 6 displays the causality-in-variance test results between changes in consumer sentiments and Equity REIT returns. The results show evidence of bidirectional Granger causality-in-variance between changes in consumer sentiment and Equity REIT returns for both the full sample period and the first sub-period. However, there is evidence of causality in-variance from changes in consumer sentiment to Equity REIT returns but not vice versa in the second sub-period. Panel C of Table 6 presents the causality in-variance between changes in consumer sentiment and Mortgage REIT returns for all of the sample periods. The results reveal evidence of bidirectional causality in-variance between changes in consumer sentiment and Mortgage REIT returns at the 1 percent level in all of the sample periods. In all, the results presented in Table 6 suggest the existence of bidirectional causality in-variance between changes in consumer sentiment and the various REIT return series in the full sample period and first sub-period. However, changes in consumer sentiment have causal influence on the variances of the three REIT return series in the second sub-period. These results indicate that the enactment of the 1993 Revenue Reconciliation Act did not diminish the causal effect of changes in consumer sentiment on all of the REIT returns.

5. Conclusions and Implication

This paper has explored the existence of causality in-mean and in-variance between changes in consumer sentiment and REIT returns for the United States. In particular, the paper used the modified ADF (DF-GLS) and the Phillips-Perron unit root procedures to ascertain the time series properties of changes in consumer sentiment, All, Equity, and Mortgage REIT returns. The BEKK-GARCH(1,1) model was implemented to test for causality in-mean and in-variance between changes in consumer sentiment and the three REIT return series. The results from the modified ADF and the Phillips-Perron unit root tests indicate that changes in consumer sentiment and the three REIT returns have zero order of integration. Based on the unit root test results, the BEKK-GARCH(1,1) models were estimated using the levels of the four series.

The results from the BEKK-GARCH(1,1) model provide evidence of causality in-mean from the REIT return series to changes in consumer sentiment but not vice versa, for the full sample period and the first sub-period. However, there was no evidence of causality in-mean in either direction in the second sub-period. The results further provide evidence supportive of Granger-causality in-variance from changes in consumer sentiment to All and Equity REIT returns for the full sample period and the first sub-period. However, evidence of causality in-variance from changes in consumer sentiment to Mortgage REIT returns is observed in all of the three sample periods. The results also reveal that causality in-variance runs from All, Equity, and Mortgage REIT returns to changes in consumer sentiment in all of the three sample periods.

These results reveal that the information flow between changes in consumer sentiment and REIT returns affect both their mean movements and their variances. However, the results suggest that the impact of the variances of the three REIT returns on changes in consumer sentiment continued even after the enactment of the 1993 Revenue Reconciliation. The finding that REIT returns have significant impact on changes in consumer sentiment suggests that the housing market serves as a consumption-based channel through which innovations in consumer sentiment are transmitted to the macroeconomy. The results of this study corroborate the behavioral finance proposition which stipulates that asset returns tend to be higher when consumers and investors are optimistic and lower when they are pessimistic about the future prospects of the economy. Our results can help both practitioners and academicians in understanding how consumer sentiment and REIT returns are related. This knowledge will enhance their ability to formulate appropriate models in the future to explore the relationships between consumer sentiment and other macroeconomic variables.

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