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Monetary Policy & Real Estate Investment Trusts^{*}

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Monetary Policy & Real Estate Investment Trusts

Abstract

This paper assesses the response of Real Estate Investment Trusts (REIT's) to unexpected changes in US monetary policy. A critical element in this study is the use of futures markets to isolate unexpected changes in the policy rate. We find a significant negative response of REIT returns to a surprise change in the policy rate. The paper then examines the potential sources behind such an observed response. We find important differences between the REIT market and the broader equity market. Intuitively the impact of monetary policy on dividend news appears to be more pronounced in the REIT case. However, the decomposition of the response to monetary shocks is largely driven by revision in expectations regarding future excess returns and these results are largely consistent with the findings for the overall stock market as reported in Bernanke & Kuttner (2005).

1: Introduction

Real Estate Investment Trusts (REIT's) are the primary traded real estate vehicle in the US and are structured in a similar fashion to mutual funds in order to enhance their tax transparency in comparison to conventional corporate structure. Dividend payments of the trust are tax exempt provided two conditions are satisfied with respect to the underlying assets and dividend payments of the trust. The two requirements are that a minimum of 75% of a REIT's assets must be invested in real estate and a minimum of 90% of taxable income must be passed through to shareholders. The last decade in the US has witnessed dramatic growth in REIT's, with returns of 300% since the end of 1999. However during this time, REIT's have begun to behave more akin to general equity markets, e.g. REITs have now been incorporated into broad market indexes (S&P 500) and large index funds now buy and sell them with the rest of the market.

Concomitantly monetary policy has become the main instrument in the stabilisation of inflation and output with commentators and analysts paying close attention to changes in monetary policy in the belief that such changes, particularly unexpected changes, can influence stock market values immediately. It is then natural to ask whether the characteristics of REIT's, due to their structure and the nature of the underlying real estate market, gives rise to a different response with respect to unanticipated monetary policy as compared to the broader equity stock market. In particular is the source of any response to surprise changes in monetary policy the same or different between REIT's and the stock market in general? If the structural aspect of REIT's are the key, then we may well expect to find a more enhanced role of dividends in response to any surprises. However, if in fact the nature of the underlying asset is the determining factor then we may expect to find a larger impact to the surprise in terms of current excess returns and evidence of persistence in future excess returns. The latter may indicate the sensitivity of the real estate market to news about Central Bank behaviour.

Bernanke & Kuttner (2005) argue that the impact of policy rate changes on the general equity market occur through three main channels, namely; the impact on the expected future dividends, changes in the real interest rate used to discount these

dividends and changes in the equity risk premium. Is it likely that these factors will affect REIT's in a similar fashion to that observed in the broader stock market and are what are the additional issues that require consideration in a REIT context. In particular, the constraints placed on the REIT sector with respect to assets and dividends tie the performance of the trusts very closely to that of the underlying property portfolio. A key issue here is that the underlying private real estate market has a number of fundamental and well-documented linkages to interest rate movements. Interest rate changes may influence general economic activity, which itself will feed through to occupational demand in the underlying real estate market and this should lead to changes in obtainable rental values and therefore income and subsequently REIT dividends. Moreover, changes in interest rates will also affect upon real estate yields therefore leading to an additional impact on property values.

The existing literature on the relationship between REIT's and interest rates has largely concentrated on the impact of changes in actual market interest rates (e.g. Liang et al., 1995, Mueller & Pauley, 1995, Devaney, 2001 and He et al., 2003). However, these studies fail to distinguish between (un)anticipated movements in interest rates. If markets are efficient the timing of the response in returns will be dependent on the expectation of rate movements, with REIT prices only responding to unanticipated movements. This paper extends recent work by Bredin et al. (2008) who examine the impact of monetary shocks on the first and second moments of REIT returns in a GARCH framework. Similar to this study, the authors use the fed funds future rate to proxy market expectations concerning changes in the Fed Funds Rate. Their results show a strong response in both the first and second moments of REIT returns to unexpected policy rate changes. Previous work addressing interest rate changes only, such as Devaney (2001), found no significant impact on REIT's returns and so highlights the importance of capturing market expectations.

In a broader context a large number of papers have examined the influence of monetary policy on stock returns with Pearce & Roley (1985) being one of the first studies to examine the impact of unanticipated rate changes. Market expectations are obtained through survey data and their results show that stocks react significantly to unanticipated interest rate changes post 1979. Thorbecke (1997) finds that an expansionary monetary policy increases ex-post returns and that monetary shocks

affect smaller firms to a greater extent while Patelis (1997) notes that monetary policy changes can provide predictive information on stock price movements. Finally, Bernanke & Kuttner (2005) highlight the importance of US monetary policy shocks on US stock returns using a futures markets based proxy for the surprise. They find that unanticipated monetary policy has a significant negative effect on aggregate stock returns and this is primarily driven by the interest rate impact on news regarding future expected returns¹.

In this paper we seek to answer two key questions. Firstly, we examine the impact of unanticipated interest rate changes on REIT returns within an event study methodology. The second part of the paper builds on this analysis to assess the likely reasons behind the observed response of the REIT sector to monetary policy surprises. In line with Bernanke & Kuttner (2005) we use a variance decomposition in the spirit of Campbell (1991) and Campbell & Ammer (1993) to identify the channels behind the response of REIT returns to monetary policy surprises. This approach decomposes unanticipated changes in excess returns into the following components; revisions in expectations regarding future dividends, real rates and future excess returns and then assesses how each of these components are affected by an unanticipated interest rate change. **The second part of the study will indicate the source of any response to surprise changes in monetary policy and whether this response is consistent with general equity markets. The importance of the structural aspect of REIT's and the nature of the underlying asset will be evident from the variance decomposition approach.** The remainder of the paper is structured as follows. Section 2 discusses the data used in the analysis, with the main empirical findings reported in Section 3. The final section provides concluding comments.

2: Impact of Monetary Policy Shocks

The event study is based around the following baseline regression.

$$\Delta R_t = \alpha_0 + \alpha_1 \Delta r_t^e + \alpha_2 \Delta r_t^u + \mu_t \quad (1)$$

where ΔR_t is the 1-day REIT return and is defined as the log 1-day change in the REIT from t to $t-1$ while Δr_t^u is the unexpected change in the policy rate on the day of the policy rate decision and Δr_t^e is the expected change. The latter is simply measured as the difference between the actual policy rate change between t and $t-1$, Δr_t , and the unexpected change, Δr_t^u .

An important element in the above specification is the need to derive a proxy for the unanticipated component of the policy rate change. In the US, the policy rate target is the federal funds rate (an interbank market rate trading excess reserves between commercial banks) with the target rate set after each FOMC meeting. With the advent of federal funds future contracts in the late 1980s researchers have focused on the information contained in the federal funds futures rate to identify expectations of changes in future policy. The settlement price of the contract is 100 minus the average of the daily overnight federal funds rate during the month of the contract. Hence, a forecast of the federal funds rate is implied by the price of the contract. At a daily horizon, we use the one-day change in the federal funds futures rate between t and $t-1$ to capture unexpected changes in the federal funds rate (policy rate). This approach is consistent with work of both Kuttner (2001) and Bernanke and Kuttner (2005).

2.1: Data and Empirical Results

Our sample frequency is daily and runs from January 1996 through to March 2005. The Equity REIT sector is proxied by the Dow Jones-Wilshire Equity REIT Index, while the S&P500 is included as a control variable.² The data is sourced from Datastream, US Federal Reserve and SNL Financial. Our event study focuses on Federal Open Market Committee (FOMC) meeting dates and days when the policy rate was changed outside meeting dates. The unanticipated change in the target rate is proxied by the 1-day change in the price of the 1-month ahead 30-day Federal Funds Futures contract traded on the Chicago Board of Trade (CBOT). The fed funds futures contract has been used as a proxy for market expectations regarding rate changes in a number of studies (e.g. Bomfim & Reinhart, 2000, Kuttner, 2001, Poole & Rasche, 2000, Reinhart & Simin, 1997, Roley & Sellon, 1998 and Thornton, 1998) while

Gurkaynak et al. (2002) found that the fed funds futures contract provides the best available forecast of the Fed's Fund Rate.

Our analysis contains a total of 71 meeting dates of the FOMC. During this period a total of 29 changes in the Federal Funds Target Rate occurred, all but four of which coincided with scheduled meetings of the FOMC. The four changes that occurred outside scheduled meetings were the rate change associated with the collapse of Long Term Capital Management (October 15th 1998) and three changes in 2001. The October 1998 rate change was a 25 basis points cut. The 2001 rate changes, all of which saw the rate change by 50 basis points, were on January 3rd, April 18th and September 17th.

The initial results, reported in Table 1, examine both changes announced after scheduled meetings of the FOMC and the four unscheduled rate changes. Four alternative specifications are examined. The first, shown in column 1, reports a significant negative coefficient with respect to unexpected rate changes. In addition, the response to the expected component in rate changes is not significant at conventional levels and thus consistent with the efficient markets hypothesis. The magnitude of the response to unexpected changes is relatively smaller than that found for the overall stock market index in Bernanke & Kuttner (2005) who report a coefficient of -4.68.

However, it is important to note that the sample periods are different, with Bernanke & Kuttner (2005) examining a total of 55 rate changes over the period 1989 through 2002. Over their sample period there was an important change in FOMC operating procedure. Prior to February 1994, when the FOMC made a policy rate decision it didn't communicate its decision explicitly to the market. Market participants had to infer such decisions by observing the actions of the Open Market Desk. Since February 1994, the FOMC notifies the markets of its decision after each FOMC meeting.³ Hence, this change in operating procedure during the Bernanke and Kuttner (2005) sample period could explain the difference in results.

Next we seek to assess the robustness of our results. It could be that our results are driven by the fact that REIT's returns simply respond to changes in general stock

market on the day of a monetary policy announcement but not to monetary policy change itself. Hence the second specification, reported in column 2 of Table 1, incorporates the overall market, as proxied by the S&P 500 Composite Index. Once the behaviour of the general market is controlled for, the significance of the monetary surprise disappears.

It is however possible that the results for specifications (i) and (ii) are driven by outliers in the sample and the accompanying response on those days of the general market. We therefore re-estimate the first two specifications excluding the monetary policy change announced on September 17th 2001, which was the first day of trading on US exchanges following the attacks of September 11th. While this rate change was in direct response to the terrorist attacks it is effectively impossible to isolate the impact of the rate change on the markets. Specification 3 in Table 1, excludes this date and the coefficient associated with the unexpected interest rate change becomes more significant while specification 4 which includes same day S&P returns we find the surprise interest rate change is now negative and statistically significant.⁴ The coefficient relating to the unexpected component of the rate change is -2.179 , is statistically significant and is very similar to the initial coefficient of -2.201 and that reported for the general stock market reported in Bernanke & Kuttner (2005). The results reported here would suggest that the particular structure associated with REIT's does not unduly influence the behaviour of REIT returns as a result of a surprise change in monetary policy.

3: Variance Decomposition of REIT's Returns

The second part of this paper builds on the preceding analysis and endeavours to identify the sources underlying the response in REIT returns with respect to an unanticipated policy rate change. The approach adopted here draws on the work of Campbell (1991) and Bernanke & Kuttner (2005). Campbell (1991) decomposes unanticipated changes in excess returns into revisions in expectations concerning; future dividends, current and future real rates and future excess returns. Bernanke & Kuttner (2005) extends this analysis by examining the response of each of these factors to unanticipated policy rate changes.

If we define the one-period excess return as the total one-period return minus the risk-free rate, the unanticipated component of the excess return is simply the difference between the expected excess return and the actual return. Therefore, the unexpected excess return (e^y_{t+1}) can be defined as equal to revision in expectations concerning future dividends (\tilde{e}^d_{t+1}), minus news concerning future real interest rates (\tilde{e}^r_{t+1}) and future excess returns (\tilde{e}^y_{t+1}) i.e.:

$$e^y_{t+1} = \tilde{e}^d_{t+1} - \tilde{e}^r_{t+1} - \tilde{e}^y_{t+1} \quad (2)$$

Each of these components are defined respectively as:

$$\tilde{e}^d_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta d_{t+j+1} \quad (3)$$

$$\tilde{e}^r_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j r_{t+j+1} \quad (4)$$

$$\tilde{e}^y_{t+1} = (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j y_{t+j+1} \quad (5)$$

In these definitions ρ refers to the discount factor. We use a forecasting VAR to model expectations of the variables in equations (3) to (5) and this can be represented as:

$$\mathbf{z}_{t+1} = \mathbf{A}\mathbf{z}_t + \boldsymbol{\omega}_{t+1} \quad (6)$$

where \mathbf{z} consists of the following variables: excess returns, the real interest rate and any additional variables appropriate for use in the context of forecasting these two variables of interest. Based on estimates from the VAR it is possible to extract the discounted sum of revisions in expectations for each of the terms in equation (2) as follows:

$$e^y_{t+1} = s_y \boldsymbol{\omega}_{t+1} \quad (7)$$

$$\tilde{e}_{t+1}^y = \frac{s_y \rho A \bar{\omega}_{t+1}}{(1 - \rho A)} \quad (8)$$

$$\tilde{e}_{t+1}^r = \frac{s_r \bar{\omega}_{t+1}}{(1 - \rho A)} \quad (9)$$

$$\tilde{e}_{t+1}^d = e_{t+1}^y + \tilde{e}_{t+1}^y - \tilde{e}_{t+1}^r \quad (10)$$

where s_y and s_r are appropriate selection matrices. Campbell and Ammer (1993) illustrates how the variance of news concerning current excess returns can be decomposed by taking the variance of both sides of equation (2).

$$\begin{aligned} \text{var}(e_{t+1}^y) &= \text{var}(\tilde{e}_{t+1}^d) + \text{var}(\tilde{e}_{t+1}^r) + \text{var}(\tilde{e}_{t+1}^y) \\ &- 2 \text{cov}(\tilde{e}_{t+1}^d, \tilde{e}_{t+1}^r) - 2 \text{cov}(\tilde{e}_{t+1}^d, \tilde{e}_{t+1}^y) + 2 \text{cov}(\tilde{e}_{t+1}^r, \tilde{e}_{t+1}^y) \end{aligned} \quad (11)$$

Bernanke & Kuttner (2005) adapt the framework of Campbell (1991) to specifically examine the impact of monetary policy surprises on revisions in expected excess returns. The VAR is extended to incorporate unanticipated policy rate changes as follows:

$$\mathbf{z}_{t+1} = \mathbf{A} \mathbf{z}_t + \phi \bar{\Delta} i_{t+1}'' + \bar{\omega}_{t+1} \quad (12)$$

The impact of the surprise element of monetary policy is incorporated through the variable $\bar{\Delta} i_{t+1}''$, and the coefficient matrix ϕ captures the contemporaneous response of elements in \mathbf{z}_{t+1} . The disturbance term is orthogonal to the monetary shock. Consistent estimates of \mathbf{A} and ϕ are obtained through initially estimating the VAR as specified in equation (6) and then regressing the one-step ahead forecasts on the monetary surprise. Bernanke & Kuttner (2005) show that through the examination of the effect of a monetary shock on each of the discounted sums of expected future excess returns, dividends and real interest rates, it is possible to elucidate the source of the response of stock returns to the monetary policy surprise. Based on equations (8) to (10) the impact of the monetary surprise with regard to news regarding current excess returns and each of its components are derived below. For example, the impact of the policy surprise in relation to excess returns leads to equation (8) being re-defined as:

$$\tilde{\varepsilon}_{t+1}^y = \frac{s_y \rho A (\phi \bar{\Delta}_{t+1}^u + \bar{\omega}_{t+1})}{(1 - \rho A)} \quad (13)$$

Therefore, the response of the present value of news regarding future excess returns can be defined as:

$$\frac{s_y \rho A \phi}{(1 - \rho A)} \quad (14)$$

The response in real returns and dividends can therefore be similarly defined as in Equations (15) and (16) respectively.

$$\frac{s_r \phi}{(1 - \rho A)} \quad (15)$$

$$\frac{(s_r + s_y) \phi}{(1 - \rho A)} \quad (16)$$

A problem in the estimation of the VAR concerns the need for an adequate sample size. Furthermore, factors such as the change in fed policy in 1994 and the fact that the fed funds futures contract only dates back to 1989 further limits our ability to estimate equation (12) with the monetary shock directly incorporated into the VAR. We therefore follow the approach of Bernanke & Kuttner (2005). Using monthly data the initial VAR in equation (6) is estimated over the sample period January 1974 to December 2004 and the results from this serve as the basis for the variance decomposition analysis. We next examine how monetary policy information impacts upon excess returns using the post 1996 data by regressing the 1-step ahead forecast errors of the VAR on the unanticipated change in monetary policy. This is possible as $\bar{\Delta}_{t+1}^u$ can be viewed as being a prediction error from a rational forecast made at time t . As Bernanke & Kuttner (2005) note it should also be orthogonal to z_t .

3.1: Data and Variance Decomposition Results

Given that the forecasting VAR requires periodic time series data, this section uses monthly data, again collected from Datastream. The forecasting VAR in our study is run without the monetary shock. This allows us to have a longer sample for the forecasting VAR, 1974-2005, and a restricted (and consistent with that used in the previous section) sample over which we measure our monetary shock 1996-2005.⁵ The longer sample period for the forecasting VAR should give greater precision to our estimates and such an approach has been adopted both by Bernanke and Kuttner (2005) and Faust, Swanson and Wright (2004). The variables included in the VAR are the REIT excess return, the real interest rate (1 month Treasury Bill yield minus the CPI), the log dividend price ratio, the 1 month change in the short rate (treasury bill), the spread between the 10 year and the 1 month Treasury yield and finally the relative bill rate (3 month bill rate minus its 12 month lagged moving average).⁶ Besides the excess return and the real interest rate, which are required for the decomposition, we also include variables that have been found to be successful at stock return predictability (see Campbell & Ammer, 1993). The market excess return is measured using the change in the log total market return index, incorporating prices and dividends, in excess of the short-term interest rate. The real interest rate is calculated using the short-term interest rate minus the CPI inflation rate.⁷ Our definition of the monetary policy shock using monthly data is the following:⁸

$$\bar{\Delta}_t^u = \frac{1}{D} \sum_{d=1}^D i_{t,d} - f_{t-1,D}^1 \quad (17)$$

where $i_{t,d}$ is the funds rate target on day d of month t and $f_{t-1,D}^1$ is the rate corresponding to the 1 month futures contract on the last day of month $t-1$.

The variance decomposition results are reported in Table 2 along with a full set of diagnostic test results. The diagnostic test results indicate that there is no evidence of incorrect functional form, serial correlation or heteroscedasticity in the errors of the forecasting VAR. However, there is evidence of non-normality in the residuals and as a result we bootstrap our standard errors.⁹

The results from the variance decomposition for news regarding current excess returns for REIT's are broadly consistent with both Campbell and Ammer (1993) and

Bernanke & Kuttner (2005) for the aggregate stock excess returns. Overall the level of forecastability of REIT returns, 6.1%, are comparable to those reported for market returns reported in Campbell and Ammer (1993), but considerably higher than those reported in Bernanke & Kuttner (2005).

However, it is evident that the importance of dividends in a REIT context is enhanced in comparison to the analysis of the aggregate stock market index contained in Bernanke & Kuttner (2005). Whereas that paper reported that dividends contributed 24.5% the comparable finding with regard to REIT's is 133.10%. Given the minimum dividend payout requirement with REIT's and the resulting relatively high dividend yield this is not an unexpected result. Furthermore, it can be observed that the results with regard to the covariance terms are of enhanced importance in this case. In terms of levels of significance, we find that news about dividends is not precisely estimated. One reason for the lack of statistical significance in our work relative to other papers in the literature is that we calculate t-statistics based on bootstrapped standard errors while other authors use the delta method. Bootstrapped statistics are likely to be more accurate as the delta method is well known to understate true standard errors.¹⁰

We also find that news regarding the real rate accounts for almost 10% in the variance decomposition and is highly statistically significant. This result is again consistent with the previous evidence using general market returns. Both the signs and the coefficient weights on the covariance terms are both intuitive and broadly consistent with recent studies, e.g., the negative relationship between news regarding future real rates and excess returns.¹¹

The results relating the source of the response of REIT's to monetary policy surprises are reported in Table 3. We find that the decline in current excess returns due to an unanticipated change in interest rates is driven by a revision in expectations regarding future excess returns. Furthermore, a monetary policy surprise does not have a significant effect on news regarding future dividends or the real rate. It is perhaps surprising that given the importance of dividends in a REIT context that an enhanced, or indeed significant, response is not noted.¹² In addition, the results reported here are broadly in line with those reported by Bernanke & Kuttner (2005) for the aggregate stock market. The point estimate of the impact of a shock to news regarding current

REIT excess returns (although only significant at 10%) is very similar to the impact for the general stock market. There is evidence to suggest the impact on news regarding future REIT excess returns is larger, with a larger and highly statistically significant point coefficient compared to the general stock market.¹³ The results indicate that the dividend restriction on REIT's, does not influence the effect of monetary policy surprises on returns. However, the underlying asset, real estate, does have a significant implication, with a persistent future excess returns response to surprises. Implications for the general real estate market....

4: Conclusion

This paper has examined both the response and the source of response of REIT returns to unanticipated changes in monetary policy. The event study results indicate that REIT's do react in a manner consistent with market efficiency, with a negative statistically significant response in returns to an interest rate surprise. Consistency with the efficient markets is further supported by the finding that the expected component is not statistically significant. The subsequent variance decomposition analysis aims to examine the potential causes behind the response in the REIT sector. The baseline VAR model for the REIT market is broadly similar to results reported for the general equity market, with the exception of the heightened role played by news about future dividends. When addressing the impact of monetary policy shocks we find that the response is largely consistent with the findings for the stock market, as reported in Bernanke & Kuttner (2005), and does not appear to be overly affected by characteristics associated with the REIT market. The current REIT excess return reacts in a similar fashion to the surprise, although our results do suggest that the impact on future REIT excess returns is considerably larger. Overall the results do suggest that a monetary policy surprise does lead to behaviour in the REIT's sector that is consistent with efficient markets and with the general stock market. The institutional nature of REIT's and of the general real estate market does not appear to adversely influence reactions to monetary policy surprises.

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Tables

Table 1: Influence of Monetary Policy Changes on REIT Returns

	i	ii	iii	iv
Constant	0.195 (1.509)	0.058 (0.422)	0.284 (2.900)	0.251 (2.348)
Expected	0.706 (1.382)	-0.318 (-0.703)	0.269 (0.829)	0.142 (0.341)
Unexpected	-2.201 (-1.933)	1.983 (1.128)	-2.985 (-4.007)	-2.179 (-2.053)
S&P 500		0.432 (3.061)		0.074 (0.903)
R ²	0.032	0.468	0.245	0.227
Standard Error	0.893	0.491	0.297	0.304
Durbin-Watson	1.912	1.866	2.212	2.205

Note: The third and fourth specifications exclude September 11th 2001. Values in parentheses below coefficient values are robust t-statistics.

Table 2: Variance Decomposition of REIT Returns

	Total	% Share
$Var(e^y)$	18.27	100
$Var(\tilde{e}^d)$	24.31	133.10
		(0.16)
$Var(\tilde{e}^r)$	1.78	9.76
		(6.70)
$Var(\tilde{e}^y)$	19.40	106.23
		(0.14)
$-2Cov(\tilde{e}^d, \tilde{e}^r)$	7.12	38.97
		(0.45)
$-2Cov(\tilde{e}^d, \tilde{e}^y)$	-24.35	-133.32
		(-0.62)
$2Cov(\tilde{e}^y, \tilde{e}^r)$	-10.00	-54.74
		(-0.62)
Diagnostic Test Results and adjusted R² from REIT Excess return equation		
Adjusted R ² from REIT Excess Return Equation		0.061
LM test for serial correlation		0.300
Ramsey Reset test for functional form		0.818
Normality test of the residuals		0.000
Heteroscedasticity test		0.293

Note: The table reports results from the variance decomposition of revision in expectations about current excess return, e^y , Dividends, \tilde{e}^d , real interest rates, \tilde{e}^r , and future excess returns, \tilde{e}^y . The numbers in parenthesis contain t-statistics which use the bootstrap simulation (10,000 runs). The reported results are for the sample January 1974 to December 2004. All Diagnostic results refer to P values

Table 3: Impact of Monetary Policy on News Regarding Current REIT excess returns, future dividends, future real interest rates and future REIT excess returns

	e^y	e^d	e^r	e^v
Constant	-11.79 (-1.85)	-5.42 (-0.71)	0.29 (0.31)	6.08 (2.55)

Note: The numbers in parentheses contain bootstrap estimated t-statistics (10,000 runs).

Endnotes:

¹ A related literature has examined the response in volatility to monetary shocks. Bomfim (2003) examines the S&P 500 Composite and its response to Fed Funds Rate changes. The author finds evidence of a *calm before the storm* effect with volatility reduced the day prior to a fed funds rate change and higher on the day of the announcement. Bredin et al. (2008) in their examination of REIT's however not only find no evidence of this effect in the REIT sector but also highlight the sensitivity of such effects in relation to the sample with no evidence also reported with respect to S&P 500.

² Note that due to their quite different characteristics the Mortgage REIT sector is not examined.

³ Due to REIT's data availability our sample begins in January 1996 and so we have a consistent sample in relation to Fed announcement policy.

⁴ This result is in marked contrast to when the market proxy was initially included.

⁵ The rationale for using a shorter sample in measuring the monetary shock is to avoid issues such as analysing monetary policy over fundamentally different monetary policy regimes and different announcement procedures.

⁶ The market (S&P500) excess return is also included in the VAR. Omitting this variable does not appear to make any qualitative difference to the results.

⁷ We estimate a one lag VAR. The optimal lag length of the VAR was selected using the standard information criteria, Akaike information (AIC) and Schwartz Bayesian (SBC).

⁸ For the event study methodology, daily data is adopted, hence the definition of the monetary policy shock is the one day change in the 3 month sterling futures contract. However, given the VAR methodology adopts monthly data, it is unlikely that a similar definition will give an appropriate measure of the shock. The measure adopted for the monthly frequency shock is consistent with that used by Bernanke and Kuttner (2005).

⁹ We elect to obtain standard errors using a bootstrap procedure rather than a Monte Carlo simulation. The bootstrap allows us to draw from the empirical sample error distribution, which displays non-normality, rather than having to assume a given error distribution as with the Monte Carlo.

¹⁰ It should also be noted that Bernanke and Kuttner (2005) also found mixed evidence in relation to levels of significance, when using the delta method.

¹¹ However, Campbell and Ammer (1993) do find using US data that the sign on the covariance terms is sensitive to the particular sample chosen.

¹² However, as with the variance decomposition results, the use of bootstrap estimates for the t-statistics may explain the lack of significance.

¹³ Bernanke and Kuttner (2005) do find a similar sized coefficient on the news about future excess returns for their 1973-2002 forecasting VAR, although not statistically significant.